



GRANTS LITHIUM PROJECT

Draft Environmental Impact Statement

November 2018

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Abbreviations & Definitions

Abbreviations and definitions	
%S	Percentage sulfur
AAPA	Aboriginal Areas Protection Authority
ABS	Australian Bureau of Statistics
AEP	Annual Exceedance Probability
AMD	Acid and metalliferous drainage
ANCOLD	Australian National Committee on Large Dams
AoO	Area of Occupancy
As	Arsenic
ASS	Acid sulfate soil
BCF	Burrell Creek Formation
bcm	Bank cubic metres = A volumetric term used to define a cubic metre of rock or material in situ before it is drilled and blasted.
BOM	Bureau of Meteorology
Cd	Cadmium
CEC	Cation exchange capacity
Co	Cobalt
CPESC	Certified practitioner in erosion and sediment control
Cr	Chromium
Cu	Copper
d	day
DENR	Department of Environment and Natural Resources (Northern Territory) – formerly DLRM
DFS	Definitive Feasibility Study
DLRM	Department of Land Resource Management (Northern Territory) – now DENR
DMS	Dense media separation
DOEE	Department of the Environment and Energy (Commonwealth)
DPIR	Department of Primary Industry and Resources
dS/m	Decisiemens per metre
DSO	direct shipping ore
EAA	<i>Environmental Assessment Act</i> (NT)
EAT	Emerson aggregate test
EC	Electrical conductivity
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EL	Exploration Lease
EMP	Environmental Management Plan
EoO	Extent of Occupancy
EPA	Environmental Protection Approval
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)

Abbreviations and definitions	
EPL	Environmental Protection Licence
ESCP	Erosion and Sediment Control Plan
ESP	Exchangeable sodium percentage
FTE	Full-time equivalent
g/cm³	Grams per cubic centimetre
GDE	Groundwater dependent ecosystem
GHG	greenhouse gases
GPS	Global Positioning System
ha	hectare
Hg	Mercury
HSE	Health, Safety and Environment
IAP2	International Association of Public Participation
ICN NT	Industry Capability Network NT
IECA	International Erosion Control Association
JORC Code	Joint Ore Reserves Committee Code is the <i>Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves</i> . It establishes standards for public reporting, emphasising principles of transparency and materiality. All companies listed on Australian or New Zealand Stock Exchanges are required to comply with the JORC Code.
K	hydraulic conductivity
kL	Kilo-litres
L	Litres
m	metre
m³	cubic metres
mAHD	metres Australian height datum
mASL	metres above sea level
mBGL	metres below ground level
MCP	Mine Closure Plan
meq/kg	Milliequivalent per kilogram
Mg/kg	Milligrams per kilogram
ML	Mineral Lease
ML	megalitres
ML31726	Mineral Lease 31726
mm	Millimetres
MMA	<i>Mining Management Act</i> (NT)
MMP	Mining Management Plan
Mn	Manganese
MNES	Matters of National Environmental Significance
MOC	Mine operations centre
MSD	Mine Site Dam
Mt	megatonne (1,000,000 tonnes)
MTA	<i>Mineral Titles Act</i> (NT)

Abbreviations and definitions	
MWD 1	Mine Water Dam 1
MWD 2	Mine Water Dam 2
N	Nitrogen
NAPP	Net acid production potential
Ni	Nickle
NOI	Notice of Intent
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority
NTA	<i>Native Title Act 1993</i> (Commonwealth)
NVIS	National Vegetation Information System
OHD	Observation Hill Dam
PAF	Potentially acid forming
PAR	Population at Risk
Pb	Lead
PFS	Pre-Feasibility Study
PSD	Particle size distribution
RL	Relative level
ROM	Run of mine
RWD	Raw Water Dam
RWL	Rest water level
s	second
Se	Selenium
SIA	Social Impact Assessment
SIMP	Social Impact Management Plan
SWL	standing water level
TOC	Total organic carbon
ToR	Terms of Reference
TPWC Act	<i>Territory Parks and Wildlife Conservation Act</i> (Northern Territory)
TSF	Tailings storage facility
V	Vanadium
WDL	Waste Discharge Licence
WRD	Waste rock dump
yr	year
Zn	Zinc



GRANTS LITHIUM PROJECT

Environmental Impact Statement

Executive Summary

EXECUTIVE SUMMARY

Core Exploration (Core) proposes to develop Grants Lithium Project (the project) on mineral lease (ML) 31726, which is located on the Cox Peninsula, approximately 25 km south of Darwin (as the crow flies). Core is a minerals exploration company listed on the Australian Stock Exchange (ASX: CXO). The company holds Exploration Licences (EL) over 500 km² of land in the Finniss River region, where it has been actively exploring for lithium since 2016. Core also holds a number of EL's across the NT and South Australia in areas prospective for copper, zinc, lead and uranium.

In 2017, Core discovered and defined the NT's first lithium resource and completed a mining study in respect of developing the Grants Lithium Project. Global demand for lithium is underpinned by the growth in production of lithium-ion batteries for use in energy storage applications associated with renewable energy and electric vehicles. Core is in the process of finalising off-take and pre-payment agreements for the lithium with China-based company Sichuan Yahua Industrial Group Co. Ltd. If the project gains approval, it would be the Northern Territory's first lithium mine.

Compared to other lithium mines in Australia (which are primarily in Western Australia), the proposed mine is within easy trucking distance by sealed road to a major centre and an export port (East Arm, or Darwin Port). This location provides labour and services advantages, negating the need for fly-in-fly-out worker. The project is expected to provide benefits in the following areas:

- **Jobs** – Core expects to create between 100 and 150 direct employment jobs.
- **Export income** – The Australian economy will benefit from over A\$300 million in export income.
- **Royalties** – The NT government will benefit from royalties under the *Mineral Royalty Act*.
- **Develop new technology** – A long-term lithium mining project in the NT could provide opportunities for further industry development, such as lithium battery factories.

The Northern Territory Environment Protection Authority (NT EPA) determined that the proposal requires assessment under the *Environmental Assessment Act* and released Terms of Reference (ToR) for preparation of an Environmental Impact Statement (EIS) in August 2018.

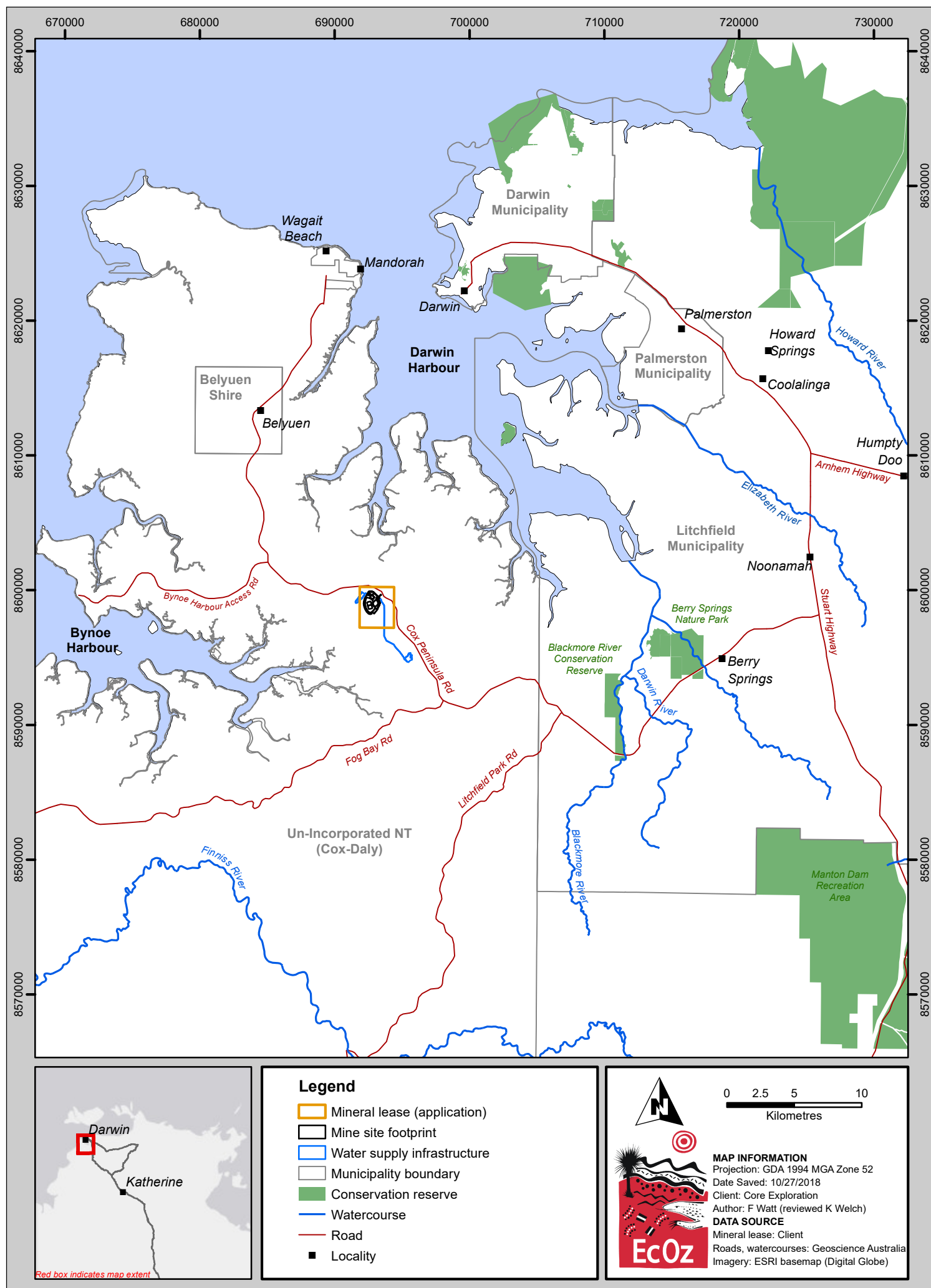
A draft EIS has been prepared by Core and will be placed on public exhibition for a period of six weeks from 3 November to 14 December 2018. During this time, members of the public, local and NT government agencies and other stakeholders, will be invited to provide comment on the draft EIS. Core will then be required to address any comments in a supplementary EIS submission. The NT EPA will consider the information provided by Core and all comments received through the public process, and then provide recommendations in relation to whether or not the project is likely to have a significant impact on the environment.

This Executive Summary provides an overview of the proposal, and the key findings of the environmental impact assessment process reported in the draft EIS documentation.

Location overview

The proposed project area is located on the Cox Peninsula Road, approximately 36 km west of Berry Springs (population 818) and 15 km south-east of Belyuen community (population 178), which is the nearest community. The site is approximately 90 km by road from Darwin. The project location is shown in Figure 1.

There are no active industrial sites nearby (including no active mines or extractives quarries) and there is very limited industrial development on the Cox Peninsula. Currently, mining exploration is the main land-use in and around the project area, and rural living, recreation and tourism are the main land-uses across the Cox Peninsula more broadly. The nearest formal residence to the project area is located on a freehold parcel of land 10 km to the south of the proposed mine site.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ18086 - Grants Project - EIS\01 Project Files\Chapter 1 maps\Figure 1-1. Project location and regional setting.mxd

Figure 1. Project location and regional setting

Proposal overview

The proposal covers the following key activities:

- Mining of Spodumene (a lithium-bearing ore) using simple open pit drill and blast mining methods over a life of mine of approximately two to three years.
- Crushing, screening and water-based processing of ore to increase the lithium concentration in the product from 1.5% to 5.5%.
- Establishment of an on-site waste rock dump (WRD) and co-located tailings storage facility (TSF) to accept waste rock and tailings from the mining and processing activities.
- Haulage of the product in road trains along public roads to Darwin Port for export to China.

To establish a reliable water supply for the mining operation, the proposal includes raising the dam wall of an old mining dam (Observation Hill dam), which will inundate a further nine hectares of land around the edge of the existing dam footprint. Clearing of a further six hectares of land will be required to install a pipeline to transport water from the Observation Hill dam to the mine site. The option of installing a second smaller dam (the mine site dam) on an ephemeral watercourse that flows through the ML is also under consideration.

The location and layout of key project components is shown in Figure 2 and Figure 3. Project details are summarised in Table 1.

Stakeholder engagement

Core has employed local communications experts, True North Strategic Communication (True North) to assist with identifying and engaging with key project stakeholders during project planning and development. Early communication commenced with key stakeholders in late 2017, with subsequent communication and consultation activities undertaken over the period July-September 2018. Engagement has focused on stakeholders likely to experience the greatest level of impact – positive or negative – from the project. The engagement process aimed to establish relationships early in the piece, and provide all stakeholders with objective information about the project, an opportunity to provide early input on potential issues, and details on how they can get information and provide feedback.

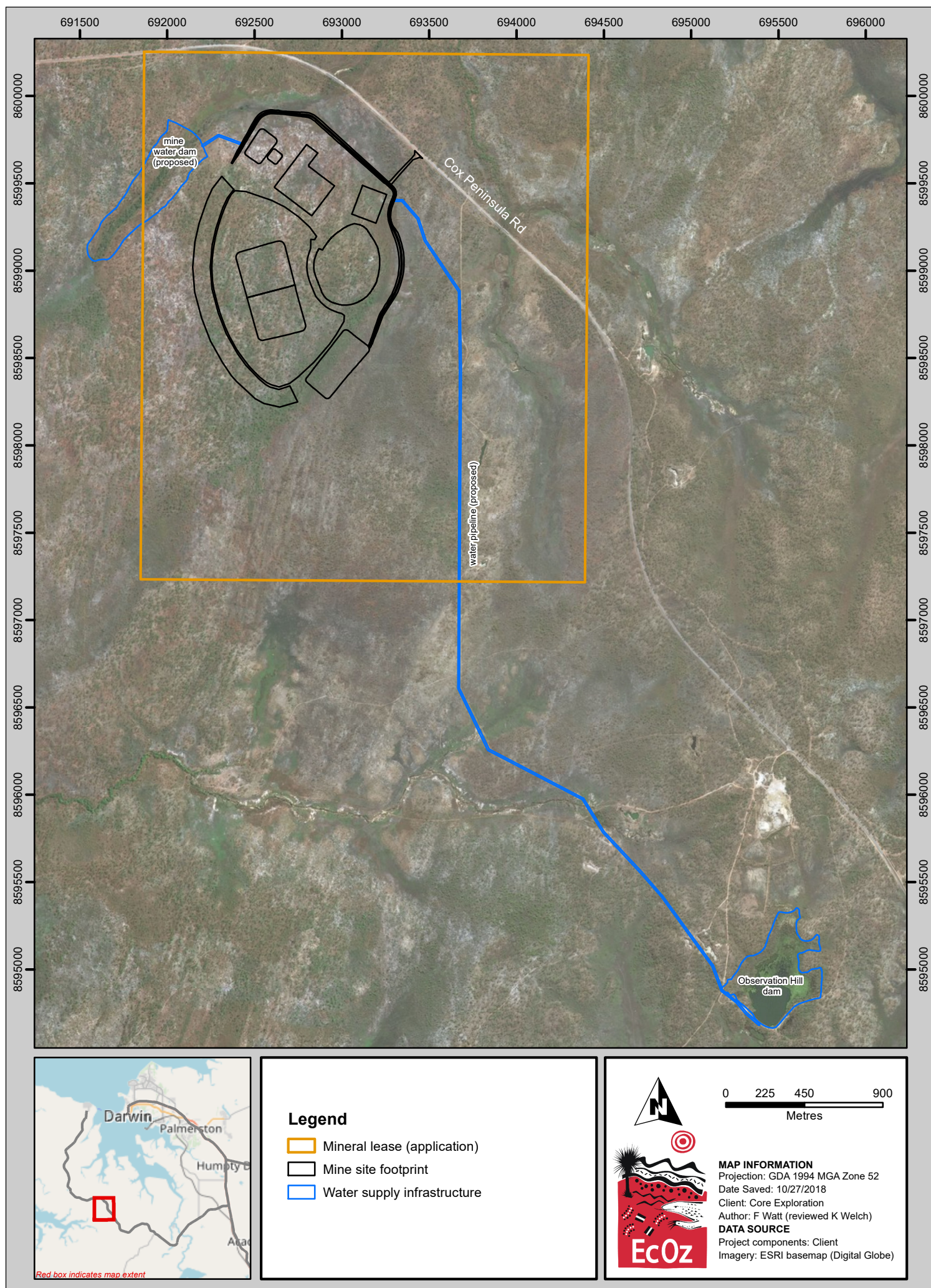
Key stakeholders interviewed by True North, independent of Core, include NT Government departments, local government councils, Community and environment groups, industry groups, essential services and the Larrakia Development Corporation. The main issues identified by the process, in order of priority, were:

- Blasting and road closure on Cox Peninsula Road leading to delays and disruption
- Road safety due to heavy vehicle traffic on Cox Peninsula Road and the potential impact to the Berry Springs community and residential properties with direct access to the road
- Jobs and opportunities for locals
- Water use – most people were satisfied that groundwater was not the water source for the project.
- Closure planning, with some concern about the pit not being backfilled
- The mining process
- Environmental impacts and how these would be managed and mitigated

Stakeholder feedback has been considered in the assessment of social impacts and a Social Impact Management Plan has been prepared, that aims to minimise impacts and maximise opportunity to local businesses and the community. Core will continue to communicate and consult with stakeholders, particularly in the lead up to and during the operational phase.

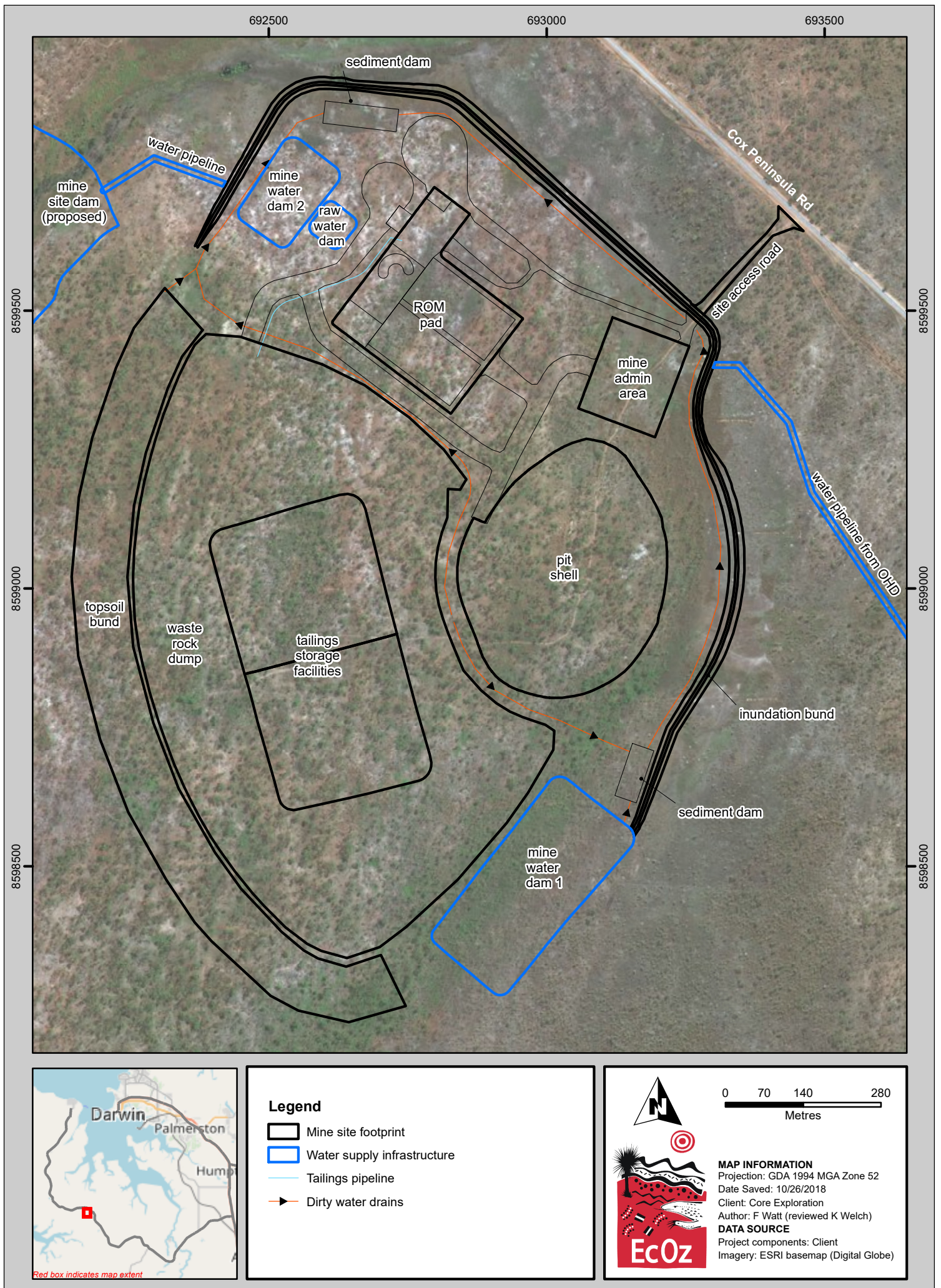
Table 1. Summary of project details

PROJECT ASPECT		DETAILS
Production details	Life of Mine	2-3 years
	Ore mined	1 million tonnes per annum; 1.8 million tonnes total production
	Concentrate produced	225,000 tonnes per annum
	Concentrate grade (%Li ₂ O)	5%
Project footprint	Mine footprint	147ha
	Water supply infrastructure	38ha
	Open pit	Dimensions = 500m north-south x 350m east-west x 180m deep
	Waste rock dump	To accept geochemically benign waste rock material Footprint ~54ha; Dimensions = ~1,000m x 600m x 25m (height)
	Tailings storage facility	Two cells incorporated within waste rock dump will accept thickened tailings; Footprint = 15ha; maximum height 9m
Mining operations	Mining method	Open pit drill and blast
	Operating hours	24 hours, 7 days per week
Ore processing	Processing	Crushing, screening and water-based Dense Media Separation
Transport	Haulage	10 quad road train loads to port each day
	Route	Cox Peninsula Rd, through to the Stuart Hwy, along the Stuart Hwy to Tiger Brennan Dve and then Berrimah Rd, to the East Arm Port
Power and fuel use	Power supply	Diesel-powered generators, requiring ~605 kL diesel per year
	Fuel use	~16,800 kL diesel for mining fleet over life of mine
Water management	Water demand	2,018 kL/day
	Sources	• Re-use of groundwater/rainfall in-flows to pit • Make-up water to be supplied from two dams – see below.
	On-site water storages	Raw water dam; Mine water dam 1 (240ML); Mine water dam 2 (60ML)
	Water efficiency	Estimate 39% of water will be re-used on site
	Observation Hill dam (existing)	Dam wall raised to increase capacity to 628 ML; will inundate additional 9ha of land around edge of existing dam footprint
	Water pipeline (proposed)	Buried water pipeline from Observation Hill dam to site; Dimensions = 6km (long) x 10m (wide) corridor
	Mine site dam (proposed)	To be constructed on an ephemeral drainage line. 387 ML capacity; Inundation footprint - 19ha of land on the ML
	Discharge requirements	Off-site discharge of water excess to requirements in November to March each year of operations. Discharge to be authorised by a Waste Discharge Licence pursuant to <i>Water Act</i> .
Workforce	Construction	Estimated 100-150 employees and contractors
	Operations	Estimated 90 direct employees
Economic scale	Capital cost	\$A53.5 million
	Net Present Value est.	\$87 million
	Tax contribution	\$53 million
	Royalties paid to NT Govt.	\$26 million
Closure and rehabilitation	Open pit	Stabilised, secured and left to form a pit lake
	Waste rock dump / TSF	Re-profiled to create a stable, non-polluting landform
	Infrastructure	All above-ground infrastructure will be removed
	Rehabilitation	Disturbed areas revegetated with local native species
	Public safety	Abandonment bund and signage in place to protect public safety



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ18086 - Grants Project - EIS\01 Project Files\Chapter 2 maps\Figure 2-2. Grants Project location overview.mxd

Figure 2. Project location overview



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ18086 - Grants Project - EIS\01 Project Files\Chapter 2 maps\Figure 2-3. Mine site footprint and layout.mxd

Figure 3. Mine site footprint and layout

Impact and risk assessment

Preliminary assessment of the proposal by the NT EPA identified five environmental factors that require more detailed assessment as part of the EIS process. These are listed in Table 2, together with the NT EPA's objective. Other environmental factors were considered, but none were deemed to warrant more detailed assessment.

Table 2. NT EPA environmental factors and objectives relevant to Grants Lithium Project proposal

Theme	Factor	Objective
LAND	Terrestrial flora and fauna	Protect the NT's flora and fauna so that biological diversity and ecological integrity are maintained.
	Terrestrial environmental quality	Maintain the quality of land and soils so that environmental values are maintained.
WATER	Hydrological processes	Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.
	Inland water environmental quality	Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected.
PEOPLE & COMMUNITY	Social, economic and cultural surroundings	Protect the rich social, economic, cultural and heritage values of the Northern Territory.

A whole-of-proposal impact analysis and risk assessment was undertaken to assess potential impacts to each environmental factor. The principles of qualitative risk management described in *AS/NZS 31000:2009 Risk Management – Principles and Guidelines* were adopted. The assessment considered direct, indirect and cumulative impacts associated with the two separate project phases: (1) construction and operations, and (2) rehabilitation and closure. Social impacts and opportunities were assessed using criteria that allowed for consideration of community/stakeholder perceptions when evaluating potential impacts.

The impact and risk assessment process considered the inherent risk posed to the environment by the proposal, and identified where additional measures are needed to reduce adverse impacts to a level that is likely to be acceptable to government regulators and the community. The purpose of the assessment was to determine whether or not the proposal is likely to result in any significant impacts to environmental or social values that would lead to the NT EPA's objectives not being met. The outcomes of the assessment for each environmental factor are documented in the various chapters of the draft EIS.

For each environmental factor, the EIS provides details of:

- Environmental characteristics and values present within and surrounding the project area.
- The likelihood and severity of potential impacts to those values associated with the proposal.
- Mitigation, management and monitoring measures that Core proposes to avoid and/or reduce impacts to as low as reasonably practicable.
- The residual level of impact associated with the proposal and the extent to which the NT EPA's objectives are likely to be met.

Terrestrial Flora and Fauna

Potential impacts and risks to terrestrial flora and fauna are addressed in Chapter 5 of the draft EIS. The vegetation in the project area was described and, and targeted surveys for threatened species undertaken, by ecologists. Details of the survey methods and results are provided in a series of reports submitted as appendices to the draft EIS.

The project area was found to be dominated by Eucalyptus woodland habitats. No significant or sensitive vegetation types occur within the disturbance footprint. The loss of approximately 181 ha of mainly Eucalyptus woodland habitat, which is regionally common, is not expected to have a significant impact to flora and fauna. To further mitigate potential impacts to vegetation and habitats, Core has prepared a Vegetation Clearing Procedure that details how land clearing will be managed. Rehabilitation of the mine site with vegetation similar to the surrounding areas is addressed in the Mine Closure Plan.

No threatened fauna species were considered likely to occur in the project area based on desktop review and field-based assessment of the habitat features by ecologists. Two threatened flora species (*Stylidium ensatum* and *Typhonium praetermissum*) were identified for further assessment based on NT Herbarium modelling of potentially suitable habitat. On-ground surveys confirmed that *Stylidium ensatum* does not occur, and a combination of desktop review and on-ground surveys indicated that *Typhonium praetermissum* is very unlikely to occur, and if it did, the extent of impact from the project activities would not be significant.

Sparse riparian vegetation associated with ephemeral streams, and some seasonal wetlands (drainage depressions) do occur within the ML and surrounding areas, and mangroves associated with the upper reaches of West Arm occur approximately 1.7km downstream of the proposed mine site. The draft EIS considered potential impacts to these communities associated with alteration of surface water and groundwater flow regimes. Results of hydrological modelling indicate that early wet season flows to the hinterland mangrove communities downstream of the mine site could be reduced by up to 40%, and flows to the riparian rainforest downstream of Observation Hill dam, could be reduced by up to 35%. Later in the wet season, the impact on flows reduces as the dams fill and overflow. The reduction in early season flows is expected to have limited impact on these communities as they are naturally adapted to highly variable ephemeral flows.

Weed density is relatively low in the project area and surrounds. Based on past experience on other mine sites, there is a high risk associated with the introduction and spread of weeds. A program of weed survey, mapping and control is described in the project Environmental Management Plan (EMP). Effective implementation of these controls by Core would decrease this risk; however, the residual risk remains high and will require ongoing management attention.

The draft EIS concludes that, the proposal is not expected to cause significant impacts to terrestrial flora and fauna. This assessment is based on an adequate level of ecological field survey data and modelling of impacts to hydrological regimes that support flora and fauna values. There are no significant information gaps that would be likely to affect or significantly alter the outcomes of the risk assessment. The proposed mitigation and management measures are expected to ensure that the NT EPA objective for protection of terrestrial flora and fauna is met.

Terrestrial Environmental Quality

Potential impacts and risks to land and soils (terrestrial environmental quality), are addressed in Chapter 6 of the draft EIS. The assessment was informed by surface and sub-surface materials characterisation studies undertaken in accordance with accepted guidelines and procedures. Details of the sampling methods, analysis and results are provided in the materials characterisation report submitted as an appendix to the draft EIS.

The project area broadly comprises lowland plains and rises, intersected by drainage systems and alluvial plains. The land is generally flat, excepting for a short section of steep ridges traversed by the water pipeline route, where there are some slopes ranging between 10-40%.

Sampling and analysis of the surface soil characteristics across the proposed mine site disturbance footprint indicates that the soils are comprised of sandy-loams, sandy-clay-loams and gravelly-sands. Measurement of various indicators of soil suitability as a baseline growth medium for rehabilitation, indicates that the soils have naturally low water holding capacity and nutrient concentrations. Some of the surface soils have sodic and/or dispersive characteristics that could affect their suitability for use as a growth medium. Baseline salinity and heavy metal concentrations were low. The suitability of soils for use in rehabilitation of the site and any requirement for additives, will be assessed as part of rehabilitation trials commencing in year one of site operations.

Sub-surface materials characterisation was undertaken based on 156 samples of rock taken from the various lithologies and weathering profiles within the pit shell. The results indicate that there is a low risk of acid, metalliferous or saline drainage (AMD).

Soil loss and erosion hazard has been calculated for each of the site components and is provided in the project Erosion and Sediment Control Plan (ESCP). The TSF and WRD are the only site components assigned a 'very high' erosion hazard rating. The WRD is assigned a 'moderate' erosion hazard rating and the remainder of the site components were assigned a 'very low' rating. Erosion risk for the site relates to rainfall and is rated as 'extreme' for the months of December to March, 'high' for April, October and November, and 'very low' for the rest of the year.

The environmental risk assessment process determined that the greatest impacts to land and soil associated with the proposal relate to erosion from cleared areas and constructed landforms, in particular the WRD. Without effective management, there is an inherently high risk of erosion causing impacts to land and soil. The proposal poses an inherently low risk of soil contamination either by hydrocarbons or other hazardous materials, or from AMD.

The key measures proposed to reduce the likelihood of erosion and off-site release of sediments, are good engineering design and materials selection, and implementation of the ESCP. Further geotechnical investigations will be undertaken to identify sources of suitable construction materials and any required treatment to ensure stability of the constructed landforms. The ESCP has been prepared by a Certified Practitioner in Erosion and Sediment Control in accordance with the *Best Practice Erosion and Sediment Control Guidelines*. These measures combined are expected to maximise the long-term geotechnical stability of the constructed landforms and provide for good erosion and sediment control outcomes when effectively implemented.

The Mine Closure Plan provided closure concepts, a management framework and monitoring program that are reasonably expected to provide for adequate stabilisation of the site and prevention of off-site movement of sediments, when implemented effectively. The requirement for the final plan to be authorised by the DPIR under the *Mining Management Act* provides an addition layer of regulatory scrutiny and oversight beyond the EIS process, and should ensure that the risk is reduced to as low as practicable.

Unexpected early closure of the mine could increase the risk of landform instability and erosion; however, due to the short mine life and the economics underpinning the project, the likelihood of early closure is considered low. In any event, risks should be adequately addressed through implementation of a Care and Maintenance Plan, which is a requirement pursuant to the *Mining Management Act*. The bond – required as part of the mining authorisation process – will provide for stabilisation of the site. These measures are expected to decrease the likelihood of significant erosion and off-site impacts; however, the uncertainty associated with early closure scenarios means the risk remains high.

The draft EIS concludes that the mitigation, management and monitoring measures proposed by Core are expected to ensure that any impacts to land and soils are identified early and addressed, so that erosion is limited to within the disturbance footprint and immediate surrounds. As a result, the proposal is not expected to result in significant impacts to land and soils.

Hydrological processes

Potential impacts and risks to surface water and groundwater flows (hydrological processes), are addressed in Chapter 7 of the draft EIS. Assessment of baseline conditions and modelling of potential impacts to flow regimes has been undertaken for the project area by qualified hydrologists and hydrogeologists. Details of the study methods and findings are provided in the surface water and groundwater reports submitted as appendices to the EIS.

The majority of the ML, and the entire mine site disturbance footprint are located in the West Arm catchment of Darwin Harbour. Surface water flows drain north from the mine site into the branches of West Arm. A minor drainage line that originates in the south-west corner of the ML flows south-west into a tidal inlet of Bynoe Harbour. The existing Observation Hill dam, proposed to supply a portion of mining water requirements, lies within the Charlotte River catchment of Bynoe Harbour. There are no permanent watercourses within ML31726, all drainage lines are relatively small and cease to flow early in the Dry season.

Stream flows for each of the sub-catchments intersected by the mine and dam were modelled for low, average and high rainfall years. Results indicate very limited flows in the early Wet season months, and peak flow in late February and March, with significant variation in stream flows over low, average and high rainfall years.

The groundwater aquifer beneath the proposed mine site is the Burrell Creek Formation, a fractured and weathered rock aquifer with minor groundwater resources. The aquifer has low hydraulic conductivity indicating that groundwater discharge to surface features around the project area is likely to be minimal. The Observation Hill is likely a source of recharge to the groundwater aquifer, and there is some indication that the watercourses downstream of the dam have some level of groundwater dependence. The presence of the dam potentially contributes to extended recharge of the aquifer into the dry season, although the extent of this recharge is not known.

The outcomes of the environmental risk assessments undertaken for the draft EIS, indicate that the proposal is generally expected to pose an inherently low to moderate risk to downstream values (beneficial uses) that rely on maintaining the hydrological regimes of surface water and groundwater. The key reasons for this are:

- Due to the ephemeral nature of surface water flows and short-distance downstream to the receiving waters of West Arm, the freshwater watercourses downstream of the mine site do not have any significant environmental value in terms of supporting range restricted or threatened species.
- There are no residences, farms or industry within the catchment areas upstream or downstream, and no commercial or domestic uses for which surface water or groundwater is currently being extracted anywhere near the project area.
- Hydrological modelling, combined with the ecological assessment of potential impacts to sensitive vegetation communities (see terrestrial flora and fauna section) indicates that reduction in flows is not expected to be at levels that would affect the flora and fauna values downstream.
- Groundwater modelling indicates that drawdown impacts will occur only in close proximity to the open pit and impacts to groundwater flows will be localised. There are no groundwater dependent environmental values or other users within the affected area.

The potential impacts associated with reduced surface water flows downstream of the mine site was the only impact assigned a medium level of residual risk, which is primarily due to dam sizing, extraction and discharge regimes being at the feasibility stage of design at the time of draft EIS submission. If the proposal is approved, the final dam sizing, spillway heights and the proposed water extraction regime will be subject to further assessment by the Department of Environment and Natural Resources (DENR) as part of the application process for obtaining a permit under the *Water Act*. Proposed discharges of water excess to requirements will also be subject to separate authorisation by a Waste Discharge Licence under the *Waste Management Pollution Control Act*. These approvals processes provide an addition layer of regulatory scrutiny and oversight beyond the EIS process, and are expected to ensure that the project poses a low level of residual risk to hydrological processes.

The Water Management Plan submitted with the draft EIS provides a comprehensive monitoring program designed to gather information to demonstrate the project's level of impact and to detect any impacts that are greater than anticipated. The closure concepts detailed in the Mine Closure Plan, are expected to pose a low to moderate level of residual risk to surface water and groundwater. The requirement for this final plan to be authorised by the DPIR under the *Mining Management Act* is expected to ensure that post-closure risks to hydrological processes are within acceptable limits.

The draft EIS concludes that the mitigation, management and monitoring measures proposed by Core are expected to ensure that impacts to hydrological processes are limited to minor reduction in surface water flows and groundwater levels within and immediately downstream of the ML. The proposal is not expected to cause any measurable impact to environmental values in the receiving waters of West Arm (Darwin Harbour) and Charlotte River (Bynoe Harbour), and there are no other water users in proximity to the project area that will be affected.

Inland Water Environmental Quality

Potential impacts to surface water and groundwater quality (inland water environmental quality), are addressed in Chapter 8 of the draft EIS.

A program of baseline water quality monitoring was commenced in 2017. Baseline sampling has been undertaken at three surface water sites upstream and downstream of the proposed mine site in the West Arm catchment and at three sites downstream of Observation Hill dam in the Charlotte River catchment. Six monitoring bores were constructed and sampled on the ML; four in slightly weathered to fresh Burrell Creek Formation and two shallow bores were constructed in laterite and highly weathered Burrell Creek Formation. The Water Management Plan submitted with the EIS provides complete details of the monitoring program and detailed analysis of baseline water quality data.

The outcomes of the environmental risk assessments undertaken for the draft EIS, indicate that the greatest risks to water quality relate to the potential for increased sediment loads in the downstream surface water courses. The project does not require the use of chemical additives in processing and the waste rock has been characterised as geochemically benign, therefore sediment is expected to be the only contaminant of concern in drainage originating from the mine site. The measures proposed by Core to minimise leaks and spills of fuels and other hazardous substances, and to prevent release of untreated sewage, are detailed in the project EMP and are expected to result in a low risk of chemical or bacterial contamination in surface and groundwater.

Off-site release of sediments will be minimised by implementing the ESCP, and managing and monitoring discharges in accordance with the procedures detailed in the Water Management Plan. The Water Management Plan is being subject to review by an independent auditor. The outcomes of the review will be made public as part of the supplementary EIS and, if required, the Water Management Plan will be revised to address any deficiencies. Subject to the project gaining approval, discharges from the mine site require separate authorisation by a Waste Discharge Licence under the *Waste Management Pollution Control Act*. This licence will establish water quality criteria to be achieved prior to discharge so that environmental values are protected.

The risks to downstream water quality are expected to be inherently lower post-closure as discharge from the sediment and mine water dams will cease. The post-closure mine site is proposed to be surrounded by an abandonment bund and the majority of the final landform will drain internally to the pit void, which will not release to the surrounding environment. Erosion of the external face of the WRD is the key ongoing risk to water quality. The closure concepts detailed in the Mine Closure Plan, when effectively implemented, are expected to minimise this risk.

The draft EIS concludes that the mitigation, management and monitoring measures proposed by Core are expected to ensure that any impacts to downstream water quality associated with the proposal are, at worst, minor exceedances of water quality criteria that are temporary and confined to the ephemeral drainages immediately surrounding the mine site. The proposal is not expected to cause any measurable impact to water quality discharging to West Arm and therefore is not expected to impact on any environmental values that rely on good water quality.

Social, Economic and Cultural Surrounds

Potential impacts to social, economic and cultural surrounds is addressed in chapter 9 of the draft EIS.

A Social Impact Assessment (SIA) was prepared for the proposal, which involved desktop assessment and engagement with key potentially affected stakeholders to assess the impacts and opportunities associated with the proposal. Details of the study methods and findings are provided in the SIA report submitted as an appendix to the draft EIS.

Site of heritage significance were identified in consultation with the NT Heritage Branch. There is no site within the direct disturbance footprint, however, there are three sites nearby for which protection is recommended. There are no registered or recorded Aboriginal Sacred Sites within the project area and Core has applied for an Authority Certificate under the *Aboriginal Sacred Sites Act*. The project EMP includes measures to protect the known heritage sites from disturbance and procedures for dealing with unexpected finds, and works will not commence until an Authority Certificate is in place.

The outcomes of the SIA indicate that the greatest potential social impact associated with the proposal, relates to the increased heavy vehicle traffic and temporary closures on Cox Peninsula Road. This impact was rated as high because it was the key concern raised by stakeholders. The Traffic Impact Statement prepared for the proposal (submitted as an appendix to the EIS) indicates that the increase in peak traffic volumes will be small (1.3%) and is therefore not expected to cause congestion or an increased risk of collisions. Road closures for blasting, albeit for short periods of time (15 minutes, 3 times per week), will inconvenience and concern some people. Communication with stakeholders and the community in relation to road closure times is expected to reduce this risk to an acceptable level.

All other impacts were assigned a low to moderate risk rating. The key reasons why the project has inherently limited social and economic impacts are listed below:

- The mine site is remote from residential areas and sensitive receptors
- Small disturbance footprint
- Short-mine life (2-3 years)
- Small workforce (100-150 personnel)
- Local businesses have capacity to service the mine site and most employee skill sets are available in the greater Darwin region.
- Local workforce to be accommodated in the community – no onsite accommodation camp and no
- Fly-in-fly-out workforce.
- No identified AMD or other contamination issues that will restrict future land-uses.

For the rehabilitation and closure phase of the project, the highest risk relates to unauthorised public access and safety. The Mine Closure Plan provides details of how the mine site will be made safe, including the installation of an abandonment bund and adequate signage. Given the short mine life and economics underpinning the project, the likelihood of early closure, which could heighten any risk to public safety, is considered low.

A Social Impact Management Plan (SIMP) has been prepared to provide details of how Core proposes to mitigate, manage and monitor social impacts, and maximise the opportunities to the local community and economy associated with jobs and contracts for local businesses. Core has taken a proactive approach to stakeholder engagement, which is detailed in Chapter 3 of the draft EIS. Most key stakeholders have been reached and their input has been incorporated into the SIA and SIMP. Some key stakeholders have not been reached, in particular there is a gap in feedback from the Belyuen community. Core is committed to maintaining efforts to engage with Aboriginal stakeholders and all other stakeholders. Ongoing opportunities for provision of feedback are expected to ensure any issues are identified and addressed as the project planning progresses.

The draft EIS concludes that the mitigation, management and monitoring measures proposed by Core are expected to ensure that impacts to social, economic and cultural values are minimised and not at levels that would be considered unacceptable to stakeholders.

Environmental Management

Chapter 10 of the EIS collates all of the mitigation and management measures developed through the impact and risk assessment process undertaken for draft EIS, and establishes a framework for monitoring the effectiveness of the measures, responding to any emerging issues that could result in environmental impacts being greater than anticipated and reporting on environmental performance. Commitments to addressing information gaps and/or developing more detailed management plans/procedures are also collated in a Commitments Register for future reference. The resulting EMP provides an environmental management framework for each of the environmental factors assessed in the draft EIS.

Specialised management plans have been developed to provide a higher level of operational detail for key areas of environmental risk. The following additional management plans and procedures were submitted with the draft EIS:

- Vegetation Clearing Procedure
- Water Management Plan
- Erosion and Sediment Control Plan
- Social Impact Management Plan
- Mine Closure Plan.

The environmental management provisions described in the EMP, plus any recommendations made by the NT EPA and conditions of subsequent approvals/permits/licences, will be used by Core as the basis for preparing the future Mining Management Plan (MMP) for the project. The MMP will be the plan that is submitted for authorisation under the *Mining Management Act* and will become the key document used by Core and its contractors to manage, monitor and report on environmental performance on a day-to-day basis. The MMP will also be the key regulatory document against which Core's environmental performance is monitored by the Department of Primary Industry and Resources (DPIR) over the life of mine and into the rehabilitation and closure phase.

Core has established an Environmental Policy to communicate the company's commitment to understanding and managing environmental and social impacts and risks associated with its proposed activities. This policy will guide the development of environmental management systems, processes, plans and procedures for the Grants Lithium Project. A copy of Core's Environmental Policy is illustrated below.

Environmental Policy



Core Exploration is committed to ensuring an environmentally respectful workplace for our employees and contractors whilst working towards minimising our potential impact on the environment. Core Exploration will operate in compliance with all relevant environmental legislation and will strive to use environmental best practices in all areas of its operations.

Core Exploration commits itself to minimising its impact on our environment through:

- Having an environmentally sustainable aware culture, where responsibility is assigned and understood;
- Being an environmentally responsible neighbour in our community;
- Conserving natural resources by reusing and recycling;
- Using, in our operations, processes that do not adversely impact the environment;
- Ensuring the responsible use of energy throughout the organisation;
- Participating in efforts to improve environmental protection and understanding;
- Taking steps to improve environmental performance continually;
- Working with contractors who promote sound environmental practices; and
- Enhancing awareness among our employees, contractors and stakeholders – educating and motivating them to act in an environmentally responsible manner.

This policy is supported by an Environmental Management Plan developed for each of Core's projects. The project specific Environmental Management Plans describe Core Exploration's environmental management focus in minimising and eliminating environmental impacts wherever practicable.

Core Exploration will regularly report on its environmental performance in accordance with recognised standards and targets as listed in the respective Environmental Management Plans. This policy and the project specific Environmental Management Plans will be reviewed annually.

Stephen Biggins
MANAGING DIRECTOR



GRANTS LITHIUM PROJECT

Draft Environmental Impact Statement

Chapter 1

Introduction

1 INTRODUCTION

On 3 May 2018 the Northern Territory Environment Protection Authority (NT EPA) published their decision that Core Exploration's proposal to develop an open cut lithium mine at a site on the Cox Peninsula, approximately 25 km south of Darwin, requires assessment under the *Environmental Assessment Act (EAA)* at the level of an Environmental Impact Statement (EIS). The proposal was not referred under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* as it does not involve any activities that are likely to have a significant impact on the Matters of National Environmental Significance (refer section 1.7.3).

This EIS has been prepared to address the Terms of Reference (ToR) released by the NT EPA on 3 August 2018 (Appendix A). A table listing how the ToR have been addressed in the EIS – cross-referenced to chapters, sections and/or appendices – is provided at Appendix B. Where an aspect required more detailed technical study or review, stand-alone reports prepared by suitably qualified technical experts have been provided as Appendices, with key findings summarised in the relevant EIS chapters.

The purpose of the EIS is to provide regulators and other stakeholders with information about the proposal and the predicted environmental and social impacts, so that they can make informed decisions. When deciding whether or not the proposal can proceed without causing significant impact to the environmental and/or social values, the NT EPA will take into account comments received from the community, local government and NT Government agencies and other stakeholders. Any matters raised during the public comment period will be directed to Core for addressing in a supplementary document and taken into account by the NT EPA when making a final decision.

1.1 Proposal overview

Core proposes to develop **Grants Lithium Project** (the 'proposal') on Mineral Lease (ML) 31726 (under application). The proposal encompasses the following key activities:

- Mining of spodumene (a lithium-bearing ore) using simple open pit drill and blast mining methods over a life of mine of approximately two to three years.
- Crushing, screening and water-based processing of ore to increase the lithium concentration in the product from 1.5% to 5.5%.
- Establishment of an onsite waste rock dump (WRD) and co-located tailings storage facility (TSF) to accept waste rock and tailings from the mining and processing activities.
- Haulage of the product in road trains along public roads to Darwin Port for export.

An old mine dam located 5 km to the south of ML31726 (Observation Hill dam), will be used as one of the primary operational water sources. A water pipeline will be installed to transport the water from the dam to the mine site. To ensure water security for the project in the event of lower-than-average rainfall years, the proposal also includes raising the existing dam wall to increase yield, and constructing a smaller dam on the upper reaches of an ephemeral watercourse that flows through the ML. The term 'project area' is used in this EIS to refer to the area cover by the ML, dams and water pipeline corridor. The term 'mine site' is used to refer to the site of the mining operation within ML31726.

The project is expected to employ 100-150 people and is planned as a daily drive-in-drive-out operation with personnel living in the greater Darwin region. There is no requirement for an on-site mine camp.

The project is estimated to have a post-tax Net Present Value (NPV₁₀)¹ of A\$140 million and is estimated to contribute in excess of A\$26 million in royalties to the NT Government.

¹ Net Present Value is a measurement of profit calculated by subtracting the present values of cash outflows (including initial cost) from the present values of cash inflows over a period of time.

1.2 Location and regional setting

The proposed mine site is located on the Cox Peninsula Road, approximately 36 km west of Berry Springs and 15 km south-east of Belyuen community. The site is located 90 km by road from Darwin CBD, or 25 km south as the crow flies. The site access road is approximately 10 km to the west of the Fog Bay Road turn-off to Dundee Beach and 20 km west of the Litchfield Park Road. The Bynoe Harbour Access Road turn-off is 9 km to the east of the site.

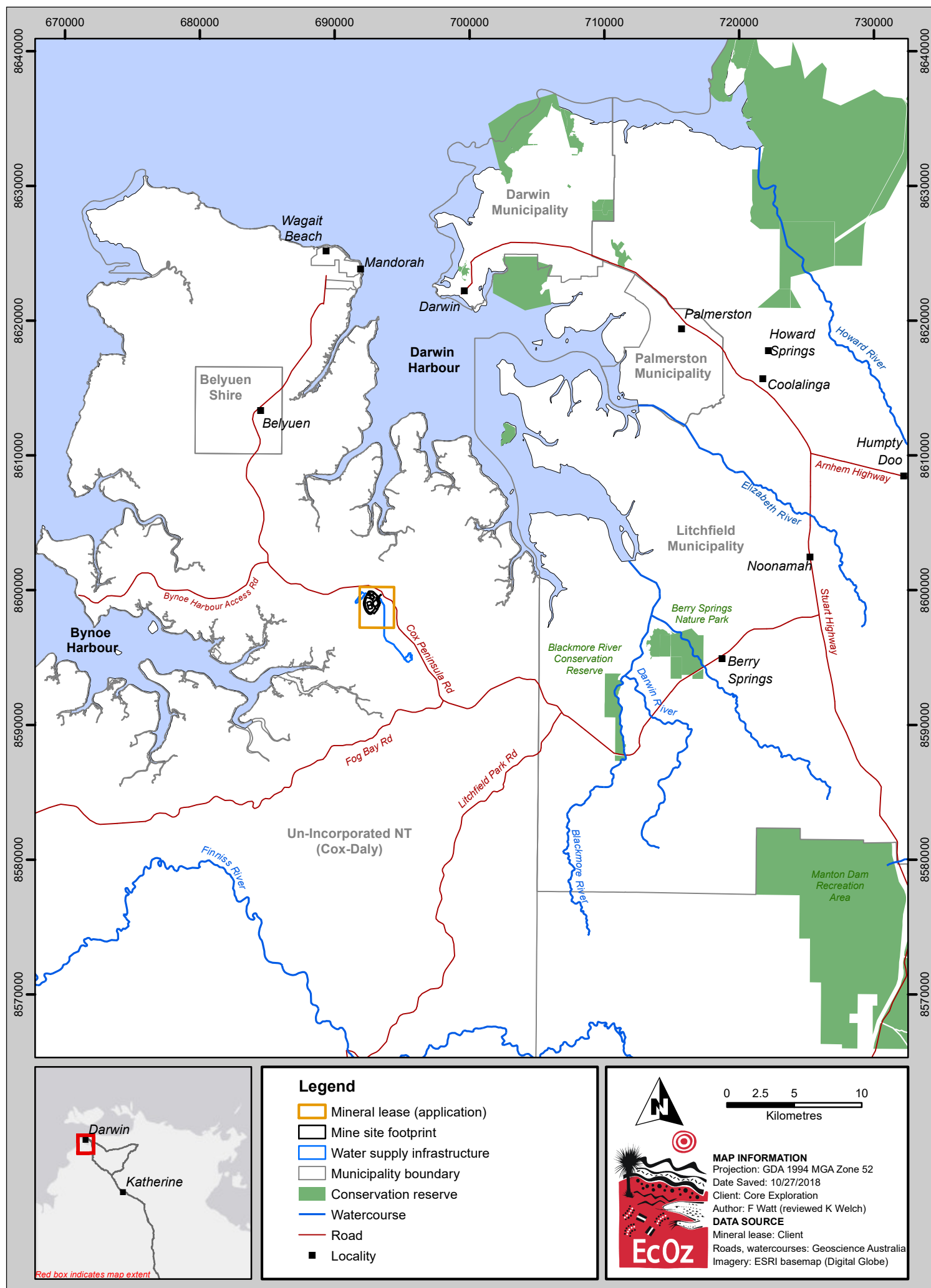
The project area is located on undeveloped Vacant Crown Land (Section 1 Hundred of Parsons) and is surrounded by this land tenure for seven to eight kilometres in all directions. There are no active industrial sites nearby (including no active mines or extractives quarries) and there is very limited industrial development on the Cox Peninsula. Currently, mining exploration is the main land-use in the project area, and rural living, recreation and tourism are the main land-uses across the peninsula more broadly. The nearest formal residence is located on a freehold parcel of land 10 km to the south of the proposed mine site.

There are a number of historic mines visible on aerial photography of the surrounding area; the closest are located 1.5 km to the east and south-east of the project area. These sites have relatively small scale visible ground disturbance and historic pit lakes. The most recent mining activities in the area were in the 1980's to early 1990's when tin and tantalum were mined at Observation Hill. The Observation Hill dam (OHD) has old pipeline and pumping infrastructure present from when it was used as a water supply for mining activities.

There are no protected areas in close proximity to the site. The Blackmore River Conservation Reserve and Berry Springs Nature Park are located 32 km and 41 km to the east, and Litchfield National Park is located 42 km to the south. The proposed mine site is located in the upper catchment of minor ephemeral watercourses that flow into the West Arm system 1.7 km downstream. The OHD is in the catchment of the Charlotte River, within the Bynoe Harbour watershed. The groundwater aquifer beneath the mine site is limited and there are no registered groundwater bores/users within 12 km of the site (Knapton and Fulton, 2018).

The project area is not located within the boundaries of any local government area; however, the haul route is along NT Government controlled main roads that pass through the areas of Litchfield, Palmerston and Darwin municipalities. The site is not serviced by mains power, water or sewage, and the closest police and fire emergency services are located at Humpty Doo (60 km by road). Medical general practitioner services are available in Berry Springs and the closest hospital is the Palmerston Regional Hospital (70 km by road).

The location and regional setting of the proposal is shown in Figure 1-1.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 1 maps\Figure 1-1. Project location and regional setting.mxd

Figure 1-1. Project location and regional setting

1.3 About Core Exploration

Core Exploration is a minerals exploration company listed on the Australian Stock Exchange (ASX: CXO). The company holds Exploration Licences (EL) over 500 km² of land in the Finniss River region, where it has been actively exploring for lithium since 2016 (see Figure 1-2). Core also holds a number of EL's across the NT and South Australia in areas prospective for copper, zinc, lead and uranium. Further information can be found on the company website (see below).

1.3.1 Contact details

Business name: Core Exploration Limited
Managing director: Stephen Biggins
Company website: www.coreexploration.com.au
EIS contact: Blair Duncan – General Manager Project Development
Postal address: PO Box 6028, Halifax Street SA 5000
Contact details: Phone: 0448 883 204; Email: bduncan@coreexploration.com.au

1.3.2 Environmental history

Core has demonstrated its commitment to understanding and mitigating environmental and social risks by engaging the advice of suitably-qualified technical experts, across various disciplines, to inform project development and approvals for the Grants Lithium Project proposal. The company has been operating in accordance with an approved Mining Management Plan (MMP) for its exploration activities, which are regulated by the NT Department of Primary Industry and Resources (DPIR). There have been no proceedings against Core in relation to environmental performance associated with these activities or any other actions.

Core has established an Environmental Policy to communicate the company's commitment to understanding and managing environmental and social impacts and risks associated with its activities. This policy will guide the development of environmental management systems, processes, plans and procedures for the Grants Lithium Project if the proposal is approved. Core's Environmental Policy is provided in the Environmental Management Plan (EMP) submitted with this EIS (refer Chapter 10).

1.4 Proposal background, objectives and current status

In 2017, Core discovered and defined the NT's first lithium resource and completed a mining study in respect of developing the Grants Lithium Project. A Pre-Feasibility Study (PFS) was released by Core in June 2018, which supported their decision to proceed with more detailed feasibility studies for the project. The company is in the process of finalising off-take and pre-payment agreements with China-based company Sichuan Yahua Industrial Group Co. Ltd., which has provided Core with funds to further develop the mining and logistics plans. Core is currently well funded to undertake baseline and technical studies required to support project approvals.

This draft EIS has been developed based on the project detail documented in the PFS and subsequent work undertaken towards the Definitive Feasibility Study (DFS), which is set to be released before the end of 2018. As Core has progressed with project planning since submission of the NOI to the NT EPA in late 2017, some aspects of the project have been refined/changed as investigations have improved understanding. To assist the NT EPA and other stakeholders with their assessment of this EIS, details of these changes are summarised in Table 1-1 below.

The release of the DFS and finalisation of the EIS process will underpin Core's Final Investment Decision to proceed with development of Grants Lithium Project. Proceeding would see Core transition from a mineral explorer to producer. The company's objective is that the cash generation from developing the project will enable Core to

be self-funding on future development opportunities within its EL's across the Finnis River region (refer Section 1.5).

Table 1-1. Summary of project changes between NOI and EIS

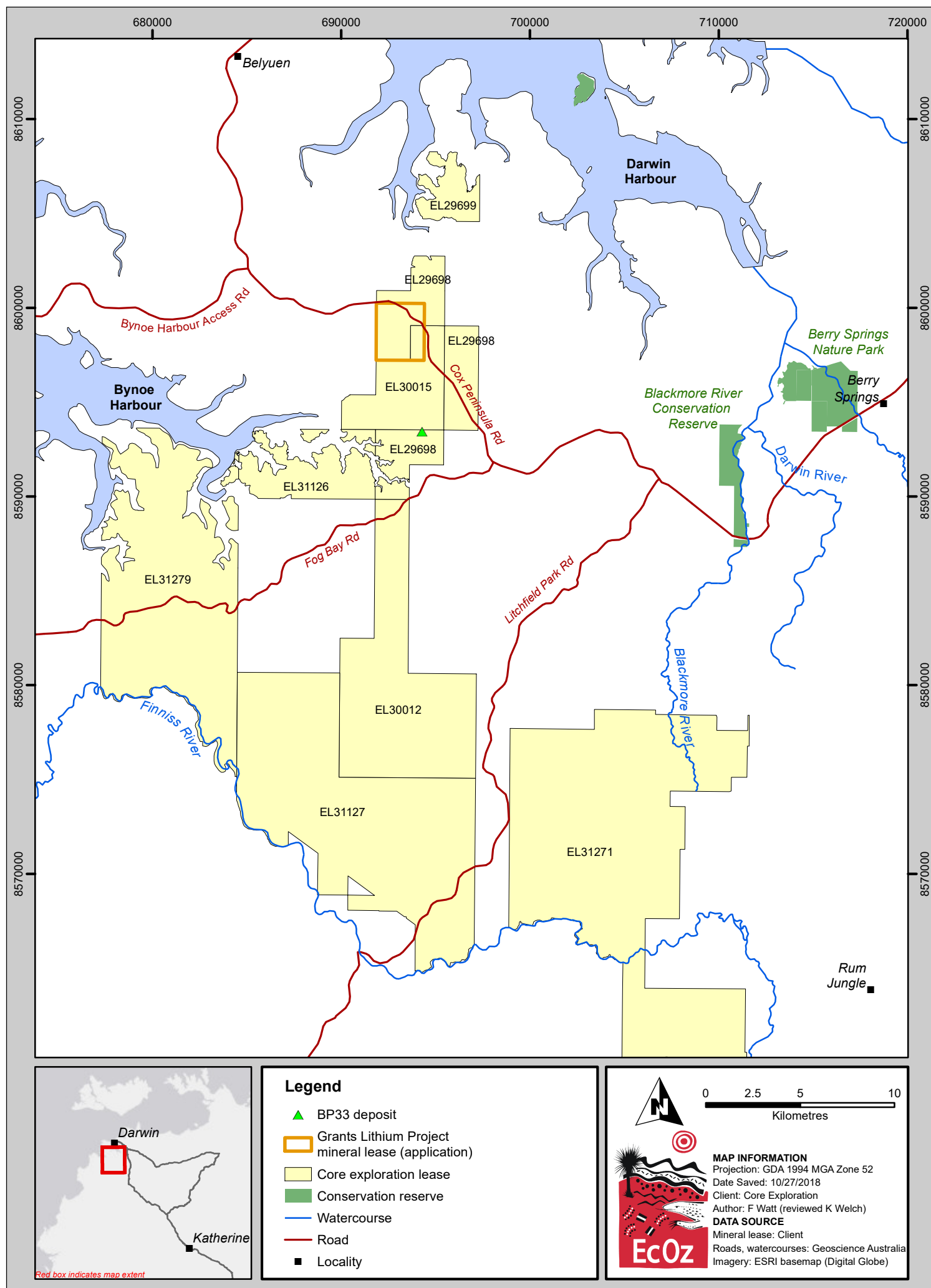
Project aspect	Status in NOI	Status in EIS
Ore processing	Both direct shipping ore (DSO) and beneficiation by water-based dense media separation under consideration.	No Direct Shipping Ore. Ore will only be processed by water-based Dense Media Separation to increase lithium concentration from around 1.5% to 5%.
Transport	Up to 29 quad road train trips per day between mine site and port for 1.8 Mt of DSO product.	Up to 10 quad road train trips per day between mine site and port for 2 Mt of concentrated product.
Water sources	All water sourced from existing Observation Hill dam. Limited groundwater resources in the area – groundwater not a primary contributor to the site water balance.	Site water balance developed to include estimates of pit in-flows (from groundwater modelling) and incident rainfall. Site design revised to incorporate water storages that will allow for re-use of water de-watered from the pit. Re-use of water on site will reduce make-up water requirements. To provide options for ensuring sustainable water supply across low, medium and high rainfall years, and to account for limitations in modelling of pit inflows, the proposal includes: • Raising the spillway level of the existing Observation Hill dam to increase yield. • Building a new dam on the Mineral Lease to supplement water available from Observation Hill dam.
Employment	50 to 100 direct jobs	100 to 150 direct jobs following receipt of commercial tenders
Water discharge	No discharge requirement	More detailed modelling predicts that rainfall and pit inflows will exceed the projects water requirements and storage capabilities in the peak of the wet season. During the months of December to March there will be a requirement to discharge rainwater and groundwater dewatered from the pit off-site. Any discharge to water will require a Waste Discharge Licence under the <i>Waste Management Pollution Control Act</i> .

1.5 Future prospects in the Finnis River Region

Core is actively exploring across its 500 km² of EL's in the Finnis Region, in particular focussing on the BP33 deposit located around 6 km to the south-west of Grants (Figure 1-2). There is also potential to further grow Core's mining operations, as many of the lithium-rich pegmatites have been identified within Core's EL's to date that are yet to be drill tested. Further exploration drilling by Core in 2018 and 2019 is aimed at substantially growing the mineral resource base to underpin a potential long-life lithium mining operation beyond the initial planned development of Grants Lithium Project.

Core has publicly stated that the company's goal is to be in a position to provide an updated Joint Ore Reserves Committee (JORC)² resource estimate for the BP33 deposit in late 2018, with the aim that BP33 can then be considered in development Feasibility Studies later in 2018 and 2019. If this goal is achieved, baseline environmental studies would commence at BP33 in early 2019 and Core would submit a further NOI to the NT EPA later in 2019. Subject to gaining approvals, including finalisation of a subsequent EIS if deemed necessary by the NT EPA, Core's intent would be to commence mining at BP33 on completion of mining at Grants (i.e. in 2021). Any development of the BP33 deposit would therefore be expected to extend the life of the mining operation by a number of years, with ore mined at BP33 most likely be transported to the processing facilities that will be already established at the Grants mine site.

² Joint Ore Reserves Committee Code is the *Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves*. It establishes standards for public reporting, emphasising principles of transparency and materiality. All companies listed on Australian or New Zealand Stock Exchanges are required to comply with the JORC Code.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 1 maps\Figure 1-2. Core Exploration Leases in the Finnis River region.mxd

Figure 1-2. Core Exploration Leases in the Finnis River region

1.6 Project benefits and consequences of not proceeding

The proposal presents an opportunity to develop the NT's first lithium mine. Demand for lithium is underpinned by the global boom in production of lithium-ion batteries for use in energy storage applications associated with renewables and electric vehicles. Lithium raw materials are the vital ingredient for lithium ion battery technology and so, as the desire for renewable energy supplies increases, demand for lithium is expected to continue. This presents an opportunity for Grants Lithium Project to be the first phase of a longer-term lithium mining operation in the region, subject to Core being successful in defining further mineral resources across its ELs.

Compared to other lithium mines in Australia (which are primarily in WA), the proposed mine site is within easy trucking distance by sealed road to Darwin Port – Australia's nearest port to Asia – where the key demand for lithium raw products is expected to be driven by China. The site also has the advantage of being close to Darwin, a major population centre capable of providing labour and services without the need for fly-in-fly-out workers, and the associated costs of moving and accommodating those workers. The project is expected to provide benefits in the following areas:

- **Jobs** – Core expects to create between 100 and 150 direct employment jobs.
- **Export income** – The Australian economy will benefit from over A\$300 million in export income.
- **Royalties** – The NT government will benefit from royalties under the *Mineral Royalty Act*.
- **Develop new technology** – A long-term lithium mining project in the NT could provide opportunities for further industry development, such as lithium battery factories.

If the project is unsuccessful in gaining approval, the above opportunities would be delayed indefinitely and Core would need to re-evaluate its mineral exploration aspirations in the region.

1.7 Approvals and conditions

Environmental and social aspects of the project will be regulated under NT law. The *Mineral Titles Act (MTA)* and *Mining Management Act (MMA)* are the primary regulatory instruments for mining proposals in the NT. The application of these Acts to the proposal is discussed below, along with details of the approvals already obtained and those that are required prior to commencement of mining activities. Other relevant NT legislation and approvals applicable to each of the NT EPA's environmental factors are also identified and discussed. Some key pieces of Commonwealth legislation that often apply to mining proposals in the NT are not applicable to this proposal; these are also summarised with details provided as to why they do not apply.

1.7.1 Mining approvals (NT)

The DPIR oversees the approval and regulation of mining activities. Under the *MTA*, Core has applied for ML31726 over an area of 768 ha that encompasses the proposed mine site. Ancillary mineral leases will be required over the dams and water pipeline corridor.

Authorisation of the proposed mining operation is required under the *MMA*. This authorisation is the key regulatory instrument used by the NT Government for approval and compliance monitoring of mining operations in the NT. To apply for an authorisation, Core will prepare a Mining Management Plan (MMP). Pursuant to section 40 of the *Act*, a MMP is to include the following:

- Identification and description of mining activities
- Particulars of the implementation of the management systems to address environmental issues
- A plan and costing of closure activities
- Particulars of the organisational structure
- Plans of current and proposed mine workings and infrastructure and other information as required.

Most of these details are provided in the EIS and will be transferred across to the MMP, with updates made where required to reflect the most current mine planning.

Authorisations for mining operations are granted by the Minister for Mines on the advice of DPIR. For projects such as Grants Lithium Project, that are assessed under the *EA Act*, the Minister may impose conditions relating to recommendations received from the NT EPA. Authorisations are granted following completion of the EIS assessment process.

The *MMA* also contains the following provisions that will apply to the project and are relevant to protecting the environment:

- The operator must provide a security (Section 37), which can be used to secure the payment of costs/expenses related to the Minister taking action to prevent environmental harm and/or complete rehabilitation activities.
- The operator must notify the Department on becoming aware of a serious environmental accident or critical incident on the site (Section 29).
- When a serious environmental accident occurs, the operator must carry out an investigation to determine its cause and forward a written report to the Department (Section 31).
- The operator of a mining site is to notify the Minister in writing of the proposed cessation of mining activities if it does not form part of the MMP proposal (Section 42).

1.7.2 Other NT legislation/approvals

Other relevant governing legislation, permits and licences are summarised in Table 1-2.

Table 1-2. Summary of governing legislation and approvals applicable to Grants Lithium Project

Legislation	Regulation/approval	Project relevance
Flora and Fauna		
<i>Planning Act</i>	Land Clearing Permit	Vegetation clearing on mining interests is controlled by application of the <i>MMA</i> and <i>MMP</i> 's. No permit is required, but vegetation clearing procedures will need to be included in the Grants Lithium Project <i>MMP</i> .
<i>Territory Parks and Wildlife Conservation Act</i>	Permit to take or interfere with wildlife that is threatened	Pursuant to Section 56, the taking or interfering with wildlife that is listed as threatened, requires approval at the Ministerial level. Desktop and survey work for threatened species in the project area did not identify any threatened species' populations and none are expected to occur (refer Chapter 5). No permit is required.
<i>Weed Management Act</i>	Not applicable	Occupiers of land (including mine sites) have an obligation to ensure listed weeds are not introduced or spread. A baseline weed survey has been undertaken across the project area and weed management is addressed in the <i>EMP</i> (refer Chapter 10).
Land and Soils		
<i>Soil Conservation and Land Utilisation Act</i>	NA	This Act provides for the prevention of soil erosion, and for the conservation and reclamation of soil, and requires Erosion and Sediment Control Plans (<i>ESCP</i> 's) to be devised for development projects. The <i>EIS ToR</i> require an <i>ESCP</i> be prepared for the mine site. A conceptual plan has been submitted with the <i>EIS</i> , which will be finalised on submission of the <i>MMP</i> .
Water Quality		
<i>Water Act</i>	Waste Discharge Licence (<i>WDL</i>)	Any off-site discharge from operational areas to a watercourse would require a <i>WDL</i> . The licencing system is managed by the NT EPA. The site water balance model indicates that controlled discharge of water from the site will be required in December to March each year. Discharge

Legislation	Regulation/approval	Project relevance
		requirements, management and monitoring are addressed in the Water Management Plan (Appendix C).
<i>Public and Environmental Health Act</i>	Wastewater works design approval	Approvals will be required for onsite wastewater management systems that accept black and greywater from ablutions. These approvals are obtained from Department of Health.
Hydrological processes		
<i>Water Act</i>	Permit to construct or alter works Licence to take or use surface water or groundwater	At the time of EIS submission, mining activities were exempt from this requirement; however, an amendment to the Act to encompass mining is expected to be in force in early 2019. Core is anticipating having to apply for these permits. Geotechnical studies, design work and hydrological modelling has been commenced to support a future permit application.
Social, economic and cultural surroundings		
<i>Control of Roads Act</i>	Permit to Work in NTG Road Reserve	Works to upgrade the mine site intersection will be within the road reserve. Details of these works are provided in this EIS, and the NT Government have been engaged. Permits will be obtained prior to commencement of works.
<i>Control of Roads Act</i>	Road closure approvals and signage	Temporary road closures will be required on the Cox Peninsula Road three times per week for approximately 15 minutes whilst blasting. Approvals will be required for road closure.
<i>Aboriginal Sacred Sites Act</i>	Authority Certificate	The Aboriginal Areas Protection Authority (AAPA) will be engaged to undertake Aboriginal sacred site clearances. Core has applied for an Authority Certificate, which will document any restrictions to protect Aboriginal sacred sites. There are no currently registered or recorded sites in the project area.
<i>Heritage Act</i>	Work Approval	There are no sites on the NT Heritage Register within the project area; however, NT Heritage Branch have identified two historic mine sites that they recommend avoiding if possible. These sites are outside of the disturbance footprint and so will not be impacted. There is an Aboriginal archaeological site located on the ML, but outside of the disturbance footprint. There is a low likelihood of archaeological sites occurring. All Aboriginal and Macassan sites are protected under the Act. If previously unrecorded sites are uncovered by the project activities a Works Approval may be required from the NT Heritage Branch.
Other		
<i>Work Health and Safety (National Uniform Legislation) Act</i>	Risk Management Plan (RMP)	Mine sites in the NT must not permit any mining activity or a related mining activity to be carried out unless the mine operator has given to the regulator an RMP for the mine site that has been certified in accordance with regulation 614.
<i>Dangerous Goods Act & Regulations</i>	Explosive Permits	The storage and transport of explosives requires an approval to be obtained from Worksafe NT. Explosives will be stored in a magazine to be constructed at the mine site (refer Chapter 2). An Explosives Business Licences will be required.
<i>Waste Management and Pollution Control Act</i>	Environmental Protection Approval or Licence (EPA and EPL)	EPA and EPL are required for construction and operation of facilities that store and handle listed wastes. General and hazardous wastes will be removed from site by a licenced contractor. There is no onsite landfill proposed. No approval or licence is required.

1.7.3 Commonwealth legislation

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

A desktop assessment was undertaken to consider the potential for project activities to have a significant impact on Matters of National Environmental Significance (MNES) protected under the *EPBC Act*. An EPBC Protected Matters Search was generated on 3 October 2017 for the Darwin Coastal bioregion (the bioregion in which the project area occurs). This report identified two MNES may occur within the project area – listed threatened species and migratory species protected under international agreements. A summary of potential to impact on either of these matters is provided below. Complete details of potential impacts to flora and fauna are provided in Chapter 5 of this EIS.

The EPBC assessment concluded that the proposed activities are not expected to cause a significant impact. On this basis an EPBC Referral has not been submitted.

Threatened species

There are two Commonwealth-listed threatened species – Black-footed Tree-rat and Partridge Pigeon – that have a high likelihood of occurring based on the presence of suitable (albeit marginal) habitat and recent proximate records. Loss of habitat due to land clearing is the key potential impact to both of these species. Mortality/disturbance due to use of machinery/operations may also negatively impact both of these species. The potential impacts and mitigation measures are summarised below:

- Loss of habitat – Approximately 181 ha will be cleared or inundated (by dams). This clearing is concentrated within the *Eucalyptus* woodland and open *Eucalyptus* woodland vegetation types. These habitats may be utilised by both the Black-footed Tree-rat and Partridge Pigeon; however, the site-based assessment suggests that the project area is unlikely to provide critical habitat. Further, these habitats dominate the broader region, which is sparsely developed. The removal of *Eucalyptus* woodland habitats is not expected to have a significant impact on either of the species due to the regional availability of similar habitats.

Mortality during land clearing – Direct mortality is a potential impact to the Black-footed Tree-rat during vegetation clearing; however, the species is mobile and is expected to avoid operating machinery. Further, the main risk would be associated with the species sheltering in tree hollows. Tall trees with hollows do occur in the project area but are low in abundance. It is not expected that project activities will cause direct mortality to Partridge Pigeon.

Fauna species assessed as having a medium likelihood of occurring, if they did occur in the project area, would likely be using the area for foraging rather than breeding/roosting. The moderate likelihood of occurrence indicates there is no core habitat present. In the absence of habitats that would support breeding or roosting, the Project is unlikely to impact any of these species.

Migratory species

The EPBC Protected Matters Search Tool report identified the possibility of migratory species protected under international agreements occurring in the region. However, when each of these migratory species was assessed, all species were determined to have a low likelihood of occurring within the project area (refer Chapter 5). When assessing if a project will significantly impact upon a migratory species, the key considerations under the *EPBC Significant Impact Guidelines 1.1* (DOE 2013) are whether an important habitat for a migratory species or an ecologically-significant proportion of a population of a migratory species is involved.

Even if a migratory species was to seasonally utilise the habitat within the project area, numbers are expected to be low and that are would be used for only a short period. Additionally, any migratory species utilising habitat within the project area could reasonably be expected to utilise the areas of similar contiguous habitat surrounding the project area. As such, the habitat within the project area is not considered to be important habitat for any migratory species, and any migratory species occurrence is not expected to be considered an ecologically-significant proportion of a population.

It is unlikely that there will be any contamination of Darwin Harbour through off-site drainage such that it causes a significant impact to any migratory species or their habitat. Impacts to downstream water quality and environmental values that rely on good water quality are further discussed in Chapter 8.

Native Title Act

Registered Native Title claimants and determined Native Title holders have certain rights under the provisions of the *Native Title Act 1993 (Commonwealth) (NTA)* future act regime. A 'future act' is an act done after the 1 January 1994, which affects Native Title. The future act can be a proposed activity or development on land and or waters that has the potential to affect Native Title, by extinguishing it or by creating interests that are inconsistent with the existence or exercise of Native Title. The granting of a ML under the *MTA* is a future Act and therefore ML applications are required to undergo an advertising period pursuant to section 29 of the *NTA*. Core's application for ML31726 has been through this advertising period and no Native Title claims have been registered; therefore, the ML is expected to be granted and Native Title extinguished.

National Greenhouse and Energy Reporting Act

Under this Act there are requirements for controlling corporations to register and report if they emit greenhouse gases (GHG), produce energy, or consume energy at or above specified quantities in a given financial year. GHG emissions calculations for the proposal are presented in Chapter 2 (Section 2.13). The project may trigger the reporting thresholds in the first year of operations due to the combined emissions from land clearing and construction activities.

1.7.4 Standards and Codes of Practice

Mine planning and design have considered the following standards, guidelines and codes of practice relevant to avoiding or minimising environmental and social impacts. Policy and guidelines relevant to assessment of impacts to the NT EPA's environmental factors are referenced in the relevant EIS chapters where applicable.

Mining best-practice guidelines

- *A Guide to Leading Practice Sustainable Development in Mining* (Australian Centre for Sustainable Mining Practices, 2011)

Waste characterisation/Acid Mine Drainage

- *Global Acid Rock Drainage Guide* (International Network for Acid Prevention, 2014)
- *Materials Characterisation Baseline Data Requirements for Mining Proposals* (Department of Mines and Petroleum, 2016)
- *Environmental Assessment Guidelines on Acid and Metalliferous Drainage* (NT EPA, 2013)
- *Preventing Acid and Metalliferous Drainage – Leading Practice Sustainable Development Program for the Mining Industry* (Department of Foreign Affairs and Trade 2016a)

Stormwater management, erosion and sediment control

- *Best Practice Erosion and Sediment Control* (International Erosion Control Association, 2008)

Noise and dust

- *Airborne Contaminants, Noise and Vibration – Leading Practice Sustainable Development Program for the Mining Industry* (Department of Foreign Affairs and Trade, 2009)

Tailings management

- *Tailings Management – Leading Practice Sustainable Development Program for the Mining Industry* (Department of Foreign Affairs and Trade 2016b)
- Australian National Committee on Large Dams (ANCOLD) “Guidelines on Tailings Dams” (ANCOLD, 2012)

Water management

- *Water Stewardship – Leading Practice Sustainable Development Program for the Mining Industry* (Department of Foreign Affairs and Trade 2016c)
- *Water Accounting Framework for the Australian Minerals Industry* (Minerals Council of Australia, 2014).

Storage and handling of hazardous substances and dangerous goods

- *Australian Dangerous Goods Code 7.6*
- *AS1940:2017 The Storage and Handling of Flammable and Combustible Liquids* (Standards Australia, 2017)

Mine closure planning

- *WA Guidelines for Preparing Mine Closure Plans* (Department of Mines and Petroleum and Environment Protection Authority, 2015).
- *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (Department of Foreign Affairs and Trade 2016d)
- *Mine Closure – Leading Practice Sustainable Development Program for the Mining Industry* (Department of Foreign Affairs and Trade 2016)

1.8 EIS contributors

Details of key personnel invoiced in contributing to preparation of the EIS are provided in Table 1-3.

Table 1-3. Key personnel involved in preparing the EIS

Role/Contribution	Name/qualifications/experience	Company
Acquisition, discovery & definition	Stephen Biggins -MBA, BSc (Hons) Geology, years exp. 28+	Core Exploration
Project Development	Blair Duncan – BEng (Mining), MBA, years exp. 30+	Core Exploration
Exploration Manager	David Rawlings - BSc Hons, PhD, years exp. 30+	Core Exploration
Project engineering and design	Sean Buxton – BEng (Mining); years exp. 29+	Innicon
Project engineering and design	Andrew Simmons – BEng (Mining); years exp. 10+	GHD
EIS Project Manager and review	Kylie Welch - MSocSc, BSc(Hons); EIANZ Certified Environment Practitioner No.975; years exp. 15+	EcOz
Impact assessment, Mine Closure Plan, materials Characterisation	Aiden Campbell – MSc, BSc (Hons); years exp. 10+	EcOz
Impact assessment, GIS and mapping	Felicity Watt – BArts (Geography), Grad Dip. Remote Sensing and Land Info; years exp. 15+	EcOz
Ecology and threatened species	Steve Reynolds – PhD (Zoology) BSc(Hons); years exp. 15+	EcOz
Botany and threatened species	David van den Hoek – BSc(Env), Dip. Cons Land Mgmt; years exp. 10+	EcOz

Role/Contribution	Name/qualifications/experience	Company
Water Management	Emma Smith – BSc (Hons (Applied Geology), Grad Dip. NRM; years exp. 15+	EcOz
Erosion and Sediment Control	Tim Elder – BSc, Grad Dip NRM; Certified Practitioner in Erosion and Sediment Control (CPESC#4799); years exp. 20+	EcOz
EIS review and Environmental Management Plan	Glen Ewers - BSc, BLaw, Grad Cert Ornithology; years exp. 15+	EcOz
Materials characterisation	Carel van der Westhuizen – MSc (Hydrogeology), Certified Environment Practitioner (Contaminated Land Specialist); years exp. 20+	Pendragon
Principal Hydrogeologist	Simon Fulton - BSc (Hons); years exp. 10+	CloudGMS
Principal Groundwater Modeller	Anthony Knapton – BSc (Hons) (Geophysics); years exp. 15+	CloudGMS
Social Impact Assessment and stakeholder engagement	Jo Madin - Bachelor Applied Science (Planning), Certificate of Public Participation, IAP2; years exp. 20	True North Strategic Communication
Social Impact Assessment and stakeholder engagement	Claire Butler - BintBus, Grad Dip. Mgmt, Certificate of Public Participation, IAP2; years exp. 20	True North Strategic Communication

1.9 References

References cited in this chapter are listed below.

Australian Centre for Sustainable Mining Practices (2011). *A Guide to Leading Practice Sustainable Development in Mining*, [online] Available at:

<https://archive.industry.gov.au/resource/Documents/LPSDP/guideLPSD.pdf> [Accessed 5 Sept 2018].

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GRANTS LITHIUM PROJECT

Draft Environmental Impact Statement

Chapter 2

Project Details

2 PROJECT DETAILS

This chapter provides details of the Grants Lithium Project proposal. The content has been developed to address Section 2 of the EIS Terms of Reference (ToR) and with the purpose of documenting the project information used as the basis for assessing environmental impacts.

2.1 Mineral Resource

The defined maiden resource at Grants deposit is 1.8 million tonnes (Mt) of ore, containing approximately 1.5% concentration by weight of lithium oxide (Li_2O). The deposit is modelled as a near vertical pegmatite. The mineralised component (i.e. the fresh pegmatite that contains the lithium) is approximately 400 m in strike length and 32 m width. Further drilling of the deposit continues to improve the Joint Ore Resources Committee (JORC) classification and may result in further resource material being identified to the south, but this drilling is unlikely to result in a materially larger pit. Figure 2-1 shows the occurrence of the fresh pegmatite ore resource (pink) that will be mined by the project.

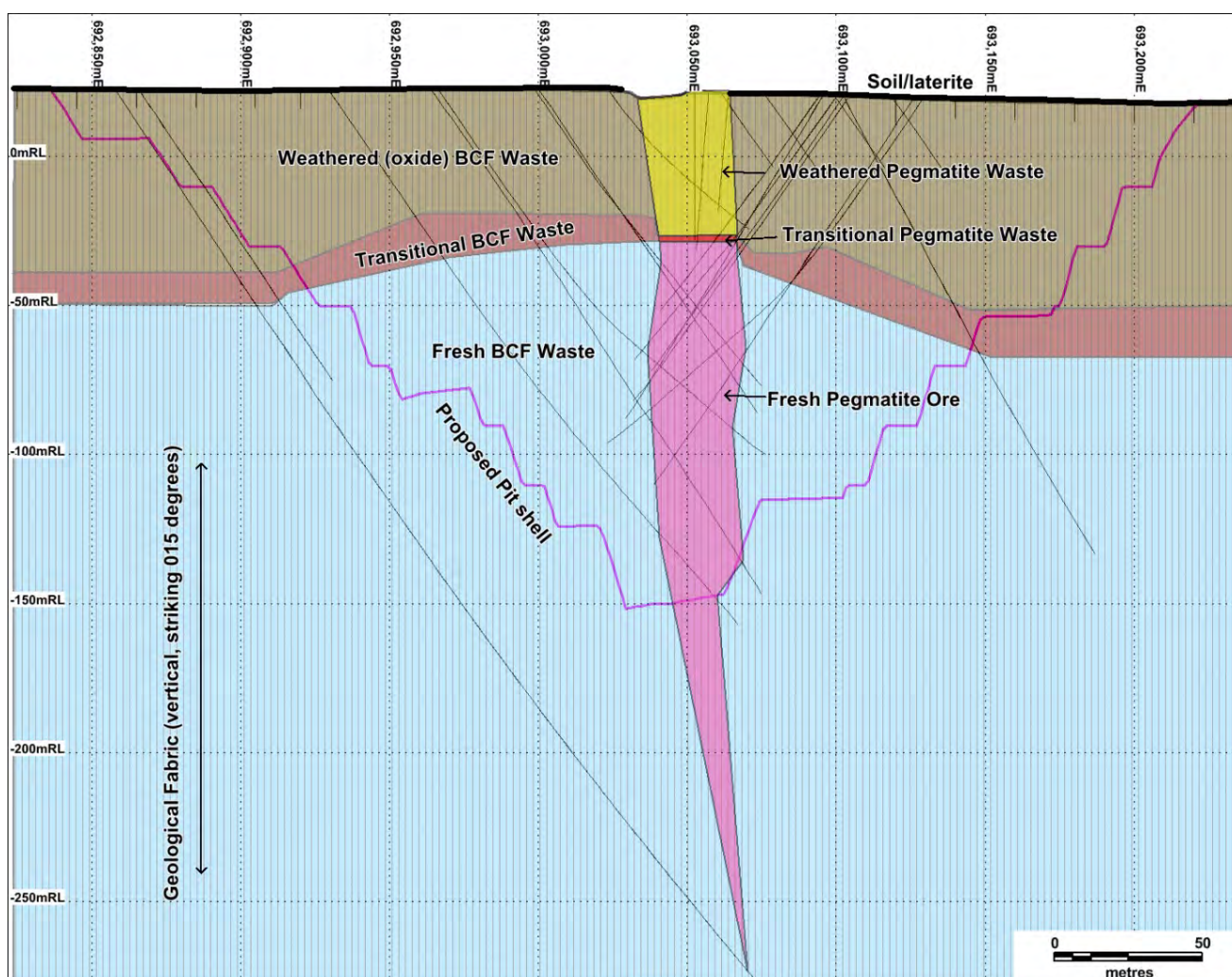


Figure 2-1. Cross-section of Grants Lithium Project ore resource

2.2 Disturbance footprint and site layout

The proposed mine site is located within Mineral Lease (ML) 31726 (under application), which covers an area of 768 ha. The mine site development envelope is approximately 147 ha, with the remainder of the ML providing a vegetated buffer to surrounding areas. A key feature of the mine site design is the use of an integrated waste rock dump (WRD) and tailings storage facility (TSF), which substantially reduces the mine site footprint compared with more traditional mine site designs, where these are separate landforms. The site inundation bund has been located such that it can function as an abandonment bund on closure, thus avoiding the need for further disturbance outside of the operational mine footprint.

To establish a reliable water supply for the mining operation, the proposal includes raising the dam wall of an old mining dam (Observation Hill dam), which will inundate a further nine hectares of land around the edge of the existing dam footprint. Clearing of six hectares will be required to install a pipeline to transport water to the mine site. The option of installing a second dam to the east of the mine site (Mine site dam) is also under consideration.

Table 2-1 documents the location and extent of each project component. The footprint and layout of the mine site, dams and water pipeline are shown in Figure 2-2 and Figure 2-3.

Table 2-1. Summary of the location and extent of infrastructure components

Component	Location	Approximate dimensions (l x w x d) and/or capacity	Extent (ha)
Mine Site Infrastructure			
Mine pit	ML31726 Figure 2-3	470m x 375m x 180m	147ha
Waste rock dump		1000m x 600m x 25m(h)	
Run of Mine (ROM) pad		310m x 270m	
Processing plant		310m x 75m	
Topsoil stockpile		1,700m x 100m x 1.5m	
Flood bund		2,390m x 30m	
Access roads		2,900m x 30m	
Mine Operations Centre		175m x 150m	
Raw water dam		70m x 70m (4.6ML)	
Mine water dam 1		380m x 180m (240ML)	
Mine water dam 2		180m x 120m (60 ML)	
Water Supply Infrastructure			
Mine Site dam	Dam wall located on ML31726 at 692200E 8599800N	Area of inundation: 930m x 230m Capacity (max. required) = 387 ML	19ha ¹
Observation Hill dam	Dam wall located at approx. 695400E 8595600N	Area of inundation with wall lift: 700m x 570m; Capacity ~ 628ML	9ha ²
Water pipeline	Start 695400E, 8594700N. End 693300E, 8599400N.	6km (l) x 10 m (w)	6ha
		Total area of disturbance	181ha

¹ Dam sizing is based on worst-case that off-site dams need to supply the entire project water requirements at some stage during the life of mine. Current modelling of pit inflows and TSF decant return indicates a significant portion of the project water could be supplied by re-use of water within the mine site. Capacity of off-site supply requirements will be confirmed in the detailed planning phase.

² 9ha is the additional area inundated by raising the spillway to 31.5mAHD. The entire inundation footprint of the Observation Hill dam is approximately 40ha.

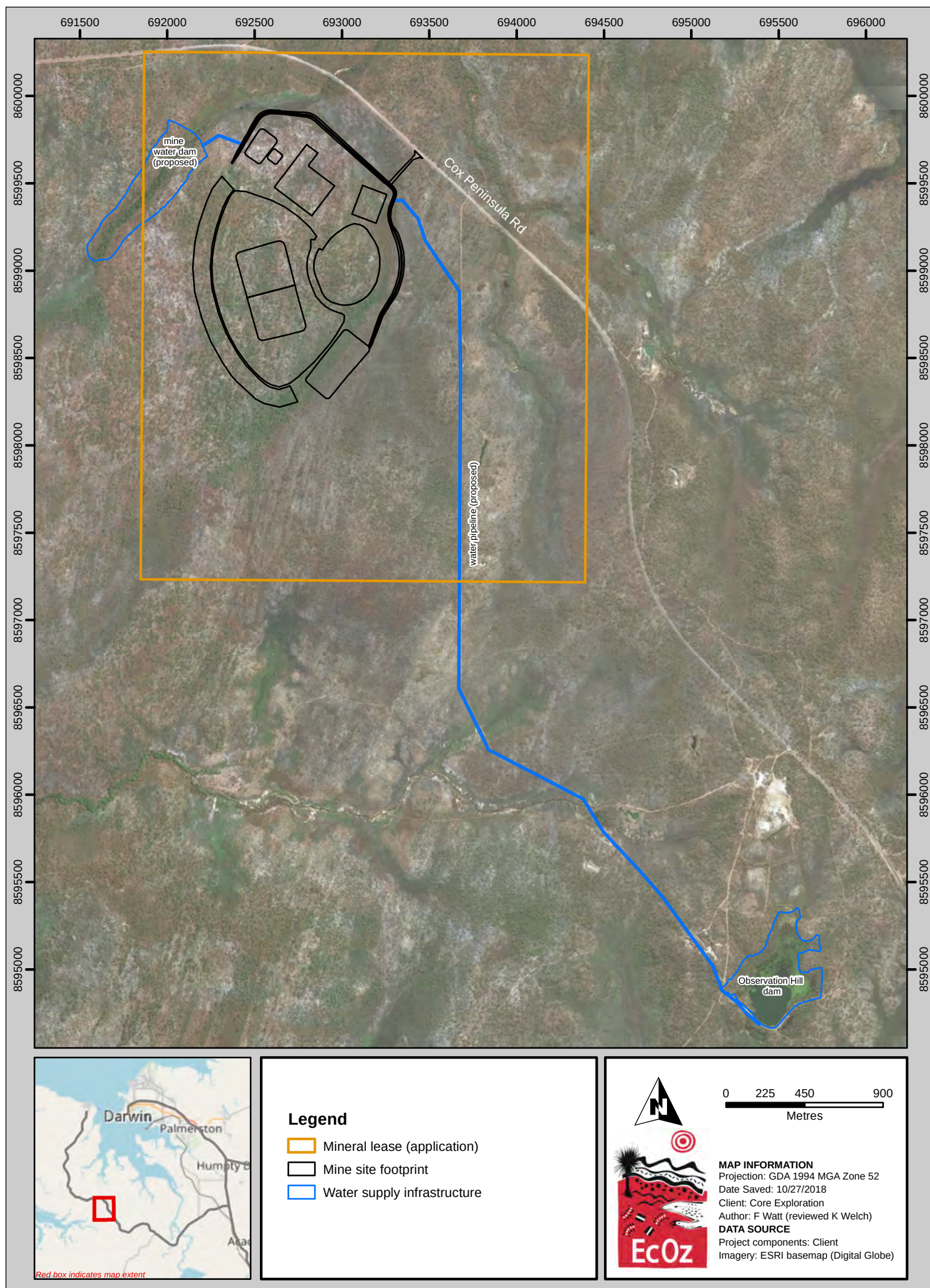
For the purpose of the EIS, Core's lease area within Darwin Port is not considered part of the project footprint. Material stockpiling and ship loading activities of this nature are permitted at the port. The Spodumene concentrate material that will be shipped does not have any specific hazardous characteristics or handling requirements, and environmental risks will be identified and managed in accordance with the Darwin Port Environmental Management System requirements. Core will provide all information requested by the Port in order to assess environmental risks and will comply with any environmental conditions included in lease agreements.

2.3 Schedule

The mine life associated with extraction of 1.8 Mt of ore is expected to be two to three years. The pit will be mined over a period of 25 months. Ore is expected to be intercepted around month four in the schedule and the first shipment from Darwin Port will occur around month six. Mining phases are set out in Table 2-1.

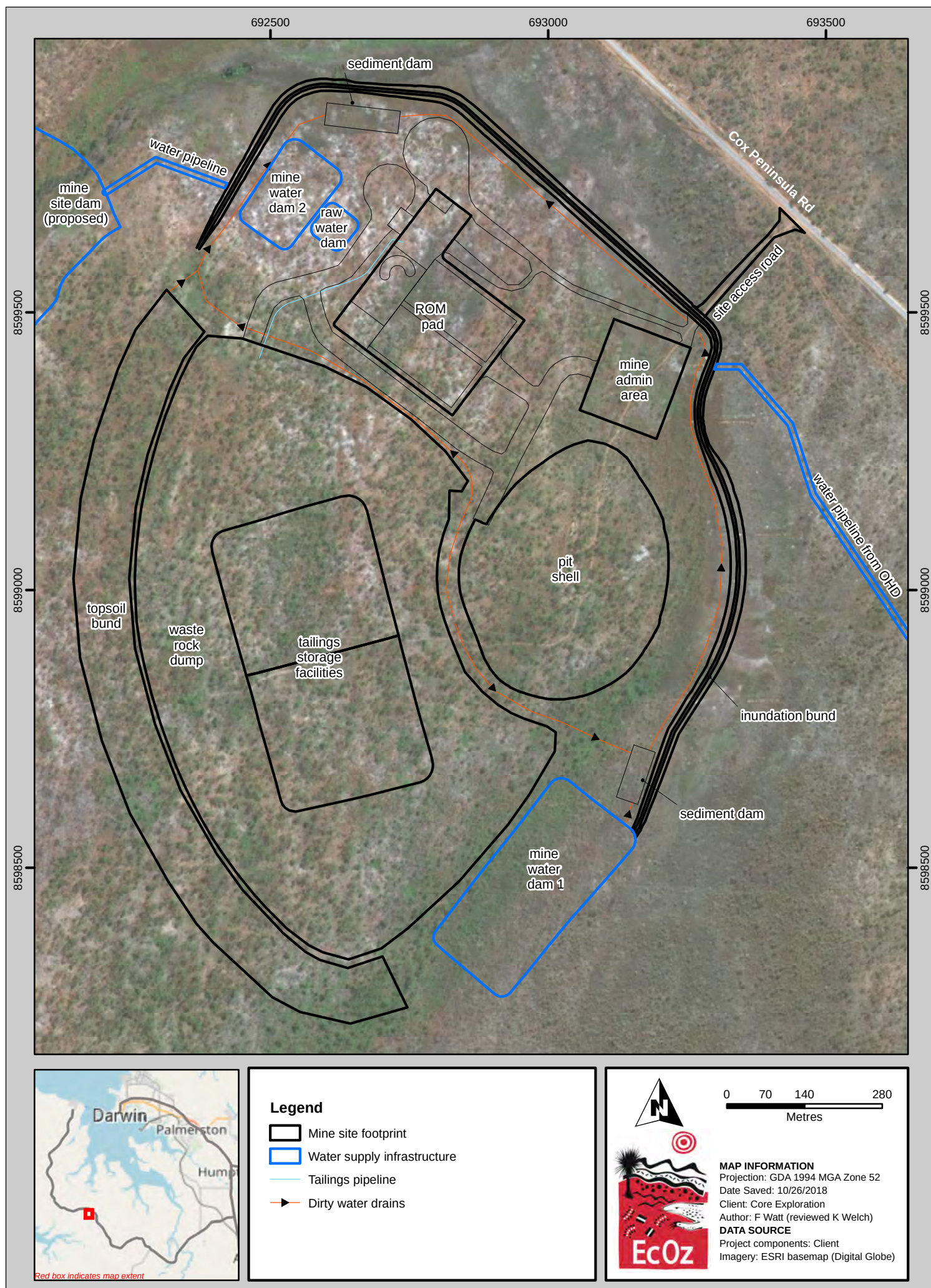
Table 2-2. Indicative project schedule

Year/Month	Months 1-3	Months 4-25	Months 26-30	Months 31 onward
Phase	Pre-strip & construction	Operation	Rehabilitation & Closure	Post-closure
Activities	Removal of oxide waste and oxidised pegmatite waste. Construction of site infrastructure and processing facilities.	Mining of the pegmatite ore body and adjacent 'fresh' waste, ore processing and transport of product to Darwin Port	Rehabilitation and mine closure activities	On-going monitoring of the mine site until rehabilitation completion criteria are achieved and the site is relinquished.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 2 maps\Figure 2-2. Grants Project location overview.mxd

Figure 2-2. Project location overview



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 2 maps\Figure 2-3. Mine site footprint and layout.mxd

Figure 2-3. Mine site footprint and layout

2.4 Mine site infrastructure

Design concepts for key components of the proposed mine site are provided in the sections below.

2.4.1 Open pit

The pit will occupy a surface area of 14 ha, will be approximately 500 m north-south, 350 m east-west and approximately 180 m deep. A pit design study has been completed by SRK Consulting (2018), using geotechnical, structural and hydrogeological data to provide design parameters and recommendations on a Ground Control Management Plan (i.e. the plan used to manage the risks associated with ground movement). The acceptance criteria for the pit design was based on *Guidelines for Open Pit Slope Design* (Read and Stacey, 2009).

The optimised pit shell will comprise three separate design sectors where the characteristics of the rock types encountered (weathered, transitional and fresh pegmatite) dictate different wall heights and batter configurations in order to achieve pit wall stability. The pit will have a 25 m wide dual lane access ramp from the surface down to 130 m below ground level, then it will reduce to a single lane (12.5 m wide) for the remaining depth down to the pit floor. The ramp will exit at the north west of the pit (close to the ROM pad and WRD). The conceptual design details of the pit are summarised in Table 2-3.

Pit construction will be via excavation, drilling and blasting. Once blasted, excavators will be used to remove the material from the pit to either the WRD or ROM pad. Two excavators will be used to remove the overburden, then a single excavator will continue once the ore has been intercepted.

Table 2-3. Pit design criteria (Source: SRK 2018).

Design Sectors	Height	Inter ramp angle (°)	Batter Configuration		
			Bench face angle (°)	Bench height (m)	Bench width (m)
Weathered rock (to -20mRL)	40	38.1	60	10	7
		40.3	60	10	6
Transitional rock (-20 to -40mRL)	20	45.7	60	20	8
Fresh rock (beneath -40mRL)	140	60	80	20	8

2.4.2 Waste rock dump

The strip ratio for the Grants deposit is 13.8:1. Estimated waste rock volumes and tonnage are presented in Table 2-4. A WRD will be constructed adjacent to the pit, ROM pad and dense media separation (DMS) processing plant (Figure 2-3). The TSF will be integrated within the WRD (refer section 2.4.3). This design concept has the benefit of minimising the mine site footprint and allows for the WRD to entirely encircle the TSF on closure, therefore avoiding ongoing issues associated with water management and revegetation of an exposed tailings dam. A plan view of the combined WRD/TSF concept is shown in Figure 2-4.

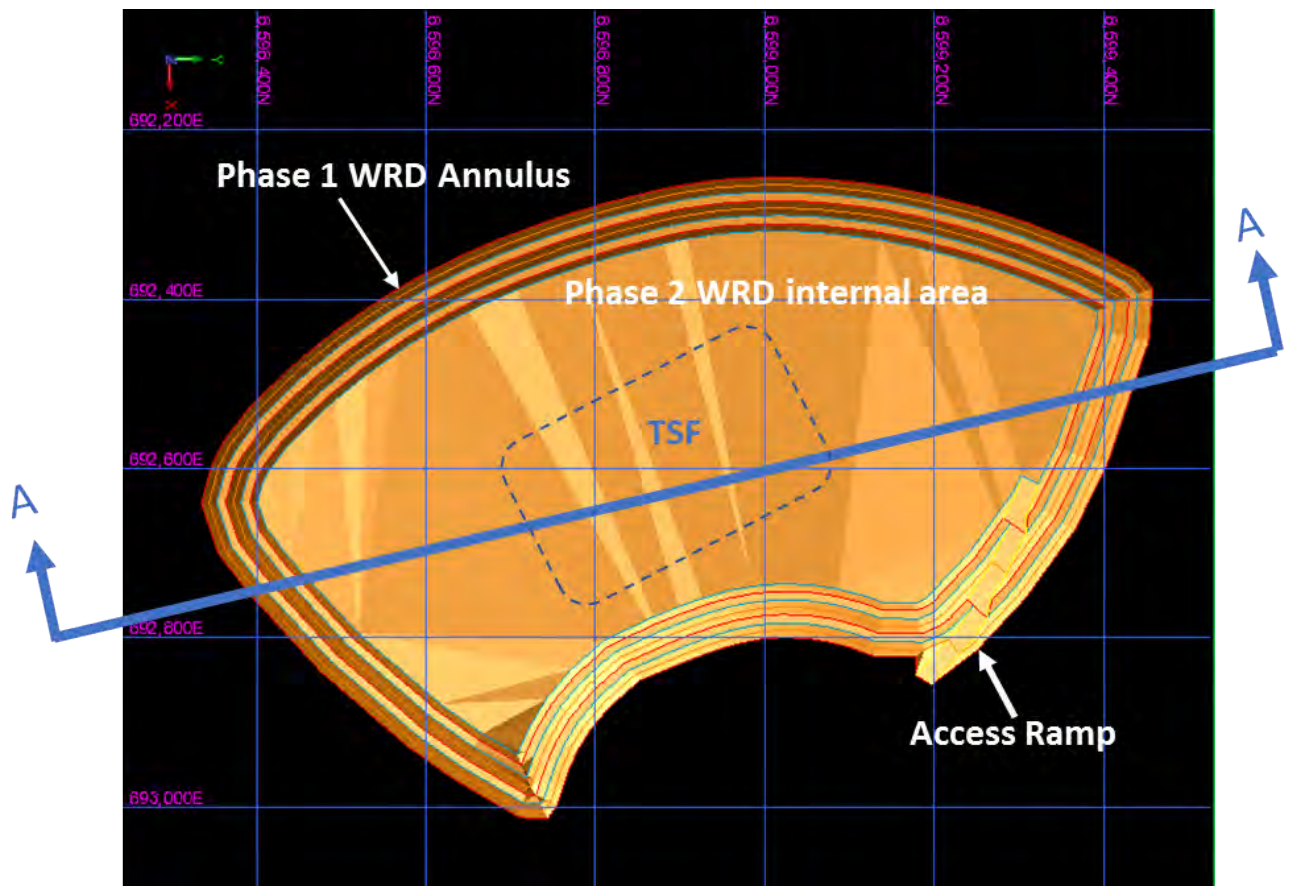
The WRD will accept all waste rock material removed from the pit and coarse rejects from the crushing/screening process. Waste characterisation studies (refer Appendix E) indicate limited potential for production of acid, saline or metalliferous drainage (AMD) from the waste rock and therefore no requirement for construction of containment cells. Some waste material has dispersive characteristics and may need to be managed by selective placement and storage towards the centre of the WRD, so as not to affect the stability of the outer walls and/or TSF. The processing rejects are coarse and also do not pose an AMD risk, and therefore will be co-disposed in the WRD (refer section 2.9.3).

The outer wall of the WRD is to be established early in the mine schedule from the shallow waste rock. Berms will be used to control run-off and manage erosion in the interim landform. Prior to rehabilitation the WRD will be reshaped to establish a continuous slope that is safe, stable and not prone to significant erosion. A cross-section of the final landform concept is shown in the closure and rehabilitation section 2.15 (Figure 2-23). Approximate dimensions of the final WRD landform are 1,000 m (l) x 600 m (w) x 25 m (h).

Table 2-4. Estimated waste rock volumes (bcm³) mined over the life of mine

Year 1	Year 2	Year 3	Total (bcm)
8,051,666	1,513,102	0	9,564,768

³ Bcm, or 'bank cubic metres', refers to the volume of earth as it exists in the ground before excavation



AA =Cross-section shown in Figure 2-23.

Figure 2-4. Waste rock dump/tailings storage facility concept plan view

2.4.3 Tailings storage facilities

The TSF will be developed in conjunction with the first stage of the WRD construction. The facility will consist of retaining embankments constructed from pit overburden / waste rock. It will comprise two cells (Cell 1 to the north and Cell 2 to the south), with centrally located decant water return structures. The overall footprint of the TSF will be approximately 15 ha, with a maximum height of approximately nine metres. A plan view of the TSF is shown in Figure 2-5, with a conceptual cross-section shown in Figure 2-6.

The TSF has been sized based on the following parameters:

- Store a minimum of 3 years of tailings production, equating to approximately 460,000 tonnes (t), which includes contingency storage in the event that tailings volumes are greater than forecast.
- Assumed consolidated dry density of 1.4 t/m³. This has been based on the following inputs:
 - o Sub-aerial deposition in thin layers allowing desiccation and consolidation;
 - o Slurry thickened to 51 % solids by weight;
 - o Specific gravity of 2.7.
- Assumed average slope on the tailings 'beach' of 1 %.
- Minimise the overall rate of rise to less than 2 m / annum.

Based on the low AMD risk, the design has been structured to maximise drainage, without a need for preventative measures for oxidation of the material. The base of the structure will be appropriately treated to provide a low permeability barrier, which, along with the underdrainage system, would allow effective management of any risk of groundwater mounding.

The containment embankments will feature an upstream zone of low permeability, primarily fine-grained materials sourced from residual soils from pit overburden excavations. This zone will allow the TSF to be a water retaining structure. The majority of the embankment will consist of weathered earth fill / rock fill won from the pit overburden.

Each cell will contain a centrally located decant water return structure, and associated access causeway. Directly around the decant return structure will be a zone of clean, durable filter rock. The decant structures will consist of precast concrete, vertical slotted pipe, with a submersible return pump within the structure.

The embankment batter slopes have been conservatively designed at 2.5 Horizontal: 1 Vertical (2.5H:1V). This will be further refined upon completion of site investigations and testing of the foundations and embankment materials.

The Dam Failure Consequence Category has been assessed as 'Significant', in accordance with the Australian National Committee on Large Dams (ANCOLD) "Guidelines on Tailings Dams" (ANCOLD, 2012). The classification was primarily driven by the impact on the business as well as the environment, in the event of a dam failure. The spillway has therefore been sized to accommodate a 0.1 % AEP flood event.

The Environmental Spill Consequence Category has been assessed as 'Low', due to the benign nature of tailings and low environmental risk of processing additives. The Design Storage Allowance (DSA) prior to spilling has therefore been set at a nominal 1 % AEP, 72-hour flood event.

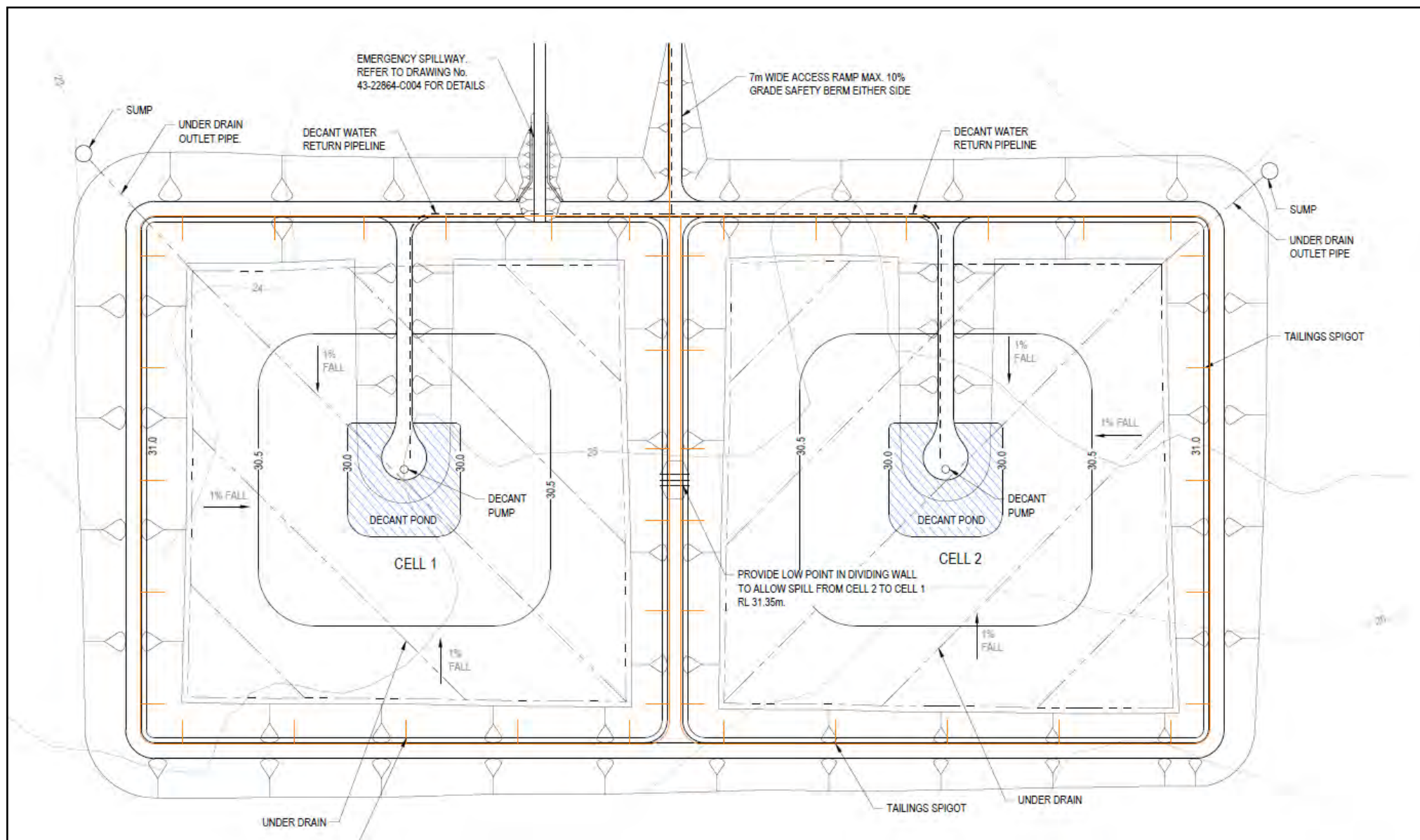


Figure 2-5. Tailings storage facility concept plan view (Source: GHD, 2018)

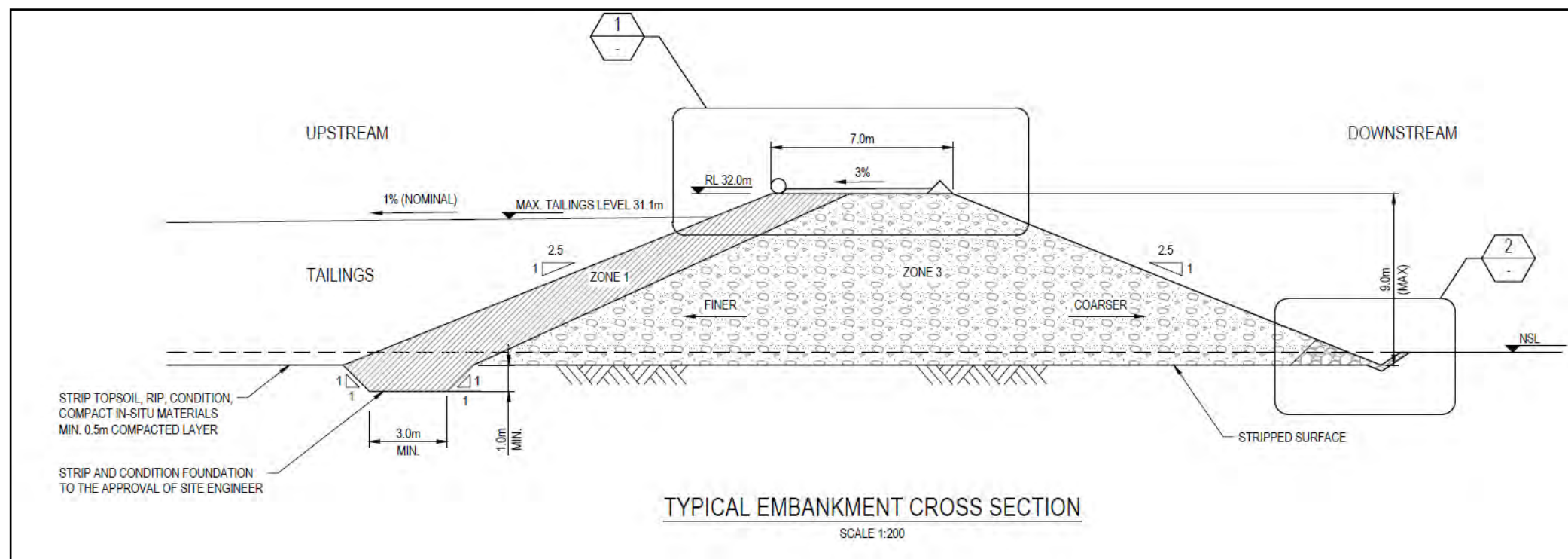
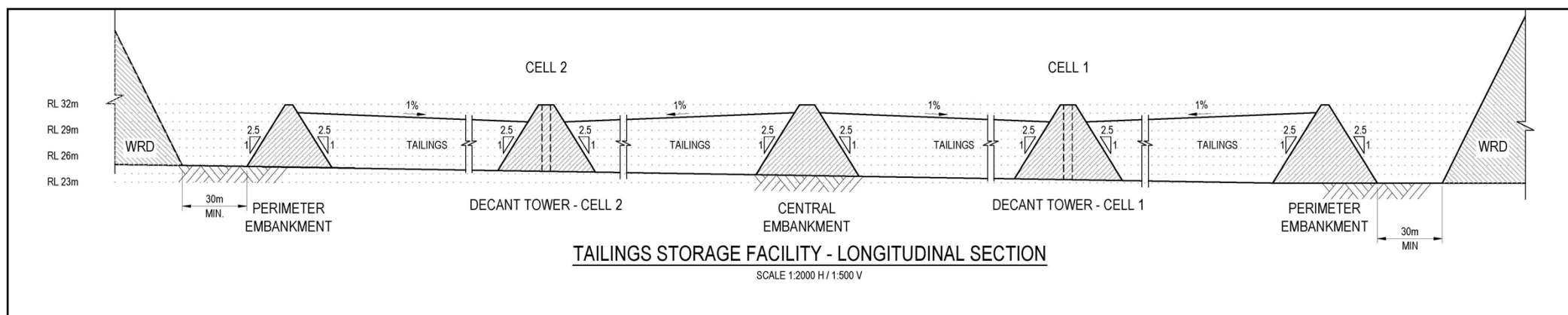


Figure 2-6. Tailings storage facility concept cross-sections (Source: GHD, 2018)

2.4.4 Run of Mine pad and stockpiles

The Run of Mine (ROM) pad will be constructed from overburden material to be a raised level surface. The ROM pad dimensions will be ~310 m by ~270 m and will cover ~7 ha. The crushing and screening operation and DMS processing plant will be located within the ROM pad. There will be two ROM stockpiles, a product stockpile and a rejects stockpile for low grade ore exiting the DMS circuit. The proposed layout of the ROM pad is shown in Figure 2-7.

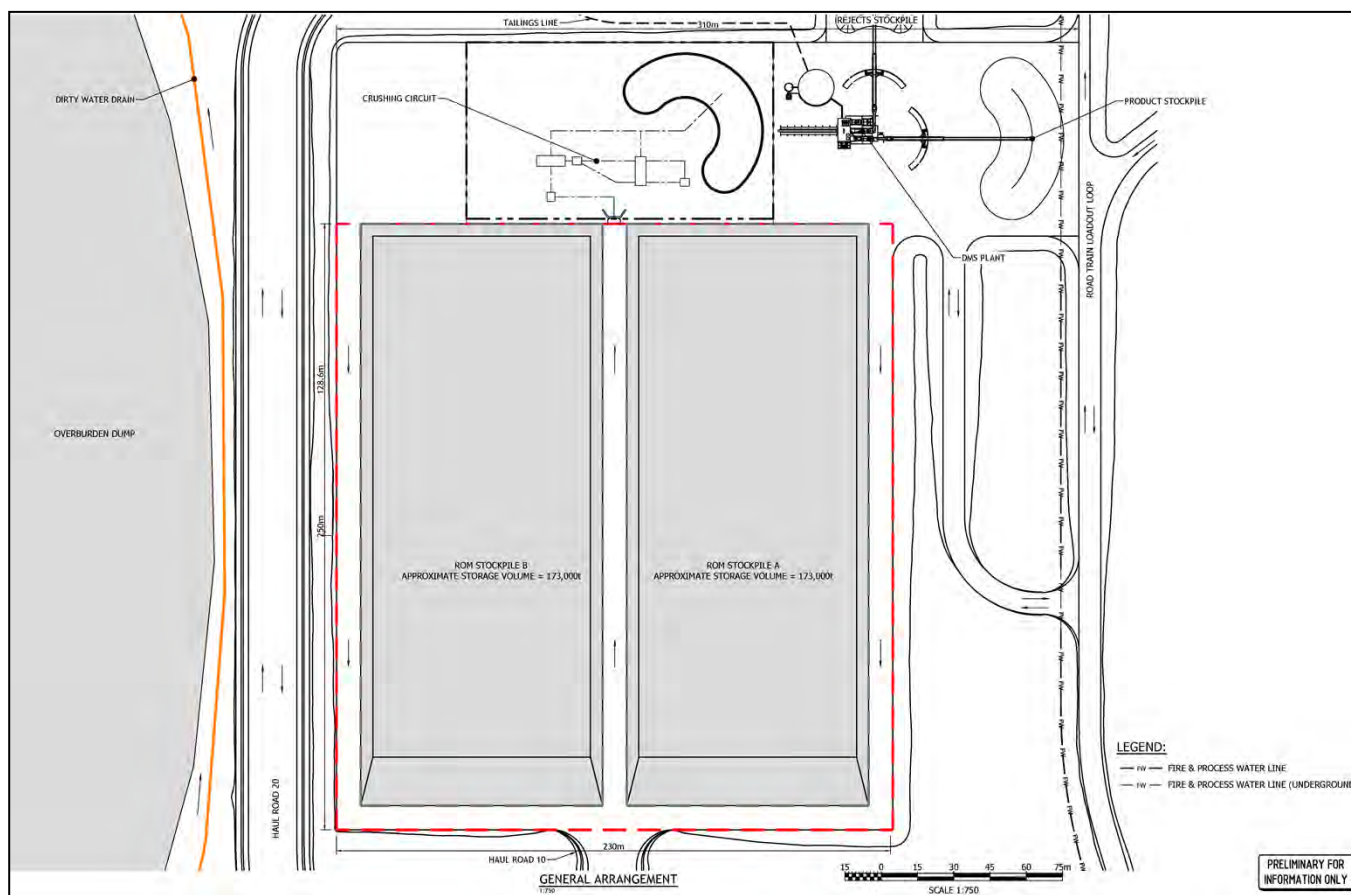


Figure 2-7. Proposed layout of ROM pad

2.4.5 Inundation bund

An inundation bund will be constructed around the eastern and northern extent of the mine site. The purpose of the bund is to prevent inundation of the mine site during the wet season. The design parameter for the flood diversion bund is 1% Annual Exceedance Probability (AEP), which is the flood height that has a 1% chance of being equalled or exceeded in any given year.

The location of the bund has been selected outside of the calculated zone of instability around the pit shell, with the intent that post-closure, the bund will function as an abandonment bund to make the site safe and secure. The location and extent of the bund is shown in Figure 2-3. The bund will be constructed from low permeability clay material excavated from the pit.

2.4.6 Internal access and haul roads

There will be a single, dual lane access/haul road constructed from the Cox Peninsula Road into the mine security and access point (approximately 500 m). The intersection design will include a slip lane and signage to provide for safe entry-exit from the public road. The access road follows the route of an existing exploration access track and crosses a broad drainage area where the road will be raised with culvert drains to allow water to pass underneath and provide all-weather access. The road will provide access for light and heavy vehicle traffic and will be engineered to be capable of supporting the 95 tonne quad road trains, which will be used to haul product to Darwin Port.

From the mine security and access point, road trains will travel 660 m along the northern internal haul route to a road train load out loop located alongside the product pad. Internal haul roads will provide Heavy Vehicle (HV) access between the pit, ROM pad, WRD and workshop area. A Light Vehicle (LV) access road will be constructed to the processing plant. The location of haul and access roads is shown in Figure 2-3.

2.4.7 Explosives compound

A compound will be constructed to store explosives materials and components used for blasting. The explosives compound will be approximately 27 m (w) x 86 m (l), within which there will be an explosives magazine, a detonator magazine, a 65,000 kg bulk emulsion tank and two cubed freight containers for storage of ammonium nitrate. The compound will be constructed to comply with Australian Standard AS2187 *Explosives – Storage, transport and use*, which includes requirements for perimeter man-proof fencing and access restrictions, signage and surveillance monitoring, minimum separation distances between materials storages and construction of earth bunds around magazines. Pursuant to the NT *Dangerous Goods Regulations*, Core will apply for an explosives business licence, which will licence storage and handling of explosives on the mine site.

2.4.8 Water storages

A raw water dam (RWD) will be constructed to store water pumped from the off-site water supply dams (refer section 2.5). The RWD will provide make-up water for the processing circuit, potable and non-potable supply to the mine operations centre (MOC) facilities and will be equipped with a dust suppression stand-pipe. The RWD has been designed to hold 48 hours of operational supply without inputs.

Mine Water Dam 1 (MWD1) has a 240 ML capacity, allowing for predicted storage of pit inflows (groundwater and rainfall runoff) without release during the dry season. It is expected that releases of water from MWD1 will be required during the wet season, at an approximate maximum rate of 50 L/s.

Mine Water Dam 2 (MWD2) has a capacity of 60 ML. It has been designed as a contingency storage, and may be used for either of the following:

- Additional storage for pit inflows, in the event of variations from the modelled scenarios
- Temporary storage of wet season run-off from the TSF, to assist in water and tailings management.

Both dams will consist of a full perimeter embankment, with materials for construction won from within the storage areas (cut / fill balance). The embankments will be built primarily out of homogenous, low permeability, primarily fine-grained residual material. A low permeability basal liner will also be constructed, either utilising in-situ material or imported from pit overburden materials as required. Rip-rap erosion protection will be placed on the upstream face, with a rock fill source to be confirmed. The downstream face will consist of a weathered rock fill layer, won from within the storage area.

The embankment batter slopes have been conservatively designed at 2.5H:1V. This will be further refined upon completion of site investigations and testing of the foundations and embankment materials.

Each dam will include a floating outlet structure, with a pipe running under the embankment and a valve on the downstream end. This valve will allow water to either be returned to the process plant (with an in-line pump), or

released to the environment by gravity when downstream mixing conditions allow (under a Waste Discharge Licence). The dams will also be equipped with a dust suppression stand-pipe.

The MWDs have been classified as 'Significant' Consequence Category dams. This is considered a conservative assumption at this stage, primarily based on the environmental impact of a dam failure. Emergency spillways for the dams have therefore been designed to pass a 0.1% AEP event.

2.4.9 Stormwater management

Drains and sediment dams will be constructed to capture and treat stormwater that falls directly onto the mine site. Indicative drainage lines and sediment dam locations are shown in Figure 2-3. Water will be treated with flocculants to remove the sediments prior to release off-site. Design criteria for the site drainage and sediment dams is provided in the Erosion and Sedimentation Control Plan or 'ESCP' (Appendix F). The site Water Management Plan provides for monitoring of water quality in the dams, proposed discharge criteria and contingency measures in the event that criteria for release cannot be achieved (Appendix C).

2.4.10 Mine operations centre

A MOC will be located just beyond the site security and access point. The area will be separated into a Core area and Contractor area. The Core controlled area has provisions for equipment laydown area, LV car parking and wash-down facilities, site office, emergency facilities and services. The Contractor controlled area includes a HV workshop and wash-down facilities, refuelling station and contractor offices.

Potable water supply to the MOC will either be brought in from off site or supplied from the RWD through a reverse osmosis treatment plant. Water for ablutions and other facilities will be supplied from the RWD. Sewage will be managed by connection to an on-site wastewater management system (septic) (refer section 2.10.3).

2.4.11 Materials requirements

Materials for bulk earthworks, dam wall construction and lining the WRD/TSF internal area/base will be sourced from the overburden waste removed from the pit, or from within the proposed storage areas. The estimated volume of waste material available is 8,920,762 bcm.

Bulk earthworks quantity estimates prepared for the mine concept layout and off-site dams are provide in Table 2-5, where the current level of design detail allows. The level of detail available is considered appropriate for the feasibility stage and indicates there will be sufficient volumes of materials available on site. Materials specifications, sources and construction treatments will be further developed following geotechnical testing.

Table 2-5. Materials requirements and sources

Site component	Volume required (bcm)	Source
Roadworks	224,919	Pit overburden
Stormwater	104,297	Pit overburden
Pads	94,021	Pit overburden
Mine Water Dams	109,600	Cut / fill from within storage area
WRD walls/lining	pending final designs	Pit overburden
Tailings Storage Facility	416,000	Pit overburden
Final WRD / TSF landform cover	pending final designs	Pit overburden
Observation Hill Dam	63,200	Borrow areas - previously disturbed
Mine Site Dam	28,700	Pit overburden
Total required	1,040,737	
Total available from waste	8,920,762	

2.5 Water supply infrastructure

To ensure water security for the project in the event of lower-than-average rainfall years, the proposal includes raising the existing dam wall at OHD to increase yield, and constructing a smaller dam on the upper reaches of an ephemeral watercourse that flows through the ML (referred to as mine site dam or MSD). Design concepts for the water supply infrastructure are provided in the sections below.

2.5.1 Observation Hill Dam

OHD is located 5 km south-south-east of the mine site and was built by a previous operator that mined tin and tantalum in the area in the 1980's. The current dam spillway height is 30mAHD and the modelled capacity of the dam is 364 ML.

Raising of the dam wall spillway was investigated as an option to increase the water storage capacity if additional supply is required. Dam yield assessments were prepared by a hydrologist for two scenarios; raising the spillway by approximately 1.5m (to 31.5mAHD) and 3.6 m (to 33.6mAHD) (Appendix G). Based on the current understanding of the site water supply requirements, Core's proposal includes works to raise the OHD spillway height to 31.5mAHD, which will increase the dam storage capacity by 58% to 628 ML.

Design of the spillway was in progress at the time this EIS was submitted. Materials required for raising the dam wall will be sourced locally from previously disturbed borrow areas. Materials specifications, sources and construction treatments will be developed following further geotechnical testing.

The surface area covered by the increased volume of water storage, compared to the existing storage, is 9 ha shown in Figure 2-8. The area that would be inundated if the spillway was raised to 35.1m AHD is also shown for reference, although this is not proposed. The results of hydrological modelling of the potential impact to downstream flows are discussed in Chapter 7.

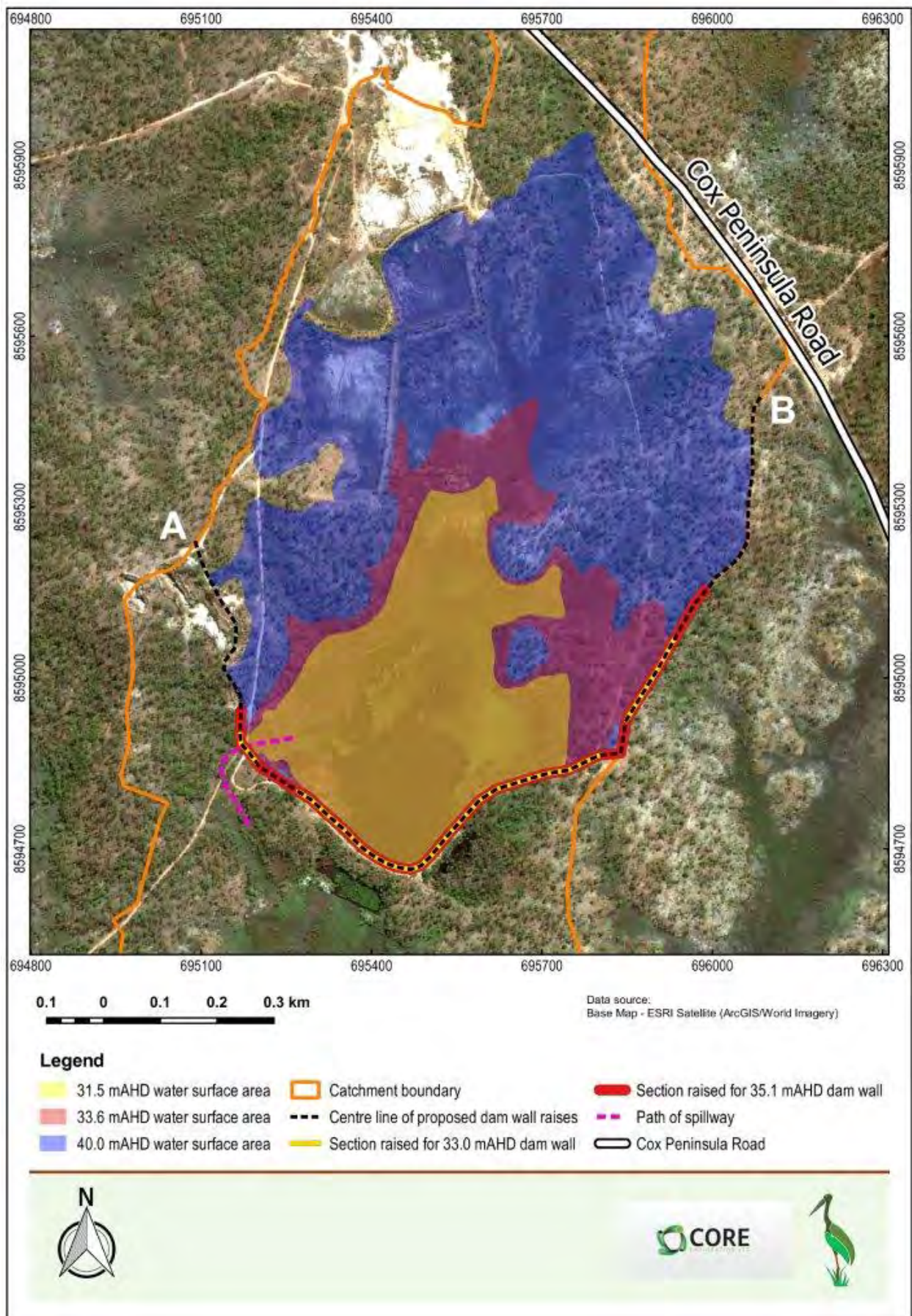


Figure 2-8. Image showing surface area of Observation Hill Dam following raise of dam wall.

2.5.2 Mine Site Dam

A second surface water storage, referred to as the Mine Site Dam (MSD), may be required to ensure that there is sufficient water available for mining operations (including dust management) in the event of drier than average years or an unexpected increase in water requirements. The current mine site water balance (section 2.12.3) indicates that the site water demand can most likely be met over the life of mine by dewatering of pit in-flows combined with pumping from OHD. Refinement of the site hydrogeological model, water reuse volumes and the design of on-site water storages, will inform Core's final decision on whether or not to proceed with construction of the new dam.

The location of the proposed MSD is on an unnamed ephemeral stream in the western portion of the ML, approximately 2.5 km upstream of the upper tidal limit of West Arm (Figure 2-2). The required spillway height will be dependent on the water volumes required to supplement supply from dewatering of pit in-flows and pumping from OHD, in lower than average wet seasons.

The proposed MSD site is topographically constrained due to the proximity to site infrastructure such as the process plant and WRD. To achieve the required spillway dimensions whilst still providing realistic earthworks requirements, the maximum spillway level was found to be relative level 16.5 mAHD. This provides a storage capacity of 280 ML. This is less than the worst-case scenario requirement of 387 ML; however, given the additional water storages outlined within this report, this is considered sufficient.

The MSD has been classified as a 'significant' consequence category dam. Due to the proximity of the dam to the Cox Peninsula Road, the Population at Risk (PAR) has been assessed as ≥ 1 to 10. This was the primary driver in assessing the Consequence Category as 'Significant'. Accordingly, the spillway has been designed to pass a 0.1% AEP flood event.

The embankment batter slopes have been conservatively designed at 2.5H:1V. The embankment will consist primarily of homogenous, low permeability, primarily fine-grained, non-dispersive residual soil from the pit overburden. The upstream face will consist of rip-rap erosion protection, with a layer of weathered rock fill (won from pit overburden) placed on the downstream face for erosional stability. This will be further refined upon completion of site investigations and testing of the foundations and embankment materials.

The footprint of the dam embankment, storage area and spillway is approximately 19ha. The results of hydrological modelling of the potential impact to downstream flows are discussed in Chapter 7.

2.5.3 Water pipeline

A water pipeline will be installed between the OHD and the mine site. The pipeline will be constructed of polyethylene plastic and will be buried to a sufficient depth to provide for protection from bushfire. The pipeline corridor is approximately 6 km and traverses Vacant Crown Land and Core's existing tenure. The corridor will be 10 m wide and will include an unsealed access track, which will be used for inspection and maintenance. The proposed pipeline route is shown on Figure 2-3. Core will apply for an ancillary mineral lease to provide tenure over the pipeline corridor.

2.6 Pre-strip and construction

The pre-strip and construction phase will occur during months 1-3 of the project schedule. This phase involves removal of overburden waste, storage of topsoil and other materials required for rehabilitation, construction of site infrastructure and processing facilities. The key activities that will occur during the pre-strip and construction phase of the project are described in the sections below.

2.6.1 Vegetation clearing

Work at the site will commence with surveying of site boundaries and clearing of vegetation. There will be no staging of vegetation removal as all areas of the project footprint are required from commencement.

Vegetation will be cleared by bulldozer and pushed into windrows outside of the mine site footprint but within the ML. In accordance with the *NT Land Clearing Guidelines* for minimising soil disturbance and post-clearing debris management, the vegetation debris will be windrowed along the contour and then burnt as soon as practicable to minimise channelling and concentration of run-off. Details are provided in the Vegetation Clearing Procedure (Appendix S).

Erosion and sediment control structures will be installed prior to the commencement of the first wet season (expected to be 2019 – 2020 wet season). The location and types of controls will be detailed in the ESCP submitted to the Department of Primary Industry and Resources (DPIR) as part of the Mining Authorisation process. A conceptual ESCP for the site is provided at Appendix F.

2.6.2 Topsoil stripping and storage

The top 20 cm of topsoil will be removed and stockpiled to the west of the WRD for later use in rehabilitation of the site (Figure 2-3). Approximately 260,000 bcm of topsoil will be removed from the surface of the project footprint. The stockpile will be approximately 1,700 m long by 100 m wide and will occupy approximately 17 ha of surface area. Controls that will be implemented to maintain the structural integrity and seed bank viability in the stored soils, are described in the ESCP and the Mine Closure Plan (Appendix D). These controls include minimising stockpile height to approximately 1.5 m and side batter slopes to 1.5°.

2.6.3 Bulk earthworks

The material to be used for construction of site infrastructure will come from the overburden material excavated from the pit. Construction materials specifications, sources and construction treatments, will be developed following further geotechnical testing, the results of which will be supplied with the Mining Management Plan (MMP) submitted to DPIR as part of the Mining Authorisation process. As overburden material is excavated from the pit shell during months one to eight of the mining schedule, materials meeting the specifications for use in site construction will be sent to temporary stockpiles located close to each works area and/or directly to the WRD walls. High clay content materials will be reserved for use in lining the WRD internal area, constructing the TSF and dam walls. Materials with dispersive characteristics and/or excess to the construction requirements, will be placed in the WRD internal area.

2.6.4 Dam and water storages construction

Dams will be constructed using civil earthworks equipment, to specifications that will be developed during detailed design. MWD1 would need to be constructed prior to significant development of the pit, in order for the storage to be in place once groundwater inflows commence (i.e. prior to July 2019). The TSF and MWD2 would need to be constructed in conjunction with the first stage of pit development, prior to mining of ore and associated concentrate production. The MSD and OHD would need to be constructed prior to the onset of the 2019/2020 wet season.

2.6.5 Water pipeline construction

Preparation of the pipeline corridor will involve removal of vegetation and installation of erosion and sediment controls in accordance with the Vegetation Clearing Procedure and ESCP. During construction, topsoil will be stripped and placed to one side of the 10 m wide corridor for later use in re-instatement activities. A trench will be dug to approximately 500 mm depth, the pipe laid and the trench backfilled. Windrows of vegetation/soil will be re-spread across the corridor to encourage grass/groundcover and any stockpiled vegetation excess to requirements will be disposed of by controlled burning. Trees/shrubs that would affect the integrity of the pipeline will be removed as part of maintenance activities.

2.7 Mining operations

The key activities and processes associated with mining of waste and ore from the open pit are described in the sections below.

2.7.1 Material volumes

The mining effort will be focused on delivering sustainable ore quantities to the ROM pad. The total quantity of waste and ore to be mined from the pit is shown in Table 2-6 and a monthly schedule is shown in Figure 2-9. Exploration results indicate that the concentration of Li_2O within the ore is fairly consistent throughout the deposit. The volume of ore mined in each month and concentration of Li_2O (prior to processing by DMS) is shown in Figure 2-10.

Table 2-6. Quantity of material to be mined over the life of mine

Material	Volume (bcm)	Tonnage (t)
Waste mined	8,920,762	-
Ore mined	644,306	1,778,283
Total	9,565,068	19,641,900

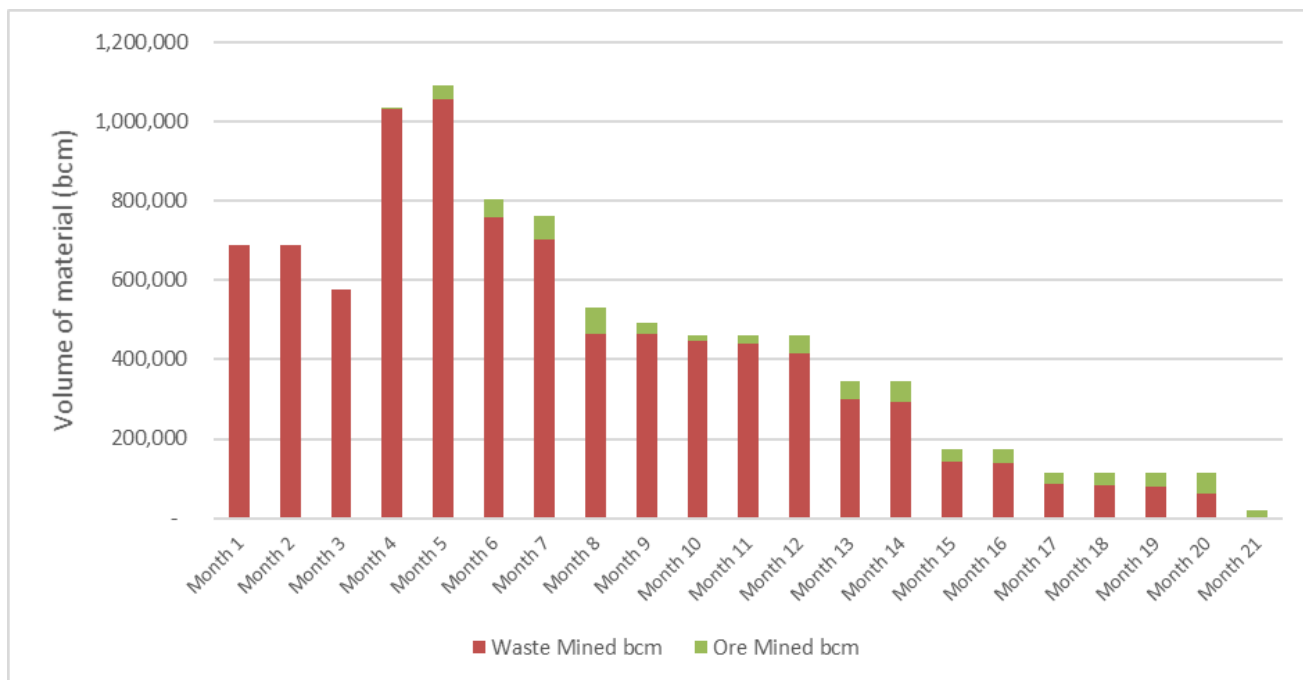


Figure 2-9. Graph of volume of material mined by month

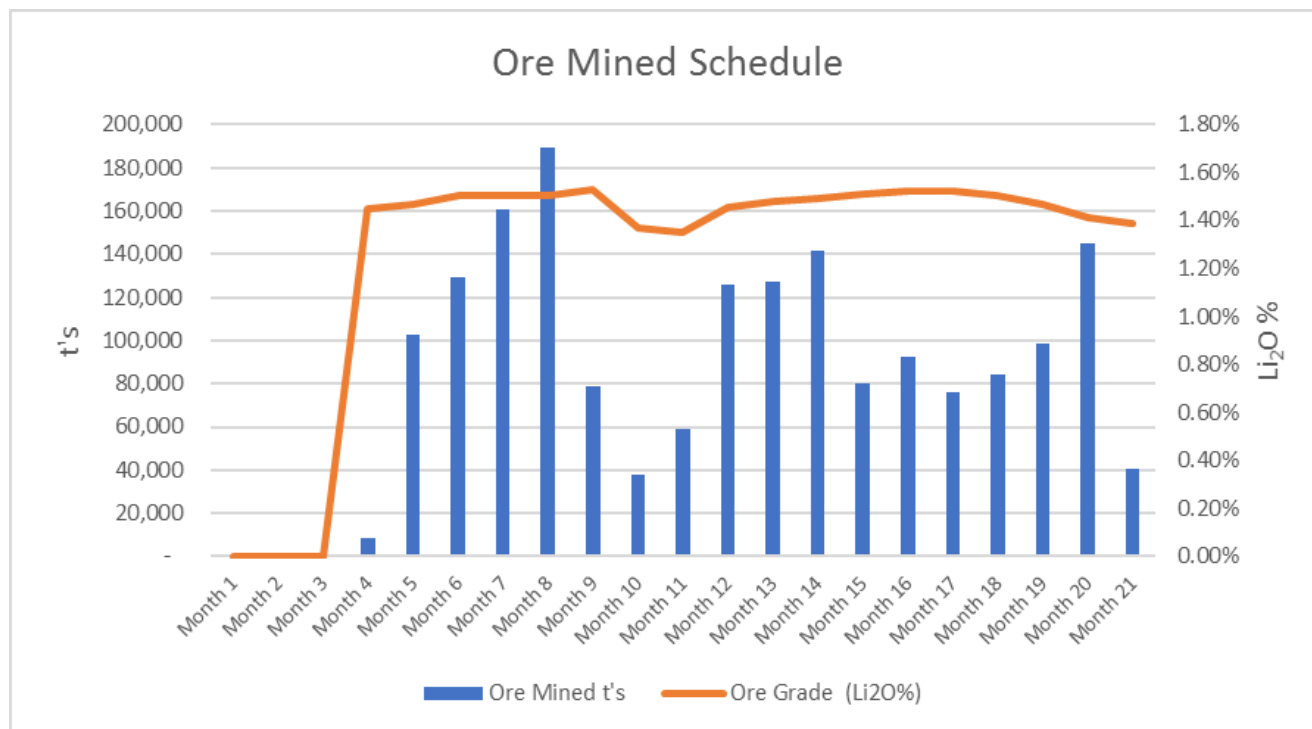


Figure 2-10. Graph of mined ore tonnage and grade by month

2.7.2 Plant and machinery

The proposed plant and machinery fleet is listed in Table 2-7. This list details the plant and machinery involved in mining operations on-site. Details on vehicles used for the transportation of product to the Darwin Port are provided in Section 2.11.3.

Table 2-7. List of plant and machinery

Description	Make and Model	Quantity
Excavator (GPS)	Komatsu PC2000	1
Excavator (GPS)	Hitachi EX1900	1
Excavator	Hitachi EX1200	1
Excavator Ancilliary	Hitachi ZX350H-3	1
Dozer (GPS)	Caterpillar D9	3
Dozer (GPS)	Caterpillar D10	1
Rigid Dump Truck	Caterpillar 777	10
Rigid Dump Truck	Caterpillar 777	7
Rigid Water Truck	Caterpillar 773	2
Grader (GPS)	Caterpillar 16M	1
Grader - Redundancy	Caterpillar 140H	1
ROM Loader (GPS) Backup	Caterpillar 988H	1
Service Truck + Fuel tracking	FTS 139-260 4x4 Crew	1
Blasthole Drill (GPS)	Based on a FLEXIROC D55 DTH Drill	3
Blasthole Drill (GPS) Redundancy	Based on a FLEXIROC D55 DTH Drill	1
IT Loader (Stemming Loader)	Caterpillar IT38	1
Mobile Manufacturing Unit (MMU)	FTS 139-260 4x4 Crew	1
Drill Service Truck	FTS 139-260 4x4 Crew	1
Light Vehicle #1 – Explosives' Transport compliant	Landcruiser 79 Dual Cab	1
Light Vehicle #2 – Explosives' Transport compliant	Landcruiser 79 Dual Cab	1
Telescopic Material Handler	Based in CAT TH408D AG Handler	1
Wheel Loader / Tyrehandler	Based in CAT TH408D AG Handler	1
Lighting Plants	Kubota type typical	12
Light Vehicle	Landcruiser 79 Dual Cab	1
Light Vehicle	Landcruiser 79 Dual Cab	12
Light Vehicle - Core	Landcruiser 79 Dual Cab	6
Crew 4WD Transport Carrier	FTS 139-260 4x4 Crew	2
Light Truck	FTS 139-260 4x4 Crew	1
Crane Truck	FTS 139-260 4x4 Crew	1
Pit Pumps	TBC	2

2.7.3 Mining method

Drilling and blasting mining methods will be used. Blasting is forecast to occur 3 times per week and will require closure of a section of the Cox Peninsula Road within the safety exclusion zone for short periods of time (~15 minutes). Details of the on-site explosives compound are provided in section 2.4.7. Storage and handling of explosives is regulated under the *Dangerous Goods Regulations* and a licence will be obtained from NT Worksafe.

Two excavators will be utilised in backhoe mode to remove the overburden, then a single excavator will continue once the ore has been intercepted. The excavators will load material into 100 t class dump trucks, which will be used to transport mined material to the surface.

2.7.4 Material handling

Waste material will be hauled from the pit by 100 t class dump trucks directly to the WRD. Ore will be hauled to stockpiles on the ROM pad.

2.8 Ore processing

There are two stages of ore processing proposed; crushing and primary screening, and DMS processing to produce a concentrate (5.5% Li_2O). The high-level process flow is summarised in Figure 2-11 and each component is described in the sections below.

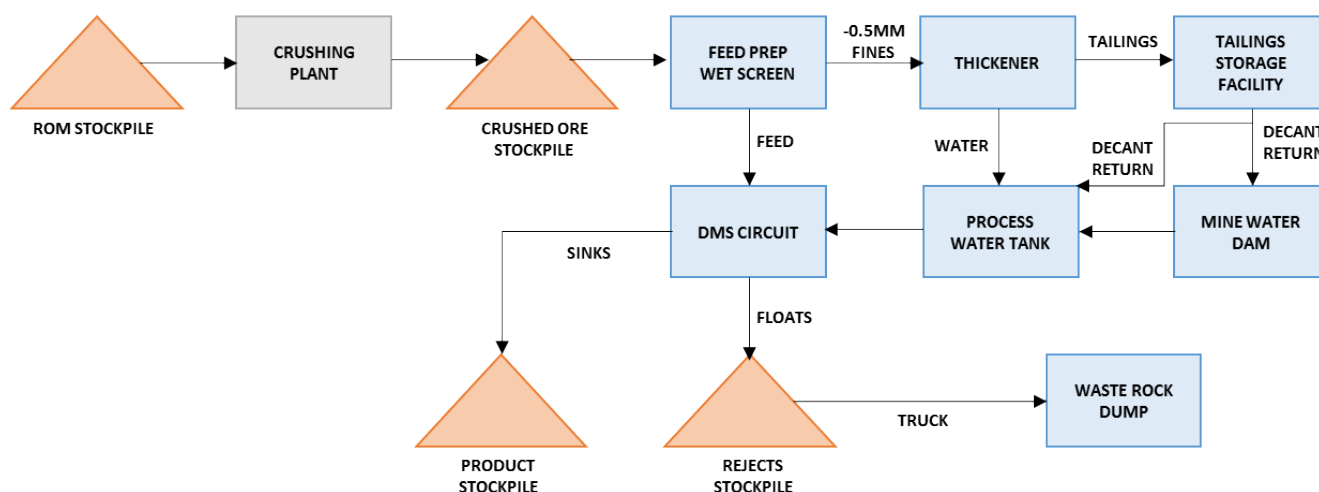


Figure 2-11. Processing block flow diagram

2.8.1 Crushing and primary screening

Mineralogical investigations indicate that the crush size required to produce a Li_2O concentrate between 5.0% & 6.0%, is approximately 100% minus 6.3 mm. The ROM material will be crushed and screened to achieve this product specification. The ROM handling and primary crushing/screening component of the operation will be undertaken by a contractor. The crushing circuit will comprise a grizzly rock screen and hopper feeding a jaw crusher, followed by screening and two stage (secondary and tertiary) cone crushing. The crushed ore will be stockpiled on the ROM pad (crushed ore stockpile) prior to loading into feed preparation for the DMS processing circuit.

2.8.2 Dense Media Separation

DMS processing involves taking the crushed ore and separating the material into two streams— a ‘sink’ and ‘float’ – using a water-based circuit. The crushed ore product is wet screened to remove fines (particles smaller than 0.5 mm). The wet screening process uses vibration to allow material smaller than the screen aperture size (0.5 mm) to fall through and the larger material (+0.5 mm) to be separated out as feedstock for the processing circuit.

The feedstock is mixed with a small quantity of dense medium slurry, which is a suspension of ferrosilicon and water, close to the density of the Spodumene (2.7 g/cm³). The material is then fed through the DMS system by conveyor belt and pumps into a cyclone and a series of panels and screens that separate the heavy particles (sinks) from the lighter particles (floats). The circuit produces a concentrated product stream, which is stockpiled adjacent to the ROM pad, and two separate waste streams – fines (tailings) and coarse rejects (refer section 2.9).

2.8.3 Tailings thicker

Tailings are pumped to a thickener where flocculant is added to separate the slurry into an underflow component (tailings approximately 50% solids) and overflow component of process water that is returned back to the processing circuit. The thickened tailings slurry is then pumped to the TSF.

2.8.4 Additives

The DMS process circuit is a water-based circuit that requires the addition of a ‘ferrosilicon’ heavy medium to achieve separation of the product. The tailings thickener will require addition of flocculant. The characteristics of these additives and potential environmental risks are considered below.

Ferrosilicon

Ferrosilicon is an alloy of iron and silicon (FeSi) that is supplied under a range of product labels. A product/supplier is yet to be chosen; however, review of various Material Safety Data Sheets available for ferrosilicon products sold in Australia indicates that the material is not considered a Dangerous Good under the criteria of the *Australian Dangerous Goods Code (ADG Code) for transport by Road and Rail*. The product is classified as a hazardous substance under *Work Health and Safety Regulations* and therefore has specific requirements for storage and handling for protection of workplace health and safety.

Detailed procedures for storage and handling of ferrosilicon will be provided in the Mine Risk Management Plan submitted to Worksafe NT for approval prior to commencement of operations. Ferrosilicon will be stored in bulk bags in a covered bulk storage area. Personal Protective Equipment is required to minimise exposure risk to workers associated with inhalation of dust. Under conditions of normal use, the product is not indicated to pose a risk to the environment.

Flocculant

Flocculants used in tailings thickeners are inorganic polymer additives that facilitate the agglomeration of tailings particles. The use of flocculant as a tailings thickener poses limited risk to the aquatic environment downstream of the mine site because the thickener is a contained system and the thickened tailings are stored in the TSF.

2.8.5 Water requirements and management

DMS processing is expected to consume 950 kl/day of water. Process water will be stored in a process water tank, which will be fed by water recovery from the tailings thickener (overflow following addition of the flocculant) and the TSF (decant water). Water recovered from dewatering of the product and rejects (via drain panels) is also returned into the processing circuit. Make-up water will be supplied from the mine water storages outlined in section 2.4.8 and/or surface water storages outlined in section 2.5. Details on project water demand, water sources and a mine water balance are provided in Section 2.12.

2.8.6 Consideration of alternative processing methods

Both DSO and processing on site (DMS) to produce a concentrated product were considered in early feasibility analysis. DMS processing provides a higher value concentrated product with less volume. DMS processing techniques will result in a fourfold reduction in the volume of material being trucked to Darwin. This benefits the project in terms of reduced transportation costs and also reduces potential impacts to road users and the Berry Springs community associated with truck movements on the Cox Peninsula Road to a more acceptable level.

The mine schedule and life-of-mine is comparable between the DSO and DMS model. DMS processing is more water intensive; however, project planning has determined that the bulk of the project water demand can be met by harvesting pit inflows and reuse of process water, with supplementary supply from off-site surface water dams (refer section 2.12).

Whole-of-ore flotation was considered as an alternative to DMS processing, however, the DMS processing was selected due to high returns of product from the processing circuit, for a lower level of capital expenditure.

2.9 Waste rock, rejects and tailings management

Mining and processing will produce three separate mineral waste streams:

- Waste rock (overburden) mined from the pit.
- Tailings from the DMS circuit
- Coarse rejects from DMS circuit.

The characteristics of these wastes and details of how they will be managed are provided in the sections below.

2.9.1 Waste rock

Sub-surface materials (waste rock) characterisation was undertaken for the purpose of:

- Evaluating potential risks associated with Acid Sulphate Soils (ASS), sodic/dispersive materials, acidic/metalliferous drainage and saline materials and/or drainage.

The characterisation program was developed with reference to the following guidelines:

- *Draft Guideline - Materials Characterisation – Baseline Data Requirements for Mining Proposals* (WA Department of Mines and Petroleum 2016).
- *Global Acid Rock Drainage Guide (GARD Guide)* (International Network for Acid Prevention (INAP), 2009).

The sampling methods, parameters analysed and results are summarised below from the complete report provided at Appendix E.

Geological information

Geological logging from the Grants deposit drilling program indicates there are 10 geological rock-type domains of homogenous character that occur in the proposed pit shell. The lithologies and weathering profiles are described in Table 2-8. The proportional volumes of each rock type are indicated on the pie-chart at Figure 2-12.

Table 2-8. Summary of the rock types and indicated volumes within the pit shell

Weathering Category	Lithology			
	Soil/Laterite	Phyllite	Quartz veins	Pegmatite
Surface zone (1-2 m thick)	Thin soil or laterite. Complete destruction and alteration of primary mineralogy and textures. Variable distribution geographically. Usually red/brown in colour.	NA	NA	NA
Volume (m³)	85,000	0	0	0
Weathered (Oxide) Zone (30-60 m thick)	NA	Almost complete destruction of primary mineralogy and textures. Dominated by fine clay and altered mica. Usually orange/brown in colour.	White quartz with minor haematite staining.	Complete destruction and alteration of primary mineralogy and textures. Dominated by white clay and quartz fragments. Generally soft or rarely silcreted.
Volume (m³)		4,230,000	8,000	300,000
Transitional Zone (1-20 m thick)	NA	Original mineralogy and textures identifiable with minor iron staining present. Usually light grey to brown in colour.	White quartz with minor haematite staining.	Predominately hard and competent with primary mineralogy clearly visible. Alteration of minerals to clay along grain boundaries.
Volume (m³)		950,000	1,500	6,000
Fresh Zone	NA	Fine grain, dark grey, thinly laminated siltstones and minor fine sandstone metamorphosed to phyllite. Usually very finely micaceous with zones of abundant fine garnets.	White quartz with minor sulphides.	Very hard and coarse grained white to grey/green in colour. Mineralogy dominated by clear to grey quartz, white feldspar, pale green spodumene and minor clear to brown muscovite.
Volume (m³)		2,410,000	5,000	530,000
TOTALS	85,000 m3	7,590,000 m3	14,500 m3	836,000 m3

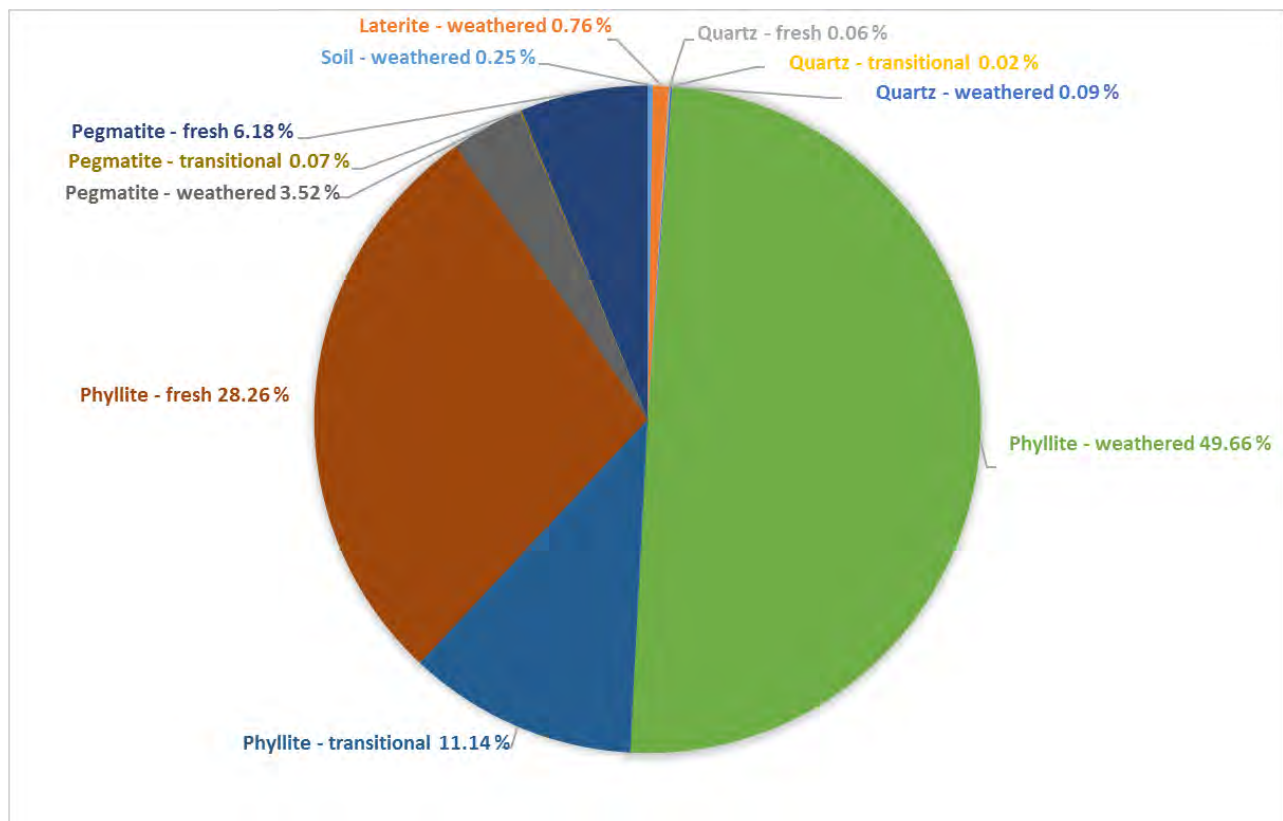


Figure 2-12. Pie chart showing volume of each geological domain within the proposed pit shell

Sampling and analysis

Samples from each weathering zone/lithology within the Grants pit shell were collected and analysed progressively as part of the exploration drilling program undertaken over 2016-2018. Samples were chosen to provide representation of the variability within each weathering zone/lithology encountered, with numbers of samples selected for analysis from each zone based on the relative contribution to the total waste rock volumes (as indicated in Figure 2-12) and the likelihood of Potentially Acid Forming (PAF) material.

A total of 156 samples were collected and submitted for analysis. The greatest number of samples were taken from the weathered and fresh phyllite, which together comprise nearly 80% of the pit shell and therefore will be the predominant materials within the WRD. The drill hole locations are shown in Figure 2-13. The number of samples taken from each lithology/weathering profile is summarised in Table 2-9.

The weathered phyllite is a geological domain unlikely to be classified as PAF; however, because it comprises almost 50% of the pit shell and will be the main source of construction materials, a larger number of samples were taken into account for natural variability. Fresh phyllite is the geological domain at Grants most likely to be classified as PAF⁴ and therefore a larger number of samples were collected from this rock type.

⁴ Preliminary waste characterisation laboratory analyses suggested there is little sulfur present in the material, which is typical of the sedimentary environment in which it was deposited – rapid deposition inhibits sea-floor sulfur precipitation. The scarcity of pyrite in geological logging of drill core and reverse circulation (RC) drilling chips also supports this contention.

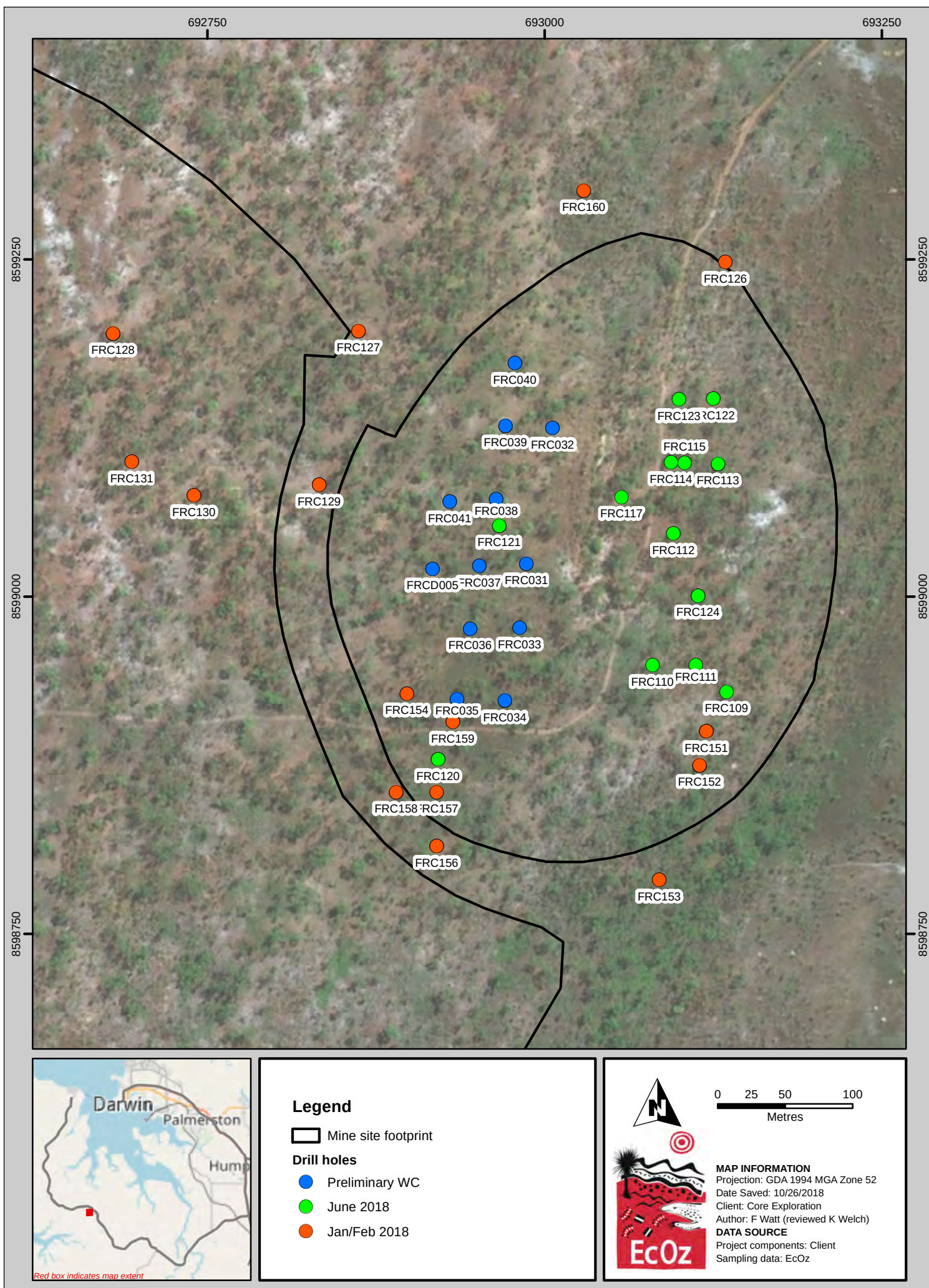
Table 2-9. Number of samples from each lithology/weathering profile submitted for characterisation

Material Type	Weathered	Transitional	Fresh	Total
Soil	2	-	-	2
Laterite	11	-	-	11
Clay	7	-	-	7
Pegmatite	4	1	2	7
Phyllite	58	15	44	117
Quartz/ Phyllite and Quartz	6	-	2	8
Sandstone	2	1	1	4
Grand Total	90	17	49	156

Samples were analysed for the parameters recommended in the *Draft Guideline - Materials Characterisation – Baseline Data Requirements for Mining Proposals* (WA Department of Mines and Petroleum 2016) (see Table 2-10). Laboratory tests were performed by Australian Laboratory Services, a National Association of Testing Authorities accredited facility. NORM testing on a selection of samples was undertaken using a RadEye B20 – ER contamination meter (17 keV – 3 MeV).

Table 2-10. Parameters analysed for sub-surface materials characterisation

Parameter	Relevance
Sulfur - Total as S	AMD screening
pH	AMD screening
Electrical Conductivity	AMD screening; saline drainage
Emerson Aggregate Test	Dispersive or sodic materials
Exchangeable Cations	Dispersive or sodic materials
Leachable metals	Metalliferous drainage
Soluble metals	Metalliferous drainage
Acid Neutralising Capacity (ANC)	Acidic drainage
Net Acid Production Potential (NAPP)	Acidic drainage
Net Acid Generation (NAG)	Acidic drainage
Naturally occurring radioactive material (NORM)	Radioactive materials



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 2 maps\Figure 2-13 Location of drill holes for waste characterisation sampling.mxd

Figure 2-13 Location of drill holes for waste characterisation sampling

Waste rock characteristics

Table 2-11 summarises the waste rock characteristics in relation to physical stability, and potential risks associated with AMD.

Table 2-11. Summary of waste rock characteristics

Acid Sulphate Soils (ASS)
None of the soil samples collected at the site are indicative of ASS. This result concurs with the land unit mapping, which shows the project area has a Nil (class 1) risk of ASS conditions.
Acid drainage potential
The majority of sub-surface material collected at the site have a sulfur concentration less than 0.05 %, which indicates a low risk of PAF material. 17 samples had an elevated sulfur concentration; only 1 of these within the pit shell is classified as potentially acid forming material. The sulfur concentrations in samples are low; total sulfur concentrations vary between <0.01 %S and 1.88 %S. 148 samples (or 90% of all samples) have total sulfur concentrations <0.05 %S indicating non- PAF material. Approximately 10% of samples have concentrations ≥ 0.05 %S. All of the samples were from depths > 50 m below surface level with the majority coming from deeper than 100 m below surface. All samples with a sulfur concentration > 0.10 %S (7 samples) were from greater than 100 m deep. Subsequent classification of samples based on NAPP and NAGpH (pHOX) results found only two samples classified as PAF. These samples are fresh hard rock phyllite located 125 m deep or deeper from the surface. One sample is from the south east section of the pit shell and the other from the central western half. Overall the waste rocks are considered materials with no AMD potential primarily due to the absence/scarcity of sulfur, which is typical of the sedimentary environment in which it was deposited. Waste rocks that classify as PAF will be limited in volume; they are not confined to a specific area and will be excavated with NAF materials and placed in the waste rock dump surrounded and underlain by materials that have sufficient Acid Neutralising Capacity to offset any potential acid generation.
Metalliferous drainage potential
126 samples were analysed for soluble metal concentrations. Some samples have detectable but very low concentrations of As, Mn, Se and Zn whilst Cd, Cr, Co, Cu, Pb, Ni, V and Hg. All below their limits of reporting. Ten of these samples with Total Sulfur concentrations >0.04 %S were submitted for determination of leachable metals. The leachates contained As (1 sample at 0.2 mg/L), Ba (ten samples at between 0.2 mg/L and 0.3 mg/L), Cu (one sample at 0.1 mg/L), Zn (ten samples at between 0.1 mg/L and 0.4 mg/L) and Mn (ten samples at between 0.2 mg/L and 11.9 mg/L averaging 2.4 mg/L). Be, B, Cd, Cr, Co, Pb, Ni, Se, V and Hg were absent in leachates. Waste rocks may leach metals; however, concentrations will be low. This finding is corroborated by baseline surface and ground water monitoring which indicates: • Groundwater contains elevated concentrations of As (0.009 mg/L and 0.166mg/L) and Fe. Most other metals i.e. Al, Cd, Cr, Cu, Pb, Ni, Se, Zn and Hg are generally absent except for a few minor detections at very low concentrations. • Surface water contains Al (between 0.01 mg/L and 0.08 mg/L) and As (between <0.001 mg/L and 0.007 mg/L) whilst metals such as Cd, Cr, Cu, Pb, Ni, Se, Zn, Sn and Hg are below their limits of reporting.
Saline drainage potential
All had very low electrical conductivity (0.004 dS/m - 0.280 dS/m) and are considered low saline and highly unlikely to produce saline drainage.
Sodic or dispersive potential
33% of samples spread across the pit shell and at varying depths, were classified non-sodic but potentially dispersive. These samples have an Emerson Class Number 3 which indicates that remoulding (at moisture content near optimum for compaction) may cause dispersion. A high portion of the samples were from the highly to moderately weathered phyllite, with the highest occurrences in the eastern portion of the pit shell from surface to 5m depth and from 8-54m depth across the whole pit shell. Where this material occurs in the shallow parts of the pit it is a potential source of construction materials and therefore further detailed geotechnical testing and assessment is required to characterise physical stability. Material from the deeper parts of the pit shell will be placed in the centre of the WRD and therefore dispersive characteristics in these materials is not of management concern.
Naturally Occurring Radioactive Material
Background and materials to be extracted from the pit shell as waste rocks have low concentrations of NORM which do not warrant further investigation and assessment and/or management measures.

Management

The shallow waste rock mined from the pit will be used in construction of roads, hardstands, water storages and dams, and in construction of the WRD base, walls and TSF. Low permeability materials will be set aside for lining of the WRD internal area and TSF.

The sub-surface materials characterisation results indicate that some of the shallow waste rock has sodic or dispersive potential that could render it unsuited to use as a construction material. Some materials may also be unsuited as a sub-soil growth medium and should not be used in the WRD walls or inundation bund. Further geotechnical testing of the shallow waste rock is required to characterise the physical stability of the materials. In conjunction with this work and as part of rehabilitation trials in year one of the mining schedule, further testing of the shallow waste rock will be undertaken to characterise growth medium attributes for rehabilitation.

Material not suited to or required for construction of site facilities, will be stored in the WRD. During Phase 1 the weathered waste materials excavated from the shallower parts of the pit shell will be used to construct the WRD walls. The reserved low permeability material will be put in place as lining, which will encase any waste material that is prone to slaking or dispersion, and will provide a foundation for the TSF. Waste rock and rejects from the crushing and screening process will be co-disposed in the WRD internal area. The waste rock characteristics indicate there is no requirement for specific containment structures within the WRD.

2.9.2 Tailings

The DMS wet screening process will produce fine rejects (tailings). Initial tailings classifications are a silty sand, that should drain successfully. Geochemical characterisation results for the fresh pegmatite ore indicate AMD is not expected to be an issue. No chemical processing is required in the DMS plant. Therefore, tailings solids are expected to be geochemically stable and not contain any contaminants. Further tailings characterisation work will be undertaken as part of processing plant trials, to confirm the tailings characteristics moving into the TSF detailed design phase.

The tailings disposal system comprises thickener, slurry pumps and pipeline to deliver the tailings from the processing plant to the TSF.

Tailings deposition

Tailings will be pumped approximately 950 m from the thickener to the TSF through the main delivery pipeline. At the TSF, the tailings will be sent to either of the two cells, where the slurry will be deposited sub-aerially, through pipelines running around the perimeter of each cell, with spigot offtakes at 50 m centres. This system has been selected in order to minimise the rate of rise and provide an even distribution of tailings deposition, thereby improving consolidation, density and strength properties of the material.

TSF staging

Due to the relatively short mine life, the TSF will be constructed to the full height in a single construction campaign. Cell 1 (to the north) may be constructed first, allowing for tailings deposition to commence during construction of Cell 2.

Water management

The TSF will feature centrally located decant water return structures, along with a system of underdrains, in order to facilitate drainage of the tailings and further promote consolidation of the material. The TSF decant water will be returned directly to the process plant for re-use, or stored at MWD 2. Wet season run-off will either be stored at the TSF, or pumped to MWD 2 for future process / evaporation.

2.9.3 Rejects

The coarse rejects from the DMS circuit will comprise rocks with diameter ≥ -6.3 mm to 0.5mm. Geochemical characterisation results for the fresh pegmatite ore indicate the coarse rejects are also expected to be benign. The rejects will be placed in the WRD, with no specific requirements for targeted placement or encapsulation.

2.10 Non-mineral waste and hazardous materials

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

2.10.1 Predicted waste streams

The industrial and domestic wastes expected during mining activities are:

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

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

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

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

Management of sewage waste is discussed in Section 2.10.3.

2.10.2 Hazardous materials

Diesel fuel will be used to power the on-site generators. Approximately 330,000 litres of diesel will be stored at the mine site in three 110,000 litre above-ground tanks. Additional remote storage will be as follows:

- TSF – 1 x 15,000 litre
- Observation Hill – 1 x 5,000 litre
- Mine Water Dam – 1 x 5,000 litre.

The remote storage is proposed to be small tanks for security and/or theft mitigation. Smaller tanks will be filled by service trucks as required.

Diesel will be stored in above-ground tanks that comply with Australian Standard *AS1940 Storage and handling of flammable and combustible liquids*. Diesel fuels will be supplied by a licenced contractor as required and all plant

and equipment will be refuelled on site in the refuelling area located within the MOC. Diesel spill response measures are incorporated in the project Environmental Management Plan (refer Chapter 10).

Processing additives (refer section 2.8.3) will be stored in designated undercover storage areas. The additives (in their powdered form) pose limited risk to the environment; however, they are classified as hazardous chemicals under Workplace Health and Safety Regulations and therefore their storage and handling will be regulated by Worksafe NT.

Explosives will be stored in an on-site magazine (refer section 2.4.7).

2.10.3 Sewage treatment

Sewage and wastewater will be managed by connection to an on-site wastewater management system. The system type and design is yet to be finalised but will comply with the requirements of the *Code of Practice for On-site Wastewater Management* (Department of Health, 2014).

2.11 Transport

The transport proposal for the ore concentrate involves trucking the material to Darwin Port, where it will be stockpiled in a designated area and then loaded onto ships for export to China. The sections below describe the proposed methods and routes for transporting the product from site to the port.

2.11.1 Product storage and handling

The concentrate product from the DMS plant will be stockpiled on the product pad (Figure 2-3). A front-end loader will be used to load the product into quad road trains. Each carriage of the road train will be covered to minimise release of dust during transport. There will be ten trucks loaded per day during operations (see Section 2.11.3).

Product haulage will commence around month four of the project and will increase to 20,000 tonnes per month during month eight. Haulage will remain around this level for the life of the project, but it is expected to increase to 25,000 tonnes in the final month (month 26). Expected monthly tonnage of material hauled over the mine life is shown in Figure 2-14.

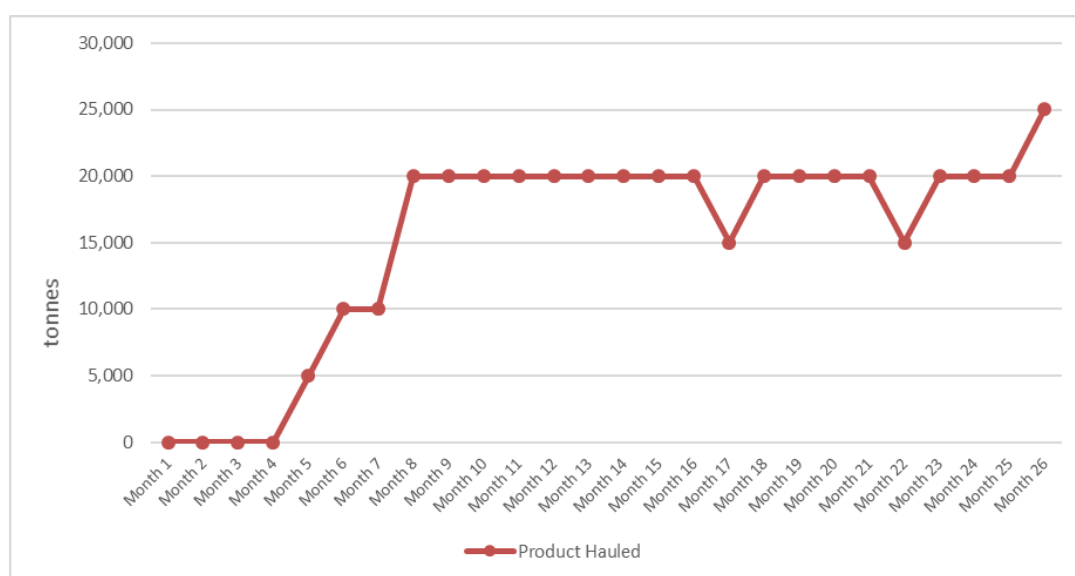


Figure 2-14. Graph showing tonnage of material hauled per month

2.11.2 Route from site to port

The proposed transport route will be along Cox Peninsula Road, through to the Stuart Highway, along the Stuart Highway to Tiger Brennan Drive and then Berrimah Road, to the East Arm Port (see Figure 2-15). Total travel distance to the Port is 94.5 km.



Figure 2-15. Proposed haul route from project area to Darwin Port

2.11.3 Road use

Trucks will take three hours to make the round trip to the port and will operate for 24 hours per day, 7 days per week. The anticipated truck movements along the transport route are up to 10 return trips per day (or 20 passes along any given section of the route).

2.11.4 Traffic impacts

A traffic impact statement has been prepared by Flanagans Consulting Group to assess potential impacts to the existing road network (refer Appendix G). Baseline traffic data has been sourced from Annual Traffic Report 2015 (TAMS, 2015) and projected to 2021 when the haulage operations will conclude. The estimated development traffic was compared to this baseline traffic data to assess the relative increase in traffic. A threshold of 5% increase on the background traffic and/or background heavy vehicle traffic was adopted, as the measure by which increase in traffic volume triggers a “material impact” and warrants further analysis.

The assessment concluded that:

- The increase in traffic along Stuart Highway, Tiger Brennan Drive and Berrimah Road is proportionally very small and the proposed development will have negligible impacts on these elements of the existing network.
- The increase in traffic on Cox Peninsula Road warranted the need for further assessment. This assessment was undertaken by Flanagans and concluded that the current road network will continue to operate safely as an outcome of the additional ore haulage movements and upgrades are not required. No upgrades to the existing road network are recommended to facilitate this development.
- The increase in traffic will reduce the life of the pavement by approximately 0.5%. This reduction in design life is considered negligible and can be managed by ordinary maintenance of the road. No upgrades to pavements are required to facilitate this development.

Particular consideration was given to Berry Springs Primary School due to the sensitive nature of this land use with respect to noise, dust and presence of children and parents/carers during school hours. The change in heavy vehicle movements when haulage commences will increase the number of heavy vehicle movements during the school peak periods by 1.3%. This is a negligible increase in the number of heavy vehicles and as such the relative increase in risk of collisions involving heavy vehicles does not materially increase. Road trains currently use Cox Peninsula Road and therefore the potential of heavy vehicle collisions with road trains exists as a managed risk.

2.11.5 Road construction and upgrades

The transport route is along sealed roads owned by NT Government and managed by Department of Infrastructure, Planning and Logistics (DIPL). The only proposed upgrade to this existing road network is the construction of a 100 m long slip lane at the intersection of Cox Peninsula Road and the mine site access road to provide for safe entry/exit. The proposed intersection concept prepared by Flanagans Consulting Group is shown in Figure 2-16. Detailed design and approval for works within the NT Government road reserve will be obtained from DIPL.

2.11.6 Consideration of transport alternatives

Darwin Port is the closest location from where product can be shipped to market. There is no domestic market for the resource. Selection of the transport route was based on a heavy haulage route assessment that considered four route options from Cox Peninsula Road:

1. Stuart Highway - Berrimah Road
2. Stuart Highway – Wishart Road - Berrimah Road
3. Jenkins Road – Berrimah Road
4. Finn Road – Berrimah Road (Flanagan Consulting, 2017).

The assessment took into account the following factors:

- Road suitability
- Approvals agency logistics
- Stakeholder concerns
- Value for money
- Technical risk.

The Stuart Highway – Berrimah Road route was rated as the most suitable option (Section 2.11.1) and is the transport route that will be used.



2.12 Water

The proposal requires water for dust suppression, processing and potable/non-potable supply to the mine facilities. Modelling of water availability and potential impacts associated with different supply options, has been prepared by suitably qualified technical specialists; technical reports are provided at Appendix H and I. Information from these studies has been used to establish water supply options that can be sustained across low, average and high rainfall years. A detailed Water Management Plan prepared in accordance with the *DPIR Template for Preparation of a Mining Management Plan (Section 6 Water Management)* is provided at Appendix C. The sections below summarise key aspects of the site water supply and management system.

2.12.1 Water demand

Predicted daily water demand for the mine site is 2,018 kl/day (Table 2-12). This volume represents the greatest anticipated daily water requirement and is a conservative estimate in that dry season dust suppression volumes have been applied throughout the year. This conservative approach is considered appropriate as it provides for contingency when developing a reliable and sustainable water supply for the life of mine.

Table 2-12. Project water requirements

Use	Volume (kl/day)
Dust suppression (pit)	600
Dust suppression (Haulage)	120
Dust suppression (WRD)	300
Dust Management Standpipe (losses)	40
Mine operation control facilities	8
Processing	950
Total	2,018

2.12.2 Water supply and storage

Water sources for the mine will comprise:

- Groundwater/rainfall in-flows to the pit, which will be dewatered to MWD 1.
- Surface water pumped from off-site dams (refer section 2.5).

A site groundwater model was developed to forecast monthly in-flows to the pit over the mine life (refer Appendix I). Potential variations over low, average and high wet season rainfall conditions are captured in the model, which uses time series climatic inputs from the period 1970 – 2018 to obtain the 50-year time series used to calculate recharge. The model predicts that inflows will increase rapidly from commencement of mining, reaching a peak at about 2,000 kL/d in month nine. Inflows are greatest during this early phase of mining as the weathered overburden has a higher groundwater storage capacity and transmissivity than the underlying fresh phyllite and ore. Once the fresh phyllite layer is intersected, pit inflows decline to around 1,600 kL/d for the rest of the life of mine.

The volume of water to be dewatered from the pit will be a combination of groundwater in-flows and incident rainfall. The expected total volume of pit water per month over the life of mine is shown in Figure 2-17.

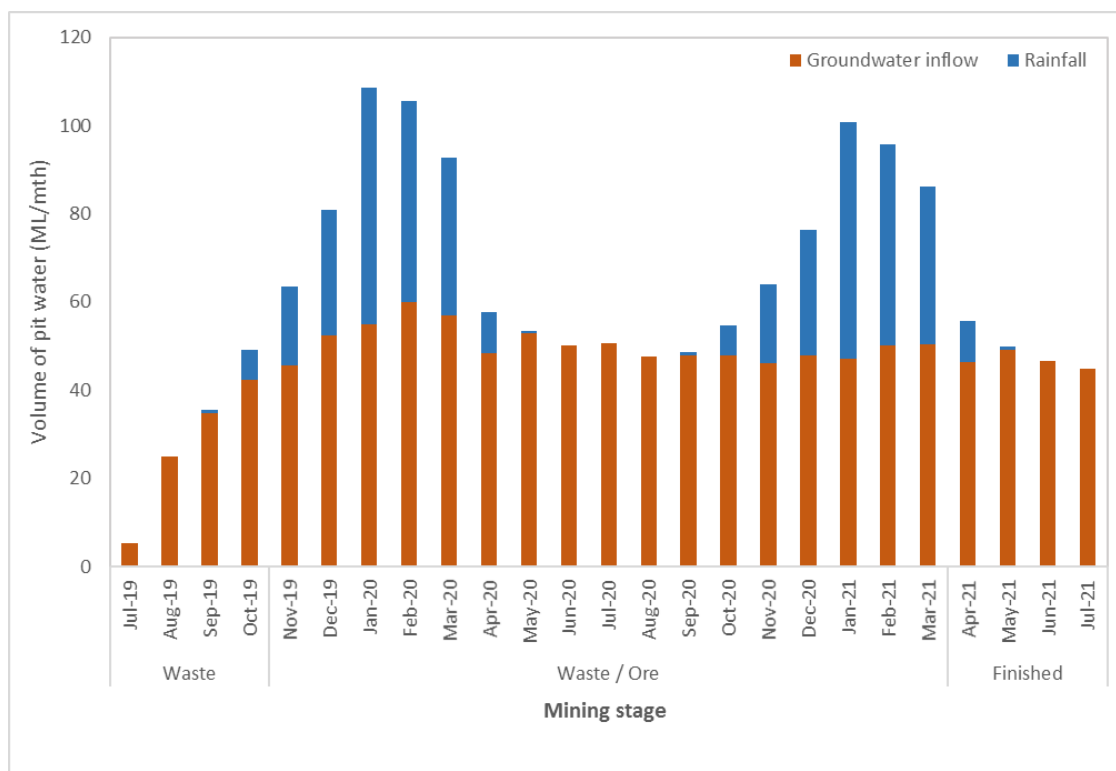


Figure 2-17. Graph showing volume of pit water (ML) to be extracted per month during life of mine

Two on-site storages will be constructed to manage the project water supply. Details of these storages are provide in section 2.4.8. The RWD will be the primary source of potable and non-potable supply to the mine facilities and a supplementary supply for processing and dust suppression during times when demand exceeds the volume available from dewatering of the pit and re-use of process water. Water dewatered from the pit will be stored in MWD 1 and decant water from the TSF will be returned either directly to the process water tank or to the MWD 2 for storage and re-use.

The RWD will be supplied from off-site dams. The volumes pumped from the off-site dams, will vary over the mine life depending on demand and re-use. The site water balance indicates that the RWD will be the primary water source during the first two months of the mining schedule, but will transition to being a supplementary supply as groundwater inflows to the pit increase, at which point the water balance currently indicates that most of the mine site water supply could be drawn from MWD 1.

2.12.3 Water balance model

A monthly water balance was developed for the life of mine in accordance with the *Minerals Council of Australia Water Accounting Framework*. The model was used to determine the requirements of the water supply and storage system, and any requirements for discharge of water during the wet season. The modelling methods and results are reported in full at Appendix J.

A schematic of the site water balance model is shown in Figure 2-18. A water balance input-output statement is provided in Table 2-15.

Make-up water

Predicted make-up water volumes range from around 30 ML/month in the first month of mining when groundwater inflows are minimal, to less than 1 ML per month during the peak of the wet season (Jan/Feb). After month two, the average volume of make-up water required per month is 1.5 ML.

Discharges

The on-site storages have been designed with sufficient capacity to store water during the dry season. During the wet season months of November to March each year, there will be water excess to the mine requirements. Modelled monthly discharges for an average rainfall year are documented in Table 2-13.

Water will be discharged from MWD 1, which will contain only groundwater/rainfall dewatered from the pit. This water is expected to be good quality and free of contaminants, excepting for sediments, which will be removed using flocculants prior to discharge. In all months, a significant portion of the discharges (44-69%) will be comprised of direct rainfall to the pit and MWD 1. A Waste Discharge Licence under the *Waste Management Pollution Control Act* will be required for discharges to adjacent surface water during the peak of the wet season. Discharge requirements and monitoring are addressed in the Water Management Plan (Appendix C).

Table 2-13. Modelled discharge volumes and composition for average rainfall year over life of mine

Month	Discharge volume (ML/month)	Portion of discharge from incident rainfall (%)	Portion of discharge from groundwater inflows (%)
2019 Dry season	No discharge	-	-
January 2020	61.72	57	43
February 2020	85.50	51	49
March 2020	66.18	46	54
2019 Wet season Total	213.40	52	48
2020 Dry season	No discharge	-	-
November 2020	3.07	44	56
December 2020	46.18	54	56
January 2021	79.99	69	31
February 2021	74.45	65	35
March 2021	58.62	59	41
2020 Wet season Total	262.31	60	40

2.12.4 Water efficiency and re-use

The DMS processing facility re-uses water at a number of points within the circuit. An operational efficiencies statement was prepared for the current water management system design. The statement indicates re-use efficiency of 39 %, as indicated in Table 2-14.

Table 2-14. Statement of operational efficiencies

Operational efficiencies	
Total volume to tasks (ML)	2,437
Total volume of reused water (ML)	961
Reuse efficiency (%)	39
Total volume of recycled water (ML)	0
Recycling efficiency (%)	0

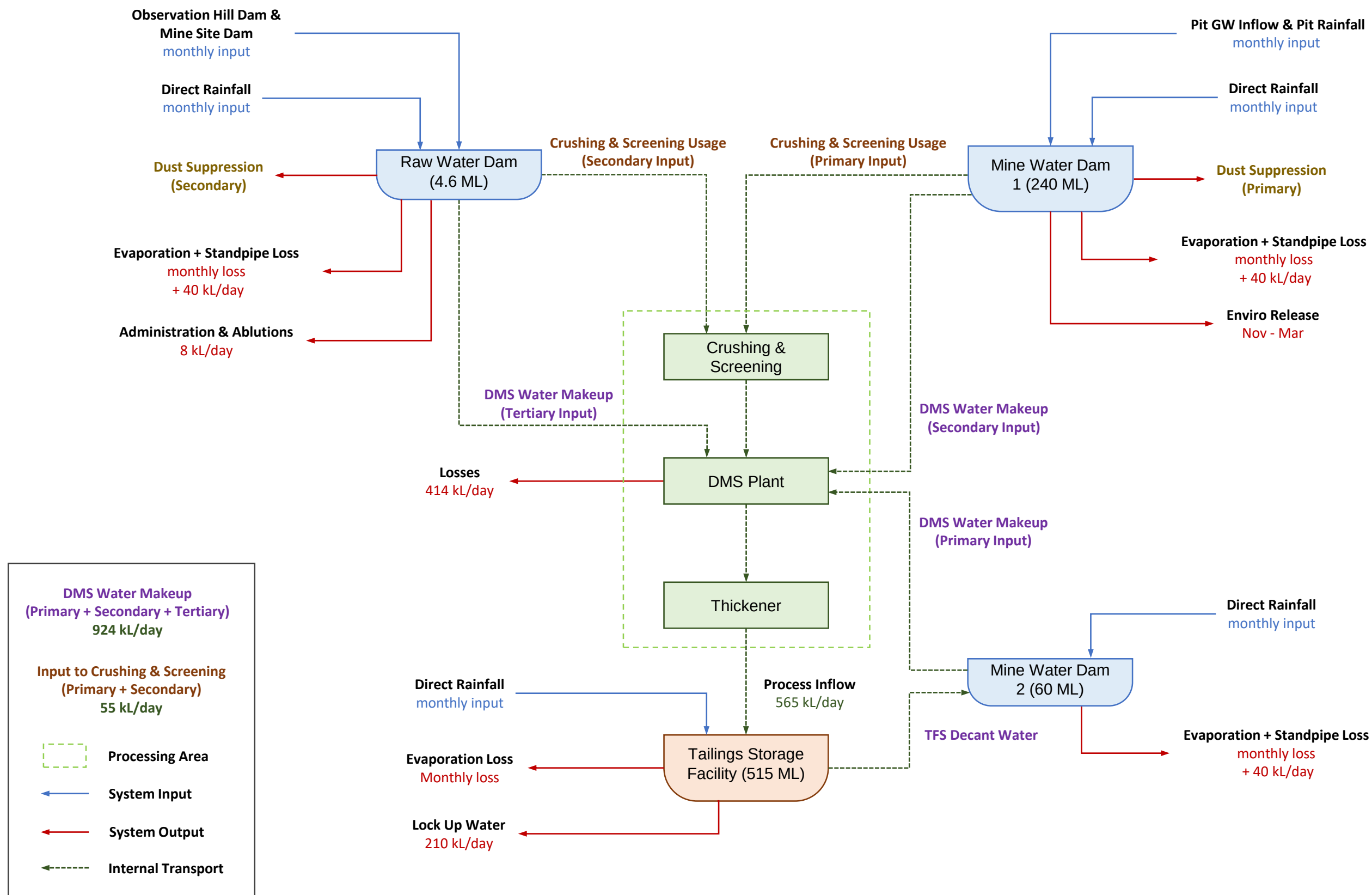


Figure 2-18 Preliminary site water balance schematic

Table 2-15. Water balance input-output statement

Inputs and Outputs for the reporting period (1st July 2019 to 31st July 2021)							
Input/ Output	Source/ Destination	Inputs/ Outputs	Water quality			Totals	How were the flows obtained and what is the confidence level of them?
			Cat1 ⁵ (ML)	Cat2 ⁶ (ML)	Cat3 ⁷ (ML)		
Input	Surface Water	Precipitation and Runoff	297	698			Estimated/Low
		External Storages	82				Estimated/Low
	Groundwater	Aquifer interception		1151			Simulated/Medium
	Total Inputs		397	1849		2146	
Output	Surface Water	Discharge	476				Estimated/Low
	Other	Evaporation	1090				Estimated/Medium
		Entrainment			231		Estimated/Medium
		Task losses		162			Estimated/Medium
	Total Outputs		1566	162	231	1909	
Diversions							
Input	Surface Water	Precipitation and Runoff		537			Estimated/Low
	Total Inputs			537			
Output	Surface Water	Discharge	537				Estimated/Low
	Total Outputs		537				

⁵ Category 1: Water is of a high quality and may require minimal and inexpensive treatment (for example disinfection and pond settlement of solids) to raise the quality to appropriate standards.

⁶ Category 2: Water is of a medium quality with individual constituents encompassing a wide range of values. It would require moderate level of treatment such as disinfection, neutralisation, removal of solids and chemicals to meet appropriate standards.

⁷ Category 3: Water is of a low quality with individual constituents encompassing high values of total dissolved solids, elevated levels of dissolved metals or extreme levels of pH. It would require significant treatment to remove dissolved solids and metals, neutralise and disinfect to meet appropriate drinking water standards.

2.13 Energy

The mine site power requirements will be met by diesel-powered generators. It is anticipated that the fuel requirement for the diesel powered generators will be 605 kL per year. In addition, the mining fleet is forecast to require approximately 16,800kL over the life of the mine; the bulk of this (over 75%) will be required during the first 12 months.

Alternative renewable sources of energy are not considered as part of the project. The short mine life, combined with set-up costs and seasonal reliability of renewable energy sources, make such technology incompatible with the project requirements.

2.13.1 Greenhouse gas emissions

National Greenhouse and Energy Reporting Act 2007 (the NGER Act) is a national framework for Australian corporations to report greenhouse gas (GHG) emissions, energy production and consumption. Under the NGER Act, reporting is mandatory from facilities with direct GHG emissions in excess of 25,000 tonnes of CO₂-e per year.

The EIS ToR require estimates of Scope 1 (direct) and Scope 2 (energy - indirect) GHG emissions associated with the proposal. Scope 1 emissions will be produced by the combustion of diesel at the mine site by vehicles, plant and equipment operated by Core, as well as those emitted as a result of land clearing. The project will generate its own power, so no Scope 2 emissions are included in this assessment.

Calculation of GHG emissions

The formula used to calculate emissions from the combustion of diesel at the project is set out below, and has been taken from the *National Greenhouse Accounts Factors* (DoEE, 2017):

$$E_j = \frac{Q \times EF_j \times EC_i}{1000}$$

E_j – emissions of carbon dioxide measured in CO₂-e

Q – quantity of diesel being burned in kL for transport purpose

EF_j – the emission factor per tonne of material used, measured in kg CO₂-e/GJ

EC_j – energy content factor of fuel type

The results of these calculations are set out in Table 2-16.

Table 2-16. Emissions summary for diesel consumption

Purpose	Diesel used (kL)	Energy content factor (GJ/kL)	Emission factor (kg CO ₂ -e/GJ)			Emissions (t CO ₂ -e) Months 1-12	Emissions (t CO ₂ -e) Months 13-25	Life of mine emissions t CO ₂ -e
			CO ₂	CH ₄	N ₂ O			
Transport ⁸	16,819	38.6	69.9	0.1	0.5	35,350.7	10,418.5	45,769.2
Stationary	1,210	38.6	69.9	0.1	0.2	1,682.4	1,597.2	3,279.5
Land clearing ⁹	-	-	-	-	-	10,147	-	10,147
						47,179	12,016	59,195

⁸ Assumes all vehicles are post-2004

⁹ Estimate using the Full Carbon Accounting Model (FullCAM)

Total GHG emissions

Total GHG emissions for the life of the mine were estimated to be 59,196 t CO_{2-e}. Averaged out over the 25-month period this represents approximately 28,414 t CO_{2-e} per annum. This equates to approximately 0.4 % of the NT's total emissions, which were estimated to be 16.5Mt CO_{2-e} in 2016 (DoEE, 2018). The majority of the emissions (over 80 %) will occur in the first 12 months of the project due to land clearing and construction of the mine. Based on these figures, reporting of GHG emissions would be required in the first 12 months only.

2.14 Workforce and accommodation

Construction and operation of the project will be achieved by a combination of contractors and direct employment of personnel by Core. The following sections provide details about the workforce required for the life of mine and the transport and accommodation arrangements proposed.

2.14.1 Workforce size and composition

The project is expected to employ between 100 and 150 people. Employment will peak in the pre-strip/construction phase and then will remain around 93 FTE until month 22 of the mining schedule. The workforce is expected to have the following composition:

- Management/Supervision/Professionals – 21 %
- Trades – 18 %
- Contractors - 61 %

Breakdown of employment numbers and roles is shown in Figure 2-19.

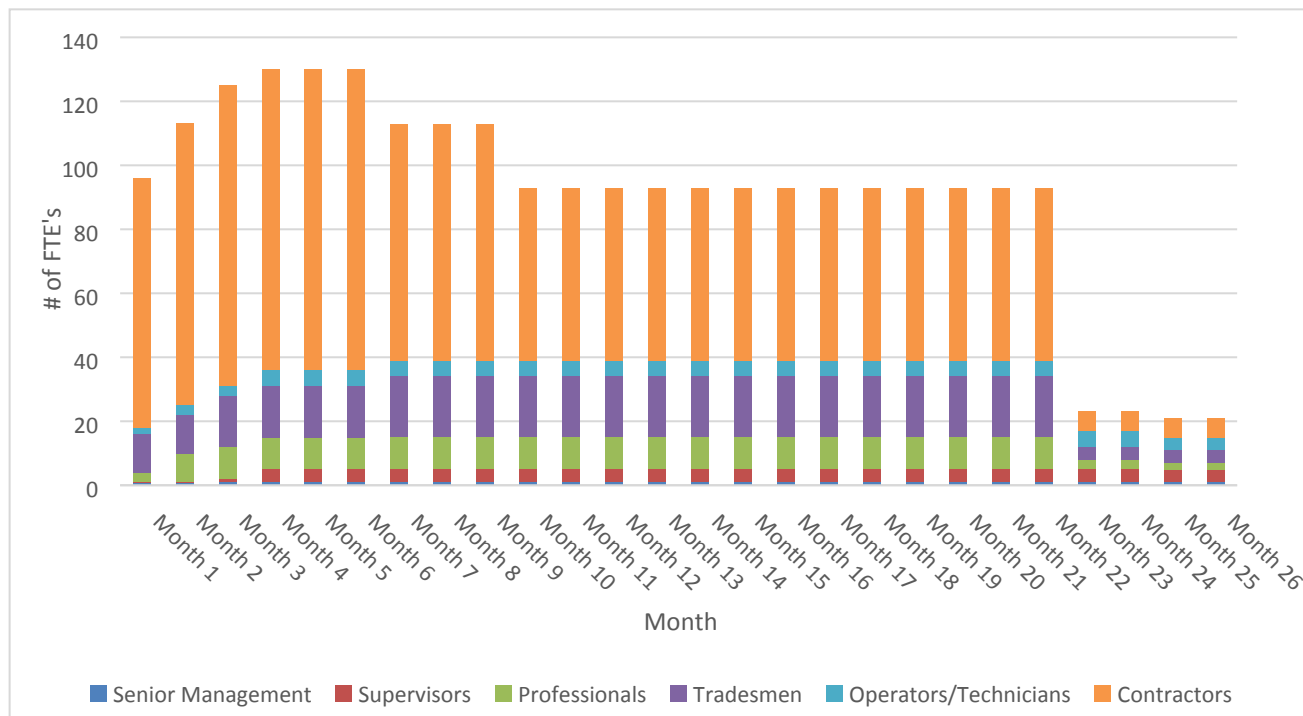


Figure 2-19. Breakdown of employment numbers and roles

2.14.2 Organisation structure

The Grants Lithium Project proposed organisation structure is illustrated in Figure 2-20. Similar to other small short-term mining projects, Core's project-specific personnel will include a Health, Safety and Environment (HSE) Manager who will be responsible for oversight of environmental compliance requirements. The company would seek to recruit a suitably qualified professional with previous mining experience for the role. To provide adequate resourcing and the required technical skill sets for certain tasks, it is anticipated that the HSE Manager will engage the services of environmental consultants as required. All contractors engaged to undertake work packages on the project will be expected to have their own HSE representative and operational procedures that comply with the environmental commitments made in Core's MMP and any relevant conditions of the Mining Authorisation.

2.14.3 Transport of workforce

The workforce is expected to be comprised mainly of residents of Darwin, Palmerston or surrounding areas. There will be no on-site accommodation camp as part of the project; workers will be expected to travel to/from site for each shift. The travel time from Darwin to the site is less than one hour.

Where skill requirements and/or lack of available personnel necessitates fly-in/fly-out arrangements for a portion of the workforce, the project would use existing commercial accommodation in the region. As the operational workforce is relatively small, the project is not expected to result in additional demand for accommodation that cannot be met by existing service providers.

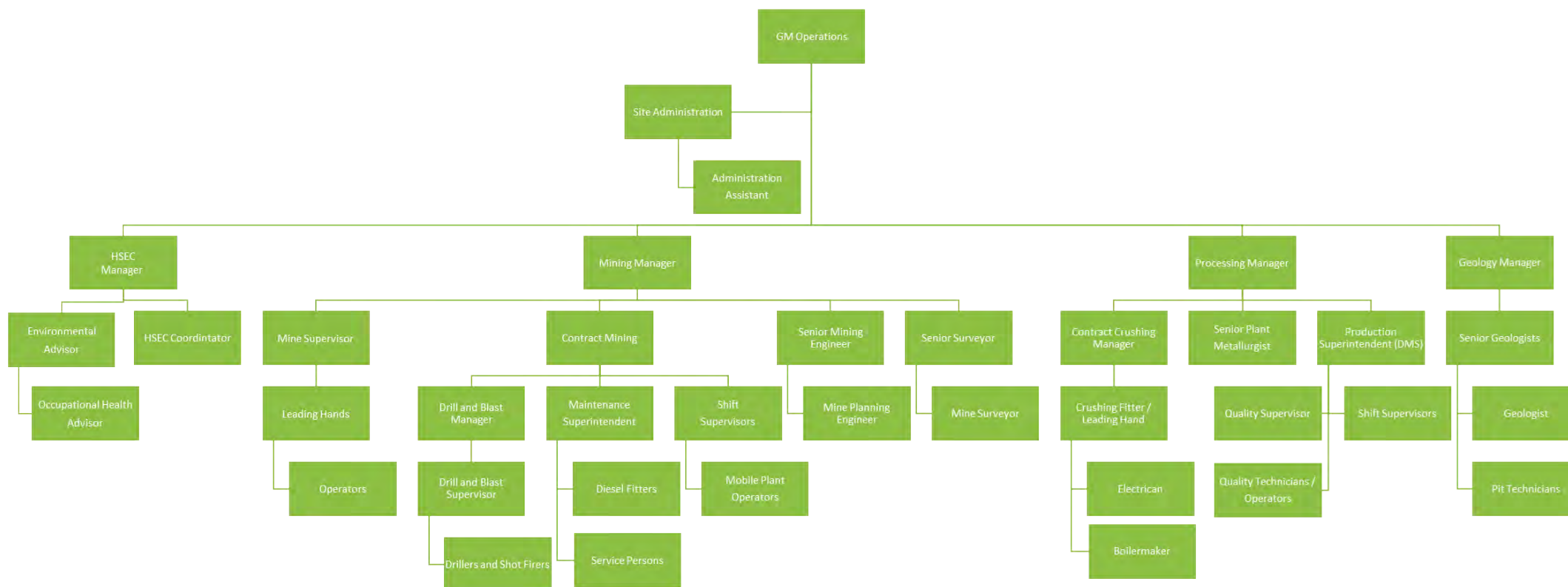


Figure 2-20. Grants Lithium Project organisational chart

2.15 Closure and rehabilitation

Core intends to leave the project area in a safe and stable condition such that the tenements can be relinquished without any future financial, environmental or safety liability for the company, land managers, government or the community. The Mine Closure Plan (Appendix D) details site-specific closure objectives and the actions that will be undertaken to achieve this outcome.

The final landform of the combined TSF / WRD will require a capping layer, consisting of growth medium sourced from top soil / residual soils, as well as a rock mulch layer that will assist in erosional stability during establishment of vegetation. As the waste rock and tailings have a low risk of geochemical instability, it is not expected that there will be a need to restrict percolation through the landform, and therefore a low permeability barrier has not been included in the cover design. The design is intended to provide a structure that will be geotechnically stable in perpetuity, and effectively blend with the natural landscape in the surrounding area.

2.15.1 Schedule

The bulk of closure and rehabilitation activities are planned to occur over months 26-30 of the project schedule. Some progressive rehabilitation of the WRD will occur at the end of year one; once the external face is complete, the surface can be re-profiled, covered with reserved topsoil, ripped and seeded. The inundation bund will also be revegetated early in the mine life to minimise erosion.

2.15.2 Closure strategy

The planned closure strategy will involve the following key components:

- Shut-down and infrastructure removal
- Stabilise and secure open pit
- TSF closure
- Re-profiling of WRD
- Temporary stabilisation of post-mining landforms
- Permanent stabilisation.

The general activities that will be undertaken are summarised below from the MCP.

Shut-down and removal of infrastructure

Processing infrastructure will be shut down, disassembled as required, and removed from site. The MOC infrastructure will likely remain on site until all closure domains have been re-profiled to the final landforms. Once these facilities are no longer required, all above ground infrastructure will be decommissioned and removed from site. Infrastructure will be re-used if practicable or disposed of appropriately.

Where possible, concrete pads will be removed from site. If this is not practicable, the pads will be buried. Above ground water pumps and standpipes will be removed from site once dust management is no longer required. Connected buried pipelines will be capped below ground and covered. Any above ground pipelines will be removed from site.

The ROM pad, access roads, water storages, explosive storage and MOC base (all constructed from overburden material) will be removed and the material incorporated into the WRD. These areas will be re-profiled to pre-mining landform which matches the surrounding areas. They will be ripped and covered in topsoil to stabilise the areas and promote natural regeneration of native vegetation species.

The stormwater drains and sediment dams will remain until determined to be no longer be required. The requirement for sediment dams as part of the closure strategy will be included in an ESCP submitted to DPIR with the final MCP.

Stabilise and secure open pit

The open pit will be stabilised and secured and left to form a pit lake. The flood diversion bund will be left in-situ as an abandonment bund. The location of the bund has been selected outside of the calculated zone of instability around the pit shell, with the intent that post-closure, the bund will be used to make the site safe and secure.

Tailings Storage Facility closure

The TSF's will be progressively capped as they are filled and tailings have consolidated. An initial 0.5 m cover layer will be spread across each cell. A second layer of 1.0 m thick waste rock will be placed and spread across each cell. The coverage of tailings cells will occur in the dry season. Once covered with initial layers, remaining waste rock will be placed on top of the TSF up to the final height of WRD.

Waste Rock Dump

The final WRD landform design objective is to ensure that the final structure is safe, stable and not prone to significant erosion. Approximate dimensions of the final WRD landform are 1,000 m (l) x 600 m (w) x 25 m (h).

The design comprises three tiers with slope lengths ranging between five and ten metres to help reduce water run-off velocity and therefore reduce erosion potential. The final height, slope lengths and batter angles will be refined following further geotechnical assessment of the materials available on site. The design criteria for the WRD are summarised in Table 2-17, and a cross-section of the final integrated WRD/TSF landform shown in Figure 2-23.

The top surface of the waste rock dump will be shaped to provide a nominal 1 % water shedding profile (Figure 2-21). The top surface will be covered with 0.5 m (nominal) of growth medium with 0.3 m rock mulch (Figure 2-22). Erosion and sediment control structures within the landform will be detailed in the Closure ESCP and will remain in place until permanent stabilisation is achieved. The surface will be reseeded with local species.

Table 2-17. Final landform conceptual design criteria for waste rock dump

Design Element	Batter Configuration			Overall Batter Angle
	BFA (°)	BH (m)	BW (m)	
Tier 1	30	6 to 15	10	20°
Tier 2	30	10	10	
Tier 3	30	5		

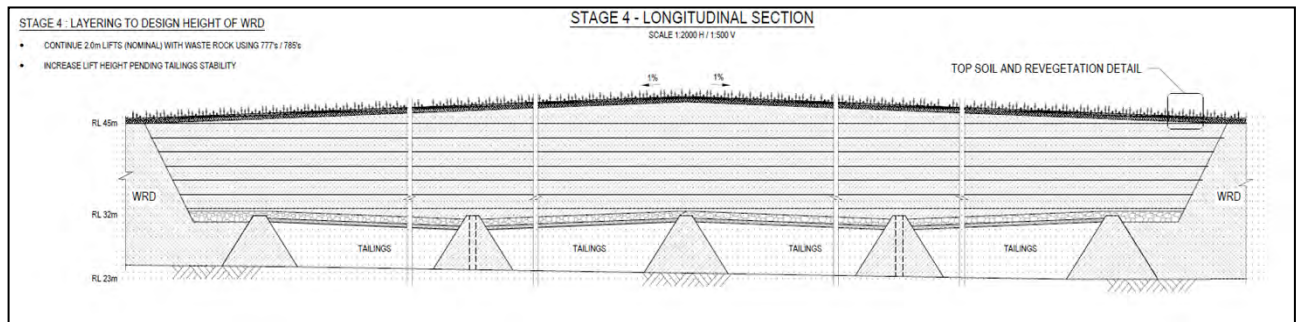


Figure 2-21. Final waste rock dump landform surface and internal profile.

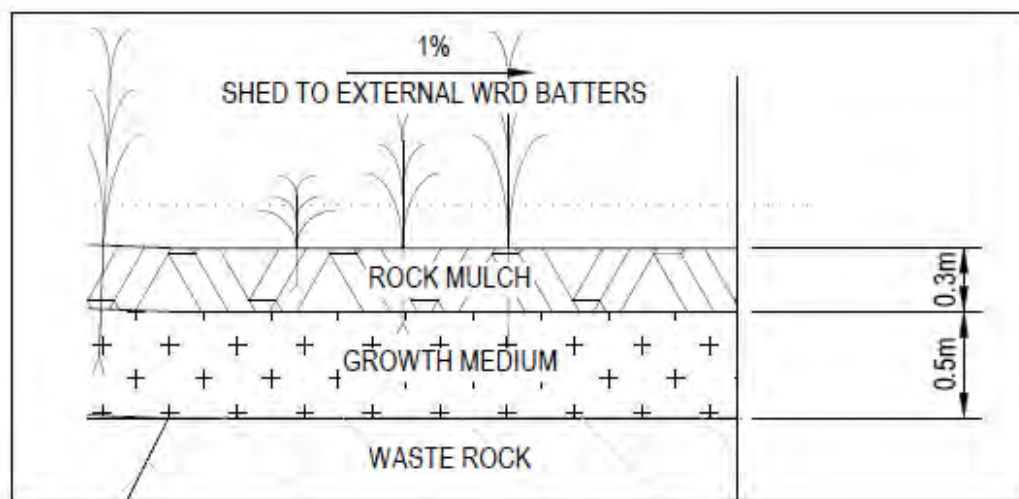


Figure 2-22. Detail of final waste rock dump surface

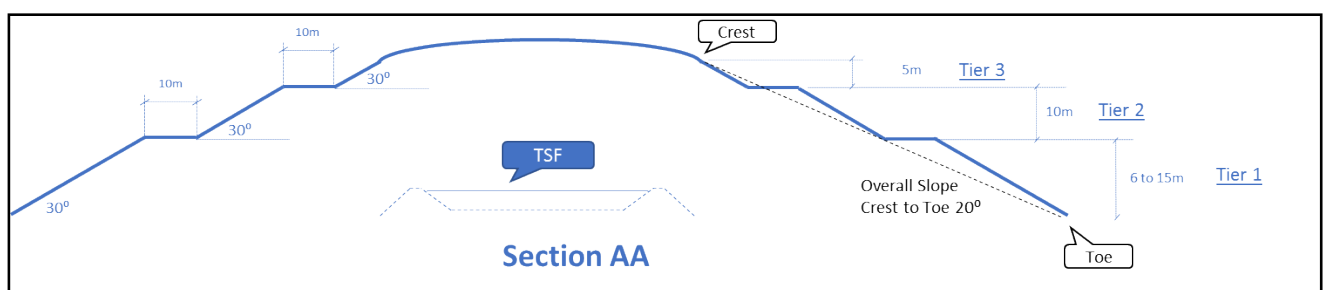


Figure 2-23. Final landform concept cross-section for waste rock dump/tailings storage facility

Temporary stabilisation

The final landforms will be temporarily stabilised through erosion and sediment control measures. The measures utilised will be specified in a closure ESCP prepared by a Certified Practitioner in Erosion and Sediment Control. The closure ESCP will be developed as part of the final issue of the Mine Closure Plan. The final issue of the plan, including the closure ESCP, will be approved by the DPIR through the mining authorisation process under the *Mining Management Act*.

Permanent stabilisation

Once the final landforms have been covered in topsoil and temporarily stabilised, all areas will be reseeded with a mix of local species. Rehabilitation monitoring will be undertaken as detailed in the Mine Closure Plan. If rehabilitation monitoring identifies areas where rehabilitation has failed, then additional corrective actions will be undertaken until the closure criteria for the site are achieved. The bond submitted prior to commencement of mining will not be relinquished by DPIR until the agreed criteria are achieved.

2.15.3 Final landform

The final landform will comprise the elevated WRD, pit lake and flood bund. The remainder of the site will be returned to the original landform. The change in topography pre and post mining is shown in Figure 2-24.

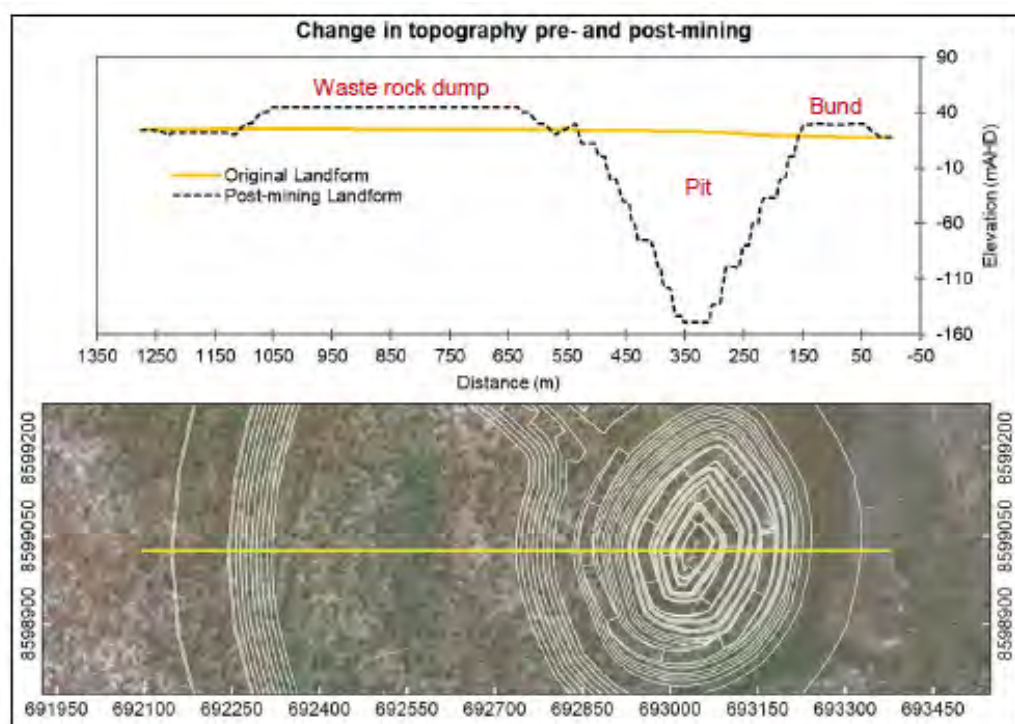


Figure 2-24. Profile of pre- and post-mining landform ground elevations

2.15.4 Temporary and/or unforeseen closure

The short mine life and finances underpinning the project make early closure an unlikely scenario. However, if this scenario were to occur, landforms and features will not have been finalised to an agreed closure standard and

completion criteria will not have been met. The environmental and rehabilitation liability remains with Core who is required to inform DPIR and submit a plan for care and maintenance of the mine site.

Depending on the life of mine stage when early closure occurs, there will be different risks associated with the mine site being unstable and unsafe. Key risks identified and assessed as part of the closure risk assessment are listed below:

- Wind-blown dust emissions from exposed WRD surface and TSF
- Uncontrolled drainage from WRD
- WRD landform, open TSF cells and infrastructure left on site pose a safety hazard to members of the public who enter the area 'unauthorised'
- Release of tailings from open TSF cells
- Fauna interaction with tailings in open TSF cells
- Fuel storages leak hydrocarbons

The complete risk register, including proposed mitigation measures is provided in the MCP. All risks were ranked as moderate to low. As the specific details of the mitigation measures required will depend on the life of mine stage, these will be developed and included in a care and maintenance plan that is issued to DPIR for approval in accordance with the requirements of the *Mining Management Act*.

2.15.5 Consideration of backfilling the pit

The EIS ToR section 4.1.2.4 require “an adequate and transparent evaluation of the benefits, risks and costs of all (closure) options.” This requirement is addressed by the ‘pit sterilisation assessment’ prepared by Innicon (2018). The sterilisation report concludes that backfilling of the pit is an option that would decrease the profit margins of the operation but is unlikely to make the open pit project unviable. However, the key factor that has influenced Core’s decision not to backfill the pit is that it would make future underground mining of the already defined ore resource beneath the pit unviable. If the pit is backfilled, the only way the resource can be accessed is from the surface, either by a surface decline or via a shaft. If a decline option is considered compared to a portal access from deep within the pit void, the additional cost to establish a twin decline would be \$22.2M, which in Core’s view would be considered unviable.

Other key findings of the sterilisation report that are relevant to decision making about the feasibility and benefits of back-filing the pit are summarised below.

- The total time to safely backfill the pit, considering climate conditions, will be up to 6.5 years post the end of processing. A reasonable amount of site infrastructure post production and mining will be required to support a pit backfilling operation including on site offices, road access, services, pit dewatering pumps and water storages for dust suppression. Dewatering will be required for the duration of the backfill operation.
- Estimates of materials volumes indicate there is potential for there to be a deficit in the material available to completely backfill the pit to achieve a stable water-shedding structure. This means that it is possible the pit lake will still remain post-closure. Whilst theoretically a surplus of material would be expected, based on material swell factors, a large portion of the waste material will be used for construction of site infrastructure and for construction and capping of the TSF, which will remain in place post-closure. Because the bund, dams and roads would need to remain in place in order to facilitate the backfilling operation, placing this material back into the pit this is likely to be difficult to achieve in practice.
- In order to back-fill the pit, a new TSF will need to be designed as an alternative to the proposed WRD encapsulated option. This would increase the mine disturbance area by up to 25 ha. A stand-alone TSF will also increase operational risks associated with water management and rehabilitation/closure will be more complex.

2.16 References

References cited in this chapter are listed below.

ANCOLD (2012) *Guidelines on Tailings Dams: Planning, Design, Construction, Operation and Closure*. ANCOLD.

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Chapter 3

Stakeholder

Engagement

3 STAKEHOLDER ENGAGEMENT

Core has employed local communications experts, True North Strategic Communication (True North) to assist with identifying and engaging with key project stakeholders during project planning and development. Early communication commenced with key stakeholders in late 2017. Subsequent communication and consultation activities have been undertaken over the period July-September 2018 as part of preparing the Social Impact Assessment (SIA) for the proposal. This chapter provides an overview of the stakeholder engagement undertaken to date and summarises the key findings. Opportunities for stakeholders to further engage with the project through the EIS and beyond are also discussed. The content of this chapter has been extracted from the consultation reports prepared by True North; the complete reports are provided at Appendix K1 and K2.

3.1 Overarching approach

Using the International Association for Public Participation (IAP2) principles that guide good community engagement, the approach adopted for the Grants Lithium Project proposal is designed to **inform, consult and involve** stakeholders (refer Table 3-1).

Table 3-1. International Association of Public Participation Engagement Spectrum

Level of engagement	Promise to the public
Inform	We will keep you informed.
Consult	We will listen to your concerns, keep you informed, and provide feedback on how stakeholder's input influenced the decision.
Involve	We will work with you to ensure your concerns are reflected in the alternatives developed, and provide feedback on how the public's input influenced the decision.
Collaborate	We will look to you for advice, ideas and solutions and incorporate those into the decisions as much as possible
Empower	We will implement what you decide.

The approach is risk-based in that it devotes the greatest communication and consultation effort to stakeholders likely to experience the greatest level of impact – positive or negative – from the project, while raising awareness of all stakeholders on how they can get information and provide feedback. The approach was designed to achieve the following objectives:

Communication objectives

- Identify all stakeholders and the best communication methods for each i.e. phone, email, face-to-face meetings, interviews and presentations.
- Ensure key stakeholders receive objective information direct from the company rather than from media or third parties.
- Build relationships and make it easy to contact the company to clarify issues and address rumours and misinformation.
- Give stakeholders a chance to provide early input on issues that may affect them and provide regular updates to these stakeholders.

Consultation objectives

- Listen to and understand the perspectives of all stakeholder groups
- Manage stakeholder expectations
- Early identification of local knowledge that may contribute to better project design, avoiding mistakes or mitigating negative impacts
- Support delivery of a project that is environmentally, economically, culturally and socially acceptable to the community and key stakeholders (i.e. earn social licence to operate)
- Provide regulators with confidence that all positive and negative impacts are well understood and can be managed through all phases of the project
- Provide guidance to the company's long-term social performance.

Stakeholder identification initially focussed on groups and agencies with a key role in decision-making and regulation of the proposal. The stakeholder list was then broadened to include a wide range of groups, agencies, individuals and the broader public, who may be affected by and/or have an interest in the proposal.

3.2 Early engagement – initial contact with key stakeholders

Early stakeholder engagement activities in November 2017 focussed on targeted contact with key stakeholders to provide them with information about the proposal. The targeted stakeholder groups were:

- Department of Primary Industry and Resources, Minister for Primary Industry and Resources.
- Local elected representatives
- Local government including City of Palmerston and Litchfield Council
- Local industry associations including the Chamber of Commerce and the Minerals Council
- Non-government organisations, including environmental groups.

Stakeholders were provided with a fact sheet, a one-on-one briefing and email updates.

When initial contact was made, the project planning was in the very early stages; a Mineral Lease had yet to be applied for and some key decisions were yet to be made in relation to the level of ore processing that would take place on-site. Subsequently details about some aspects of the project were uncertain and stakeholders were presented with the range of options being considered by Core.

The early engagement activity provided Core with an appreciation of key issues that would need to be addressed in subsequent planning and the types and levels of impact that would be of most concern to people and therefore have the greatest impact on gaining a social licence for the project. During these early consultations, the stakeholders that were engaged were generally supportive of the project and appreciative of the advanced notification of the proposal before it was made public. The key themes raised were summarised into five categories shown in Figure 3-1.

Road use by heavy vehicles was clearly and consistently raised as a key issue. This initial feedback was a significant driver for Core to progress consideration of concentrate production on-site, which would more than halve the truck traffic along Cox Peninsula Road compared to transport of Direct Shipping Ore (DSO). On-site processing, whilst requiring substantial upfront capital expenditure, was found to produce good economic outcomes for the project and subsequently has been adopted as part of the project plan moving forward.

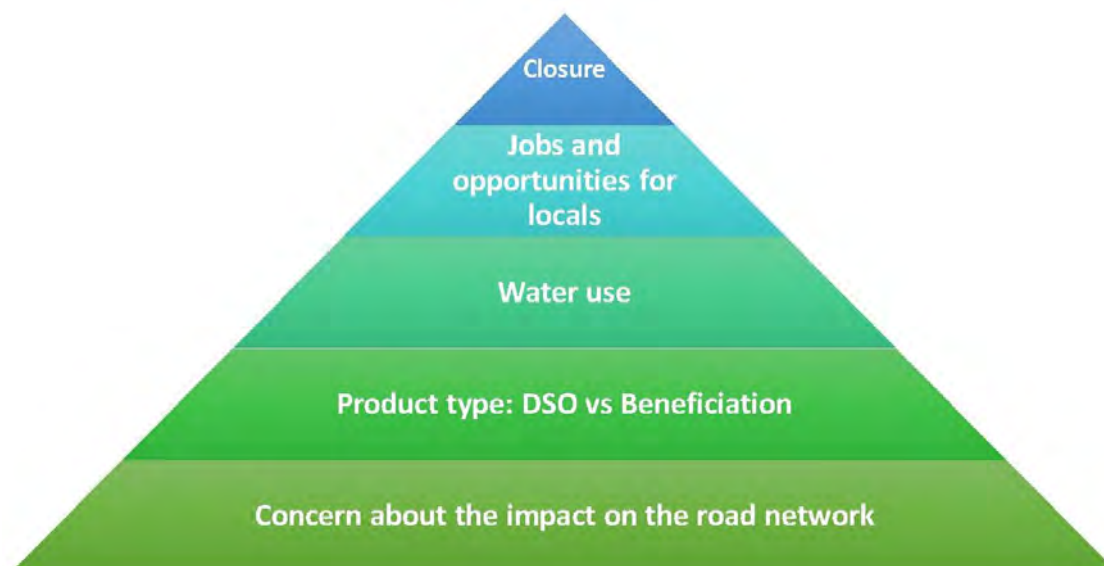


Figure 3-1. Key themes raised by stakeholders in early consultation – November 2017

Project briefings and updates

A further communication and engagement program was run over July, August and September 2018 in Darwin, Palmerston, Litchfield and the Berry Springs area. The program was designed to update previously contacted key stakeholders, and to reach out to a wider range of organisations that could be directly affected by or have a specific interest in the proposal, and the local community more broadly. The communication and engagement program implemented by True North included:

- An email sent out to stakeholders with a fact sheet outlining the project, information on the consultation process and an invitation to participate (either with an offer of a briefing and/or invitation for a formal SIA interview).
- 18 face-to-face briefings.
- 13 SIA interviews.
- An information stall at the Berry Springs Market on 26 August to reach local community members (Figure 3-2). The factsheet, maps and product samples were available at the stall to assist with informing members of the community about the project. Approximately 25-30 people engaged with Core or True North staff with another 25 people passing the stall and taking a fact sheet. It is estimated a further 30 people passed by without engaging at all.

Several informal discussions also took place, and contact was made with a number of additional stakeholders and community members following suggestions made at earlier briefings and interviews. Some stakeholders were also provided with brief content to include in their respective newsletters to maximise the reach to potentially affected people.



Figure 3-2. Photo of Core Exploration information stall at Berry Springs market

Social Impact Assessment interviews

The EIS ToR require a balanced summary of the social and economic value and potential impacts of the proposal. To address this requirement, a SIA was prepared by True North, a key component of which was formal stakeholder interviews. The goal of the interviews was to gain an understanding of likely, actual and perceived social impacts of the project and to seek input to the development of measures to manage and reduce impacts to an acceptable level. Thirteen formal SIA interviews were conducted independent of Core, with only True North staff in attendance. This independence is important to the SIA process, as it allows stakeholders to talk more freely about impacts and concerns. Organisations interviewed are listed in Table 3-2.

Table 3-2. Organisations interviewed by True North for social impact assessment

NT Government	Local Government
Department of Tourism and Culture Department of Infrastructure, Planning and Logistics Department of Education	Litchfield Council City of Palmerston Wagait Shire Council
Community and environment groups	Industry groups
Berry Springs Primary School Environment Centre NT Amateur Fishing Association	Chamber of Commerce NT Industry Capability Network
Essential services	Indigenous groups
St John Ambulance	Larrakia Development Corporation

The interviews were conducted according to a guide for consistency and asked the following questions:

1. What do you know about the Grants Lithium project?
2. What are your initial thoughts about the project, based on what you know?
3. What is your involvement or connection with the Cox Peninsula area and/or project?
4. What do you think are the potential benefits of the Core project?
5. In your opinion, how might the project impact on the region (if necessary, prompt for things like tourism, economic development, roads, safety, environment)?
6. Are there any existing issues you think we should be aware of?
7. Are people talking about this project? What are they saying? What are people's expectations?
8. Can you talk a bit about (the local community/ your department or organisation/ members/your role/ business/ school)?
9. What do you think are the potential negative impacts of this project?
10. Do you have any ideas about how to reduce these impacts, management strategies, things Core could do differently, lessons from local knowledge?
11. Are there other mining / exploration / industrial projects that you know have had an impact on the region? What are these impacts and what are your views?
12. Do you have any questions about the proposed project?
13. Who are the key people or organisations that you think we should be talking to?
14. Do you want to be kept informed (if so get all contact details)?
15. Is there anything you'd like to say that I haven't asked you, any other thoughts?

Specific questions were also asked relevant to each stakeholder's role/interest in the region. The complete list of questions is provided in the consultation report (Appendix K2).

3.3 Outcomes

The feedback received from stakeholders and the community on the project was varied, but overall True North staff felt that most stakeholders were optimistic about the project and could see that it has potential to bring positive benefits to the Berry Springs area. Six themes were clearly captured in stakeholder feedback, and are listed in priority order in Figure 3-3.

The expectation of local employment, the use of local suppliers and services and local sponsorship underpin stakeholder positive attitudes toward the proposal. The strongest positive to come out of the discussion with stakeholders and the community, was potential jobs from the project. Most people who engaged with Core and True North at the Berry Springs market had an interest in jobs, and some queried whether a plan was going to be

made for indigenous employment. Industry Capability Network Northern Territory expressed interest in working with Core to develop a website page for interested contractors to visit to find up-to-date information on available contracts.

Stakeholders had some concern about the need to close Cox Peninsula Road during blasting. At the time of the consultations Core thought that blasting would need to occur twice a day and would require closure of the road for 15 minutes; however, since then the project details have been refined and it is expected that blasting will be required three times per week. Locals making their commute to and from work, parents dropping kids to school and people accessing recreational areas were identified as people who could be potentially impacted. Berry Springs Primary School and the Department of Education asked that school drop-off and pick-up times be considered to reduce delays, and the Amateur Fishermen's Association of the Northern Territory asked that Friday afternoons and Sundays be avoided as these are peak times fishermen will use the road. Most stakeholders indicated the impact will be minimised if blasting times are chosen with good reason, are justified to the community and are communicated well and ahead of schedule.

Another concern raised was in relation to road safety. Cox Peninsula Road is a single carriageway with no overtaking lanes. Road trains are not regularly seen on Cox Peninsula Road and stakeholders have concerns that some drivers may become impatient and risk the safety of themselves and others trying to overtake the road trains.

The stakeholder feedback received over the past 10 months (November 2017 to September 2018) has been considered in the SIA process and a Social Impact Management Plan (SIMP) has been prepared, that aims to minimise impacts and maximise opportunity to local businesses and the community. The SIA Report, Social Impact and Opportunities Assessment and SIMP prepared by True North are provided at Appendix L, M and N respectively. Chapter 9 of this EIS provides a summary of the potential impacts of the proposal on social, economic and cultural surroundings based on these documents.



Figure 3-3. Key themes raised by stakeholders in consultation – July-September 2018

3.4 Future engagement opportunities

The draft EIS will be open for public comment for a minimum period of six weeks. The public comment period will be advertised in the NT News and local newspapers and copies of the draft EIS documentation will be made available online and in hardcopy at a number of locations. Where stakeholders have indicated they would like to be kept informed of the project, Core will communicate directly with those people in relation to the EIS public comment period. Any person or organisation can submit comments to the NT EPA and any comments received will be provided to Core to be addressed in a Supplementary EIS document.

In addition to the prescribed EIS public comment period, the SIMP (Appendix M) includes commitment to on-going communication and consultation with stakeholders, in particular leading up to and during the operational phase.



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Chapter 4

Impact and Risk

Assessment

4 IMPACT AND RISK ASSESSMENT

This chapter describes the approach and methods used to assess potential environmental impacts and risks associated with the Grants Lithium Project (the project) proposal. The purpose of the assessment is to determine whether or not the proposal is likely to have a significant effect on the 'environment'. Under the *Environmental Assessment Act* (NT), the environment is defined as:

All aspects of the surroundings of man including the physical, biological, economic, cultural and social aspects.

The impact and risk assessment process considers the inherent risk posed to the environment by the proposal, and then identifies where additional measures are needed to reduce adverse impacts to a level acceptable to government regulators and the community. The outcomes of the assessment for each environmental factor are documented in the various chapters of this draft Environmental Impact Statement (EIS). These will inform the NT Environment Protection Authority's (NT EPA) decision-making with respect to whether or not to recommend the project will be approved and, if so, under what conditions.

4.1 Environmental factors and objectives

The NT EPA has developed 12 environmental factors to provide a systematic approach to organising environmental information for the environmental impact assessment process. Environmental factors are those components of the environment that may be impacted by any aspect of a proposal. Objectives provided for each factor are used by the NT EPA to judge whether the impact of a proposal may be significant.

Preliminary assessment of the proposal by the NT EPA identified five environmental factors that require more detailed assessment as part of the EIS process. These are listed in Table 4-1, together with the corresponding objective and the relevant EIS chapter in which potential impacts are discussed.

Each of the other seven factors were considered, but none were deemed to warrant more detailed assessment. Table 4-2 documents the reasons why significant impacts to these other factors are unlikely.

Table 4-1. NT EPA environmental factors and objectives relevant to Grants Lithium Project proposal

Theme	Factor	Objective	EIS chapter
LAND	Terrestrial flora and fauna	Protect the NT's flora and fauna so that biological diversity and ecological integrity are maintained.	5
	Terrestrial environmental quality	Maintain the quality of land and soils so that environmental values are maintained.	6
WATER	Hydrological processes	Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.	7
	Inland water environmental quality	Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected.	8
PEOPLE & COMMUNITY	Social, economic and cultural surroundings	Protect the rich social, economic, cultural and heritage values of the Northern Territory.	9

Table 4-2. NT EPA environmental factors not requiring further assessment

Environmental theme/factor	Significant impact is unlikely because...
WATER Aquatic ecosystems	The watercourses within and surrounding the project area are ephemeral and so do not support a high diversity of aquatic flora and fauna. Impacts to surface water and groundwater flow regimes and water quality are assessed in this EIS under the Hydrological processes and Inland Water Environmental Quality factors – see Chapters 7 and 8.
SEA All factors	The project is located on land approximately 1.7 km inland from the upper tidal limit of West Arm. There will not be any direct impacts to the marine environment and, as noted above, technical studies have indicated there will be limited impacts to freshwater flows entering West Arm. Furthermore, there are no major sources of contaminants that could be transported into the marine environment.
AIR Air quality and greenhouse gases	The only major source of air emissions associated with the project is dust from ore extraction and materials handling. The project water balance includes adequate allowance of water for dust suppression activities and there are no sensitive receptors located in close proximity to the mine site. Greenhouse gas emissions estimates are provided in the EIS; however, the project is not expected to be a significant component of NT emissions.
PEOPLE & COMMUNITY Human health	The project does not involve any activities that pose a significant risk to human health and safety. There are no major sources of contaminants that could move off-site and impact the public. Workforce health and safety will be regulated in accordance with national requirements. Impacts associated with increased road traffic assessed in this EIS under the Social , Economic and Cultural Surroundings factor (see Chapter 9).

4.2 Approach and method

The EIS Terms of Reference (ToR) require a 'whole-of-proposal impact analysis and risk assessment'. The procedure adopted is illustrated in Figure 4-1 and described in the sections below. Each step was completed for each of the five environmental factors relevant to the proposal (Table 4-1). The EIS chapter for each of the environmental factors discusses potential impacts under the following standard set of headings:

1. Description of values
2. Assessment of impacts
3. Mitigation and management
4. Monitoring and reporting
5. Statement of residual impact.

These correspond to the key steps of the impact analysis and risk assessment procedure.

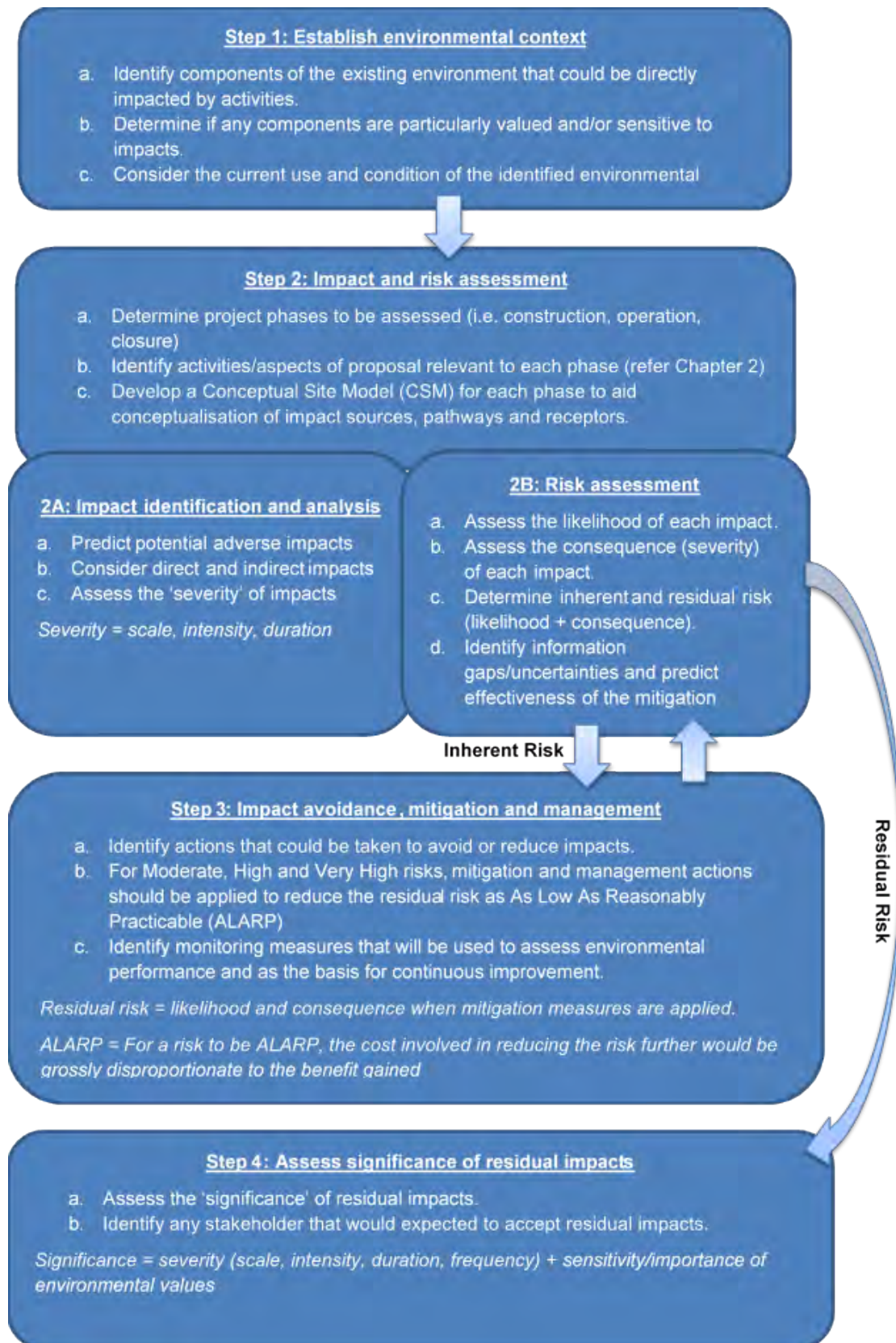


Figure 4-1. Environmental impact and risk assessment process

4.2.1 Environmental context

Project footprint

To understand which components of the environment could be impacted by the project, an *impact assessment footprint* was defined. The footprint encompasses areas that could feasibly experience impacts associated with the proposed mining activities. The impact assessment footprint comprises two areas:

- The *direct disturbance footprint* is that which will be directly affected – for example, vegetation removed by land clearing or areas flooded by the building of water storages. It encompasses the areas of land covered by the mine site (i.e. approximately 145 ha within ML31726) and areas of land that will be directly affected by construction of the off-site dams and water pipeline. The haul route from the mine site to Darwin Port, along Cox Peninsula Road, Stuart Highway, Tiger Brennan Drive and Berrimah Road, is also within the direct disturbance footprint.
- The *indirect disturbance footprint*, which encompasses the surrounding areas, that may be indirectly affected by events such as release of contaminants to surface or groundwater, dust emissions and noise. This footprint includes:
 - o Waterways downstream of the mine site – commencing with the ephemeral streams that flow off the mineral lease (ML), and extending downstream to West Arm in Darwin Harbour catchment.
 - o Waterways downstream of the Observation Hill dam – extending downstream to the receiving waters in Charlotte River in Bynoe Harbour catchment.
 - o Groundwater aquifers that could be affected by drawdown or contamination.
 - o Areas in close proximity to the haul route where any sensitive receptors could be affected by air and noise emissions from truck operations.

Within the footprint, a combination of desktop review, stakeholder consultation (refer Chapter 3), technical studies and site surveys were used to:

- Identify the components of the environment that could be impacted by the project.
- Assess the importance of those components – i.e. do any have special values associated with uniqueness or rarity, protection by legislation, or importance to the local or regional community?
- Determine how sensitive or vulnerable environmental values are to being impacted.

For each environmental factor, this information is documented in the relevant EIS chapter under the heading 'Existing environment and Values'.

4.2.2 Impact analysis

Each project component that could be a source of environmental impact during the construction/operations phase was identified using the project details provided in Chapter 2 of the EIS. For the closure phase, the closure domains in the Mine Closure Plan or 'MCP' (Appendix D) were used as sources of impact. The list of proposal components adopted to assess the impacts and risks across each phase is provided in Table 4-3.

Table 4-3. List of proposal components used in impact and risk assessment

Construction and operation components	Closure components
Site clearing and preparation	Waste Rock Dump
Construction of mine site infrastructure	Tailings Storage Facility
Water supply and use	ROM pad and stockpiles
Mining and ore processing	Pit void
Waste rock, rejects and tailings disposal	Inundation bund
Haulage of ore to Darwin Port	Support infrastructure
Storage and handling of hazardous materials	Observation Hill Dam
Non-ore waste management	Mine Site Dam
Transport of equipment and workforce to/from site	
Power generation and use	
Workforce	

For each project component, events/incidents that could cause impacts to environmental values (receptors) were identified. Potential direct and indirect impacts were then identified by considering cause and effect pathways for impacts to each environmental factor.

The severity of each potential impact was assessed using the following criteria:

- Scale (extent)
- Intensity
- Duration and frequency.

Categories used to rate the severity of impacts are shown in Table 4-4. Impact identification and analysis was informed by the project details provided in Chapter 2 and the various technical studies prepared to support the EIS.

Table 4-4. Categories used to assess the severity of potential impacts

More Severe → Less Severe			
Scale			
Widespread Impact occurs across the broader Cox Peninsula region and/or extends to the marine waters of West Arm or Bynoe Harbour.	Regional Impact occurs over a larger area than the Mineral Lease/s and/or extends to the catchment outlets at West Arm or Charlotte River.	Localised Impact is confined within the boundaries of Mineral Lease/s or in the ephemeral watercourses downstream.	Limited Impact occurs only within the direct disturbance footprint or in the short-section of the ephemeral watercourse between the mine site and sub-catchment outlet.
Intensity			
High Impact alters the integrity of environmental values.	Moderate Impact compromises the integrity of environmental values.	Low Impact alters the quality, abundance or distribution of environmental values without compromising their ecological integrity.	Very Low Impact does not noticeably alter the quality, distribution or abundance of environmental values.
Timing, duration and frequency			
Permanent Impact that is permanent; values will never recover.	Long-term Impact that is felt for many years post-closure.	Medium-term Impact that is felt during operations and for some months post-closure.	Short-term Impact that is felt during the mining operations phase only.

4.2.3 Risk assessment

The principles of qualitative risk management described in *AS/NZS 31000:2009 Risk Management – Principles and Guidelines* were used to set-up a framework for assessing the risk that potential impacts from the proposal will result in one or more of the NT EPA environmental objectives for each of the relevant environmental factors being compromised (refer Table 4-1). The environmental risk assessment methodology that has been applied in the EIS is described below. Social impacts and opportunities were assessed separately to environmental impacts because they require slightly different assessment criteria that incorporate community/stakeholder perceptions and also provide for the assessment of opportunities. The approach and methods used to assess social impacts and opportunities are detailed in Appendix L,

For each potential environmental impact identified by the project team, the risk assessment considered the likelihood of the impact occurring and then the worst-possible consequence to the NT EPA environmental objectives. The consequence assessment was informed both by the outcomes of the impact severity analysis described in the previous section, and the importance/sensitivity of environmental values. The likelihood and consequence categories adopted in the environmental risk assessment are provided in Table 4-5 and Table 4-6. The likelihood and consequence ratings were combined to derive an overall risk rating using the matrix in Table 4-7.

Inherent risk

For each potential impact, an *inherent risk rating* was assigned by ranking the likelihood and consequence of the impact in the absence of any specific mitigation or management (i.e. it is a worst-case scenario). The inherent risk rating considered the project location and design, existing environmental conditions, impact sources and pathways, and the presence/absence of important and/or sensitive values and receptors.

Risk evaluation

Each inherent risk rating was evaluated with reference to the risk level and target action matrix in Table 4-8 to determine the level of mitigation and management attention required. Generally, the higher the inherent risk rating, the less tolerable/acceptable the risk is likely to be to stakeholders and regulators, and the greater the requirement for avoidance, mitigation and management.

Residual risk

Once all practicable mitigation and management measures were defined, each impact was re-assessed to assign a *residual risk rating*. The residual rating assigned to each impact reflects the level of risk that the proposal poses to the environment (assuming effective implementation of the mitigation and management measures). Where the residual risk of an impact was ranked as medium, high or very high, the potential for cumulative impacts from other current and future land-uses was considered based on the information summarised in section 4.3.

Level of certainty

For each potential impact, any information gaps/uncertainties that preclude reliable assessment of risks, as well as any uncertainty about the effectiveness of proposed controls were identified. Each risk rating was assigned a level of certainty using the categories in Table 4-9.

Table 4-5. Likelihood categories adopted in risk assessment

Likelihood category	Description
Almost certain	The event/impact will occur or is expected to occur. The impact occurs regularly in association with similar projects and/or in similar environments.
Likely	The impact will probably occur in most circumstance but there is some uncertainty about the likelihood. The impact has occurred on more than one occasion in association with similar projects and/or in similar environments.
Possible	The impact could occur in some circumstances. The impact has occurred infrequently on similar projects and/or in similar environments.
Unlikely	The impact is not expected to occur. The impact occurs very infrequently on similar projects and/or in similar environments.
Rare	The impact is very unlikely to occur. The impact has not occurred on similar projects and/or in similar environments.

Table 4-6. Consequence categories adopted in risk assessment

Consequence or severity of Impacts	Score	Terrestrial Flora and Fauna	Terrestrial Environmental Quality	Inland Water Environmental Quality	Hydrological processes	Social, Economic and Cultural Surrounds	Community Health and Safety
Severe A Severe impact has two or more of the following characteristics: Widespread = Impact occurs across the broader Cox Peninsula region and/or extends to the marine waters of West Arm or Bynoe Harbour. High Intensity = Impact alters the integrity of environmental values. Permanent = Impact is permanent - values will never recover.	5	Widespread impacts to terrestrial flora and fauna that permanently alter biodiversity and/or ecological integrity.	Widespread soil disturbance, erosion or contamination that irreversibly alters the integrity of environmental values that rely on good soil quality.	Permanent major exceedance of water quality criteria for beneficial uses in the marine receiving waters of West Arm or Bynoe Harbour.	Catchment wide reduction in surface water flow volumes and/or timing of flows/discharges that permanently alters the ecological health, land-uses and/or amenity. Drawdown of groundwater in a regional scale aquifer that permanently alters ecological health, land-uses and/or amenity.	Permanent impact that is felt by the majority of the regional population. Unauthorised destruction of Aboriginal Sacred Sites and/or sites of national heritage significance.	One or more fatalities. More than 1 people injured with permanent disabilities.
Major A Major impact has two or more of the following characteristics: Regional = Impact occurs over a larger area than the Mineral Lease/s and/or extends to the catchment outlets to West Arm or Charlotte River. Moderate to High Intensity = Impact compromises the integrity of environmental values. Long-term = Impact that is felt for many years post-closure.	4	Regional scale impacts to terrestrial flora and fauna that compromise biodiversity and/or ecological integrity for many years post-closure.	Regional scale soil disturbance, erosion or contamination that compromises environmental values that rely on good soil quality.	Major exceedance of water quality criteria for beneficial uses at the catchment outlets to West Arm or Charlotte River, that continues for many years post-closure.	Reduction in surface water flow volumes, groundwater levels and/or timing of flows/discharges that compromises ecological health, land-uses and/or amenity for many years post-closure. Drawdown of groundwater in a regional scale aquifer that compromises ecological health, land-uses and/or amenity for many years post-closure.	Long-term impact that is felt by some of the regional population. Impact is felt for many years post-closure. Unauthorised damage/desecration of Aboriginal Sacred Sites and/or sites of regional heritage significance such that site integrity is lost.	No fatalities. One injury with permanent disability. More than 10 injuries requiring hospitalisation.
Moderate A Moderate impact has two or more of the following characteristics: Localised = Impact to environmental values within boundaries of Mineral Lease/s or in the ephemeral watercourses downstream of the sub-catchment outlet. Low Intensity = Impact alters the quality, abundance or distribution of environmental values without compromising ecological integrity. Medium term = Impact that is felt during operations and for some months post-closure.	3	Localised impact to flora and fauna that alters the quality, abundance or distribution but with no measurable impact to biodiversity and/or ecological integrity.	Localised soil disturbance, erosion or contamination that alters soil characteristics but with no measurable impact to environmental values that rely on good soil quality.	Minor sustained exceedances of water quality criteria for beneficial uses in the ephemeral water courses downstream, that occurs throughout operations but ceases within months post-closure.	Localised reduction in surface water flow volumes, and/or timing of flows/discharges with no impact on ecological health, land-uses and/or amenity. Localised drawdown of groundwater throughout operations that recovers rapidly post-closure.	Medium term impact that is felt by a small number of people during mining operations. Impact ceases within months post-closure. Unauthorised entry to a Restricted Works established for protection of Aboriginal Sacred Sites but with no physical impact to the site. Unauthorised damage to protected archaeological heritage sites assigned a Moderate level of significance such that site integrity is lost.	No fatalities. No permanent disability. 5-10 injuries requiring hospitalisation.
Minor A Minor impact has two or more of the following characteristics: Limited = Impact occurs within the immediate disturbance footprint only or in the short-section of ephemeral watercourse between the mine site and sub-catchment outlet Very Low Intensity = Impact does not noticeably alter the quality, distribution or abundance of environmental values. Short-term = Impact that is felt during the mining operations phase only.	2	Limited impact to flora and fauna that does not noticeably alter environmental values.	Short-term and/or limited soil disturbance, erosion or contamination that is reversible without significant remedial works.	Minor temporary exceedances of water quality criteria for beneficial uses at the mine site discharge points and immediate sub-catchment area.	Limited reduction in surface water flow volumes, groundwater levels and/or timing of flows/discharges in the immediate sub-catchment area with no impact on ecological health, land-uses and/or amenity. Limited drawdown of groundwater throughout operations that recovers rapidly once operations cease.	Short-term disruption/ nuisance that is felt by a small number of people. Impact is felt during the mining operations phase only and ceases immediately. Unauthorised damage to protected archaeological heritage sites assigned a Low level of significance.	No fatalities. No permanent disability. Less than 5 injuries requiring hospitalisation.
Insignificant No noticeable/measurable impact to values	1	No measureable impact to terrestrial flora and fauna	No measurable soil disturbance, erosion or contamination	No measurable exceedance of pre-development water quality conditions.	No measurable change to hydrological regimes	No noticeable impact to stakeholder and/or community values. No impact to Aboriginal Sacred Sites and/or heritage sites.	No fatalities. No permanent disability. No injuries requiring hospitalisation.

Table 4-7. Risk matrix adopted in risk assessment

			CONSEQUENCE				
			1	2	3	4	5
			Insignificant	Minor	Moderate	Major	Severe
LIKELIHOOD	5	Almost Certain	Medium	Medium	High	Very High	Very High
	4	Likely	Medium	Medium	High	Very High	Very High
	3	Possible	Low	Medium	Medium	High	Very High
	2	Unlikely	Low	Low	Medium	Medium	High
	1	Rare	Low	Low	Low	Medium	High

Table 4-8. Risk level and target action matrix used to evaluate risks

Risk level	Target action
Very High	Risk is unacceptable. Specific action plans required to reduce risk to an acceptable level. Director/CEO level management attention required.
High	Risk is generally unacceptable without action. Specific action plans required to reduce risk to 'as low as reasonably practicable' (ALARP). Senior management attention required.
Medium	Risk is generally acceptable. Proactive action is required to reduce risk to ALARP. Requires routine monitoring and adaptive management in accordance with Environmental Management Plan (EMP). Line management attention is required.
Low	Risk is acceptable. Management by routine policies and procedures.

Table 4-9. Level of certainty categories used to evaluate reliability of risk assessment

Level of certainty	Description
Low	Risk rating is based on professional opinion. Limitations in baseline data/info mean some assumptions are made, which introduces a level of uncertainty. Effectiveness of proposed controls and/or the likelihood of implementation cannot be reliably assessed at this point in time. A substantial amount of further work is required to adequately assess and treat risk prior to commencement of mining.
Medium	Risk rating is based on similar conditions being observed previously on a similar project and/or in a similar environment. Baseline data/information has some gaps that are considered minor, and the general consensus is that the results of further work are unlikely to significantly alter the risk rating. Proposed controls are proven to be effective; however, some further work is required to provide details of implementation prior to commencement of mining.
High	Risk rating is based on testing, modelling or experiments. Baseline data/info is complete and an appropriate level of analysis has been undertaken. Proposed controls were recommended by technical studies and are well developed. Minimal further work is required to adequately assess treat risk prior to commencement of mining.

4.2.4 Mitigation and management

Measures to avoid, mitigate and manage impacts were identified, focussing on impacts with an inherent risk level of medium or above. Impacts with a Low level of inherent risk were still considered for further mitigation where specifically required in the EIS ToR or where routine controls would further contribute to risk minimisation. Suitable controls were generally identified with reference to mining best-practice guidelines, as well as from the past experience of the mining engineers and other technical experts engaged to work on the proposal. Key contributors are listed in Chapter 1 Section 1.8 with details of relevant qualifications and experience.

Measures were applied with the goal of reducing all risks to 'as low as reasonably practicable' (ALARP). ALARP is considered to be the point at which the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained.

For each of the environmental factors assessed, the relevant EIS chapter includes a summary of the mitigation and management measures that will be implemented and the programs that will be put in place to monitor and report on environmental performance. Details of how the proposed measures will be implemented over each phase of the proposal are provided in the various management plans submitted with the EIS document. The purpose of these plans is to:

- Provide more detailed guidance to Core and its contractors on the implementation of the measures in a manner that will be effective in reducing risk to an acceptable level.
- Provide regulators with a level of confidence that the controls will be effective and are likely to be implemented.

As the project progresses into more detailed planning and design, these plans will be reviewed and updated as required. The final plans will be submitted with the Mining Management Plan (MMP) to be assessed and approved by the Department of Primary Industry and Resources under the *Mining Management Act*.

4.2.5 Residual impacts

For each environmental factor, residual risk ratings assigned through the risk assessment process were used as the basis for identifying residual impacts. These were considered in relation to the sensitivity/importance of the environmental values that are present.

Impacts assigned a Low residual risk rating, with a moderate to high level of certainty, are expected to have limited to no effect on the NT EPA's environmental objectives. Impacts assigned a residual risk rating of Medium or above have some potential for residual impact; either because the mitigation and management measures require further work in order to demonstrate they will be effective, or because it is not practicable to avoid some level of impact.

A statement of residual impacts to each environmental factor is provided in the relevant EIS chapter and, where relevant, any stakeholders that would be expected to accept that impact have been identified.

4.3 Outcomes

The outcomes of the impact and risk assessment processes are documented in the following registers:

Construction and Operations phase

- Environmental Risk Register (Appendix O)
- Social Impacts and Opportunities Registers (Appendix M).

Rehabilitation and Closure phase

- Mine Closure Plan (Appendix D) – the risk register is provided as Appendix B of the plan.

The distribution of risk ratings for each phase of the proposal is shown in Table 4-10 and Table 4-11. The residual risk ratings are shown in **bold** and the inherent risk ratings are shown in *(brackets)* for reference

Table 4-10. Construction and operations phase environmental risk summary

Environmental Factor	Low	Medium	High	Very High	Totals	Impacts with a high residual risk
Terrestrial flora & fauna	13 (10)	2 (4)	2 (3)	- (-)	17	Weed introduction and spread
Terrestrial environmental quality	4 (2)	2 (2)	1 (3)	- (-)	7	Erosion of WRD outer face
Inland water quality	10 (5)	4 (6)	- (3)	- (-)	14	None
Hydrological processes	6 (3)	3 (6)	- (-)	- (-)	9	None
Social, economic & cultural	13 (7)	2 (6)	- (2)	- (-)	15	None

Table 4-11. Closure phase environmental risk summary

Environmental Factor	Low	Medium	High	Very High	Totals	Impacts with a high residual risk
Terrestrial flora & fauna	3 (3)	3 (X)	- (3)	- (-)	6	None
Terrestrial environmental quality	3 (2)	1 (-)	3 (5)	- (-)	7	Landform instability and erosion
Inland water quality	9 (3)	2 (7)	- (1)	- (X)	11	None
Hydrological processes	3 (3)	3 (3)	- (-)	- (-)	6	None
Social, economic & cultural	8 (-)	3 (7)	- (2)	X (2)	11	None

Overall, the risk assessment indicates that the potential impacts associated with the proposal are expected to pose a low to moderate risk to all of the NT EPA's environmental objective. There are high residual risks associated with weeds and erosion during the construction and operations phase, which are addressed in the EMP (Chapter 10). During rehabilitation and closures there is a high risk of landform instability and

erosion, which is addressed in the Mine Closure Plan. These risks are not expected to be unacceptable, but rather the high risk rating indicates, ongoing management attention will be required for these aspects.

The technical studies and design detail available to inform the risk assessment were considered sufficient to allow for most risks to be assessed with a moderate to high level of certainty. Only a few risks were assigned a low level of certainty; these relate to the risks of instability and erosion in the WRD landform, for which the final design work is pending. The further work required so that all risks can be assessed with a high degree of certainty, is identified in the Commitments Register provided in the EMP, Chapter 10.

4.4 Cumulative impact assessment

The EIS ToR (section 3) require an assessment of cumulative impacts associated with the proposal. Cumulative impacts can be defined as effects on environmental and social values which are caused by the combined results of past, current and future activities. To consider the cumulative impacts, the residual impacts of the current proposal were assessed in the context of impacts associated with existing developments, as well as reasonably-foreseeable future developments. The assessment approach and a summary of outcomes is provided in the sections below.

4.4.1 Assessment approach

The assessment of cumulative environmental impacts focuses only on those impacts to which the proposal may be a contributing factor – i.e. where there is likely to be a residual impact of medium or higher, as discussed in Section 4.2.5. In those instances, the potential for cumulative impacts from other current and future land-uses was considered based on the information summarised below. Where potential cumulative impacts were identified, these are noted in the risk registers and the risk rating was re-evaluated. The sections below provide further detail in relation to the past, currently proposed, and reasonably-foreseeable future activities that were considered as part of the cumulative impact assessment.

4.4.2 Past and current land use

The project area is located on undeveloped Vacant Crown Land and is surrounded by this land tenure for 7 to 8 km in all directions. There are no active industrial sites nearby (including no active mines or extractives quarries) and there is very limited industrial development on the Cox Peninsula more broadly. Currently, mining exploration is the main land-use in the area; with rural living, recreation and tourism occurring across the peninsula more broadly.

There are a number of historic mines visible on aerial photography of the surrounding area; the closest are located 1.5 km to the west and south-west of the project area. These sites have relatively small-scale visible ground disturbance and historic pit lakes. The most recent mining activities in the area were in the 1980's to early 1990's when tin and tantalum were mined at Observation Hill.

The level of impact associated with past and current land-uses is summarised below:

- Review of satellite imagery indicates that land clearing and soil disturbance/erosion has occurred on a very small scale and impacts appear to be localised. West Arm is considered to be relatively undisturbed with stream inflows limited to Wet season run-off from a largely intact, undisturbed catchment (DENR 2018)
- Weed infestation appears to be more localised compared to other areas in the region where there is a higher level of rural sub-division and industrial land-use.
- Baseline surface water and groundwater quality monitoring undertaken in both the West Arm catchment and Charlotte River catchment, and in historic pit lakes, indicates that the water quality

has not been impacted by past or current land use. The Darwin Harbour Report Card 2017 states that 'water quality in West Arm is excellent' (DENR 2018).

- The project area does receive frequent bushfires, which has degraded habitat values. The cause of this impact is likely to be a combination of current land-use (i.e. informal recreation and camping activities, mining exploration) and lack of active fire management across the large areas of Vacant Crown Land.
- There is a relatively low level of road traffic associated with the existing land-uses and minimal heavy vehicle traffic (i.e. road trains).

Based on these observations, the main residual environmental impacts associated with past or current land-uses are associated with weed invasion and bushfire. The potential for the proposal to contribute to cumulative impacts associated with these aspects was considered in the risk assessment. The outcomes indicate there is potential for cumulative impacts associated with weed invasion, as weed infestations introduced by current and past land-use activities may be spread around by the project activities. The proposal is not expected to alter fire regimes.

4.4.3 Reasonably foreseeable future activities

There is no indication of future industrial type development on the Cox Peninsula or along the southern coast of Darwin Harbour in the short to medium term. There is some rural sub-division occurring; however, the land tenure (large areas of Crown land and Aboriginal land), distance to service centres and limitations of water supply, are likely to mean this will remain small-scale. There could be some increases in road traffic associated with construction of the Project Sea Dragon hatchery at Point Ceylon, rural sub-division and tourism in the Bynoe Harbour area; however, there is no indication that these activities would significantly increase heavy vehicle traffic, beyond the short-term impacts associated with construction.

Review of the NT Government STRIKE (<http://strike.nt.gov.au>) database shows a number of Exploration Licences (EL's) in the region around the project area that are held by Core. The company is actively exploring across these EL's, in particular focussing on the BP33 deposit located around 6 km to the south-east of Grants. If further lithium resources are defined, then Core may propose further mining operations in coming years. Future activities could contribute to cumulative impacts to flora and fauna associated with increasing the amount of land clearing and disturbance, and habitat degradation as a result of weed infestations and increased frequency of bushfires. There is limited potential for cumulative impacts associated with water extraction and use, or socio-economic impacts, as any future activities would occur after the Grant's pit has been mined and therefore can make use of the same water sources, haul route and workforce without increasing the intensity of impacts. Cumulative impacts to water quality are also not expected as the waste characterisation work undertaken for Grant's indicates the geology is geochemically-benign and therefore acid mine drainage is not expected to be an issue.

There are two small ML's along Fogg Bay Road to the south of the project area. These are held by Outback Metals and Victory Polymetallic. Internet searches did not identify any publically-available information to suggest foreseeable development on these leases. Three large EL applications cover a large portion of the Cox Peninsula; however, the fact that these have not been issued indicates that future development is unlikely in the short to medium term.

4.4.4 Summary

Potential cumulative impacts to environmental and social values in the Cox Peninsula region and catchments of West Arm and Charlotte River were considered in the context of the existing and reasonably-foreseeable future developments described in the sections above. The assessment indicates that there is limited potential for cumulative impacts associated with the proposal for the following reasons:

- There are low levels of existing industrial development in the region and therefore a low level of existing environmental impact.
- The life of mine for Grants Lithium Project is two to three years, meaning the higher intensity impacts associated with mining operations (i.e. road use, noise, dust and social/community impacts) are unlikely to overlap with future developments that are not yet proposed.
- The risk assessments for construction/operations and rehabilitation/closure indicates a mostly low to medium level of residual risk, which limits the potential for legacy issues that would contribute to cumulative impacts.

There is some potential for cumulative impacts to flora and fauna values associated with proliferation of weed infestations and an increase in bushfires associated with future lithium mining proposals on Core's EL's. These were noted in the environmental risk registers and the residual risk ratings were re-evaluated as part of the risk assessment process. Taking cumulative impacts into consideration did not alter any of the residual risk ratings.

4.5 References

References cited in this chapter are listed below:

Department of Environment and Natural Resources (DENR) (2018) *Darwin Harbour Report Card 2017*. [online] Available at: <https://denr.nt.gov.au/land-resource-management/water/water-management/darwin-harbour/darwin-harbour-region-report-cards/darwin-harbour-report-card-2017/zone-4-west-arm> [Accessed 1 Oct 2018].



GRANTS LITHIUM PROJECT

Draft Environmental Impact Statement

Chapter 5

Terrestrial Flora and Fauna

5 TERRESTRIAL FLORA AND FAUNA

Terrestrial flora and fauna refers to vegetation communities, plants and animals that occur on land. The NT EPA's objective for this environmental factor is to:

"Protect the NT's flora and fauna so that biological diversity and ecological integrity area maintained."

This objective recognises the value of maintaining ecosystem services to ensure that the diversity, distribution and productivity of flora and fauna from species to ecosystem levels are maintained. It recognises the importance and value of sensitive and significant vegetation communities and is supported by the protection of listed threatened species, migratory species and ecological communities under the *Territory Parks and Wildlife Conservation Act (TPWC Act)*.

This chapter describes the potential impacts to terrestrial vegetation, flora and fauna that occur within the Grants Lithium Project area and any areas downstream that could be affected by alteration of water quality and/or flow regimes. The mitigation and management measures that Core will implement to avoid and/or reduce impacts are summarised. At the end of the chapter, a statement of residual impact is made detailing the extent to which the proposed mitigation and management measures will ensure that the NT EPA's objective for this environmental factor is met.

This chapter addresses Section 4.1.1 of the EIS ToR, and has been informed by desktop review, baseline vegetation community mapping (Appendix P) and targeted assessments for the threatened flora species *Typhonium praetermissum* (Appendix Q) and *Stylidium ensatum* (Appendix R) prepared by qualified ecologists from EcOz Environmental Consultants.

5.1 Existing environment and values

The existing terrestrial flora and fauna values within and surrounding the project area are described below, with a particular focus on habitats and species that are important to maintaining biodiversity and ecological integrity, and/or are sensitive to impact.

5.1.1 Vegetation communities

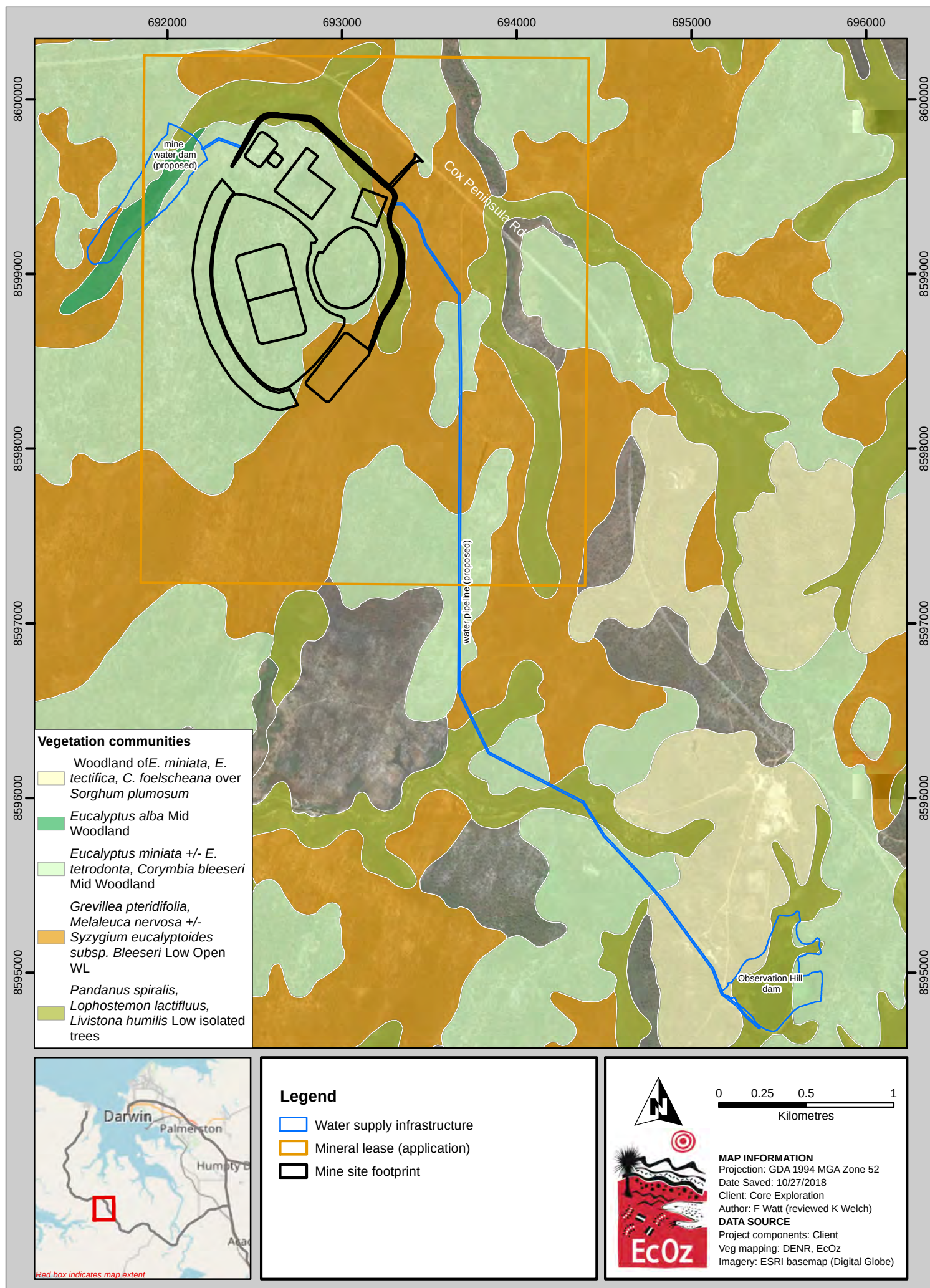
Vegetation that occurs on the Mineral Lease (ML) has been surveyed and mapped by EcOz Environmental Consultants. A complete survey report is provided at Appendix P. Vegetation community descriptions of areas outside the ML, i.e. the water pipeline and the Observation Hill dam inundation footprint, have been derived from 1: 25,000 scale land unit mapping.

Brief descriptions and areas of each of the vegetation communities that occur within the proposed disturbance footprint are documented in Table 5-1. Mapped vegetation communities are shown in Figure 5-1.

The disturbance footprint is dominated by *Eucalyptus miniata*, *E. tetradonta* and *Corymbia bleeseri* woodland over open tussock grassland. This vegetation type covers 75 % of the footprint. Drainage lines with *Pandanus spiralis*, *Lophostemon lactifluus* and *Livistona humilis* isolated trees over tussock understorey, and a small area of *Eucalyptus alba* woodland comprise 15 % of footprint. The remainder is small patches of shrubland to open woodland areas of *Grevillea pteridifolia* and *Melaleuca nervosa* over open tussock grassland.

Table 5-1. Vegetation communities within the disturbance footprint

Vegetation description	Land unit	Area (ha)			Total (ha)
		Mine site	Off-site dams	Water pipeline	
Rises					
Woodland of <i>Eucalyptus miniata</i> , <i>E. tectifica</i> , <i>Corymbia foelscheana</i> over <i>Sorghum plumosum</i>	1b	-	2	1	2
Open woodland of <i>Eucalyptus miniata</i> , <i>E. tetradonta</i> and <i>Corymbia bleeseri</i> over <i>Livistona humilis</i> , <i>Xanthostemon paradoxus</i> and <i>Erythrophleum chlorostachys</i> over open tussock grassland <i>Heteropogon triticeus</i> , <i>Sorghum intrans</i> and <i>Eriachne obtusa</i>	2a1	121	9	2	133
Drainage systems					
Low open woodland of <i>Grevillia pteridifolia</i> , <i>Melaleuca nervosa</i> +/- <i>Syzygium eucalyptoides</i> subsp. <i>Bleeseri</i> over open shrubland of <i>Petalostigma pubescens</i> , <i>Livistona humilis</i> , <i>Banksia dentata</i> over open tussock grassland of <i>Themeda triandra</i> , <i>Eriachne obtusa</i> and <i>Heteropogon triticeus</i>	6b	14	2	2	18
Alluvial plains					
Low isolated trees of <i>Pandanus spiralis</i> , <i>Lophostemon lactifluus</i> , <i>Livistona humilis</i> over sparse shrubland of <i>Pandanus spiralis</i> , <i>Lophostemon lactifluus</i> , <i>Livistona humilis</i> over tussock grassland of <i>Sorghum stipodeum</i> , <i>Eriocaulon spectabile</i> , <i>Melaleuca nervosa</i>	5a	12	6	<1	19
Woodland of <i>Eucalyptus alba</i> over a sparse shrubland of <i>Eucalyptus alba</i> , <i>Lophostemon lactifluus</i> , <i>Pandanus spiralis</i> over tussock grassland of <i>Sorghum plumosum</i> , <i>Germania grandifolia</i> , <i>Lophostemon lactifluus</i>		-	9	-	9
		147ha	28ha	6ha	181ha



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 5 maps\Figure 5-1 Vegetation communities.mxd

Figure 5-1. Vegetation communities within the project area

5.1.2 Significant and sensitive vegetation

In the NT, sensitive vegetation types are those considered 'significant' under the *NT Land Clearing Guidelines* (DNRETAS 2010). These are rainforest, vine thicket, closed forest or riparian vegetation, mangroves, monsoon vines forest, sandsheet heath and vegetation containing large trees with hollows suitable for fauna. Riparian vegetation (associated with ephemeral streams) and some seasonal wetlands (drainage depressions) occur within the ML and surrounding areas, and mangroves associated with the upper reaches of West Arm occur approximately 1.7km downstream of the mine site. The location of these vegetation types is shown in Figure 5-6. No other sensitive vegetation types are present.

Riparian vegetation is 'a distinct forest community occurring on the banks of rivers or streams that directly influences the adjacent water body' (DENR, 2018). When in good condition, riparian vegetation is considered a sensitive vegetation type as it supports a unique selection of habitat features that are relied upon by flora and fauna. Field surveys recorded a small patch of riparian vegetation in the north-east of the ML, to the north of Cox Peninsula Rd. The patch occurs on an ephemeral stream and is dominated by *Leptospermum madidum*, *Melaleuca viridiflora* and *Lophostemon lactifluus* (Figure 5-2).

The unnamed ephemeral streams in the upper West Arm catchment support a narrow band of generally sparse riparian vegetation dominated by overhanging *Melaleuca* spp. (refer Figure 5-3). These watercourses do not have any significant habitat value for terrestrial fauna species as flows only occur during the wet season when water is widely available throughout the habitats in the area. Aquatic surveys undertaken by GHD (2017) found the aquatic habitats are typical of low order watercourses in the NT. These types of habitats are common around the western side of Darwin Harbour and do not have any significant value in terms of supporting species that are range restricted or threatened.

A more dense and continuous riparian rainforest is evident along the watercourses downstream of OHD that flow into Charlotte River, starting from a point around 2 km downstream of the dam wall (Figure 5-4). The communities are supported by stream flows later into the dry season, possibly as a result of groundwater discharge. Whilst stream flows cease later in the dry season, small pools of water have been observed in the area during late dry season surveys. The presence of water into the dry season and rainforest tree species that provide food resources, indicates the watercourses are likely to have some value as a refuge habitat in the late parts of the dry season when access to water is limited in the surrounding areas. The habitat itself is not rare in the region or the specific habitat of a threatened species.

No permanent wetlands are located within the project area. Some seasonally inundated areas are patchily distributed through the ML. These areas support sedges and herbs in the ground layer during the wet and early dry season, and dry out later in the dry season (refer Figure 5-5).

No riparian, wetland or mangrove communities are located in the disturbance footprint. The impact assessment documented in section 5.2 below considers potential impacts to riparian vegetation and mangroves downstream of the project area associated with alteration of flow regimes or changes in water quality.



Figure 5-2. Riparian vegetation patch within the Mineral Lease



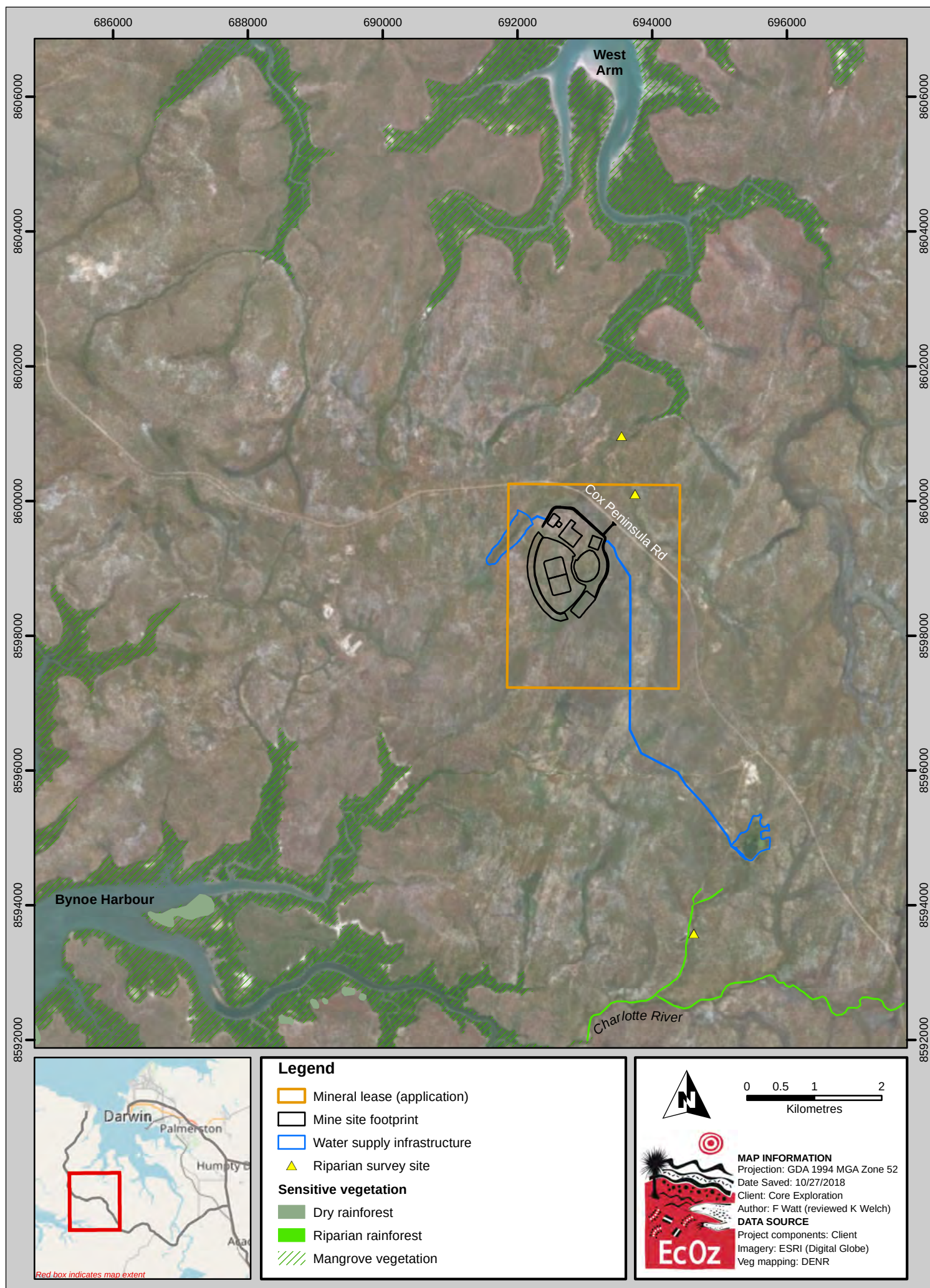
Figure 5-3. Riparian vegetation along unnamed ephemeral streams downstream of the Mineral Lease



Figure 5-4. Riparian vegetation at site downstream of the Observation Hill dam



Figure 5-5. Example of a seasonal wetland on the Mineral Lease



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 5 maps\Figure 5-6. Sensitive vegetation surrounding the project area.mxd

Figure 5-6. Sensitive vegetation communities near the project area

5.1.3 Threatened species

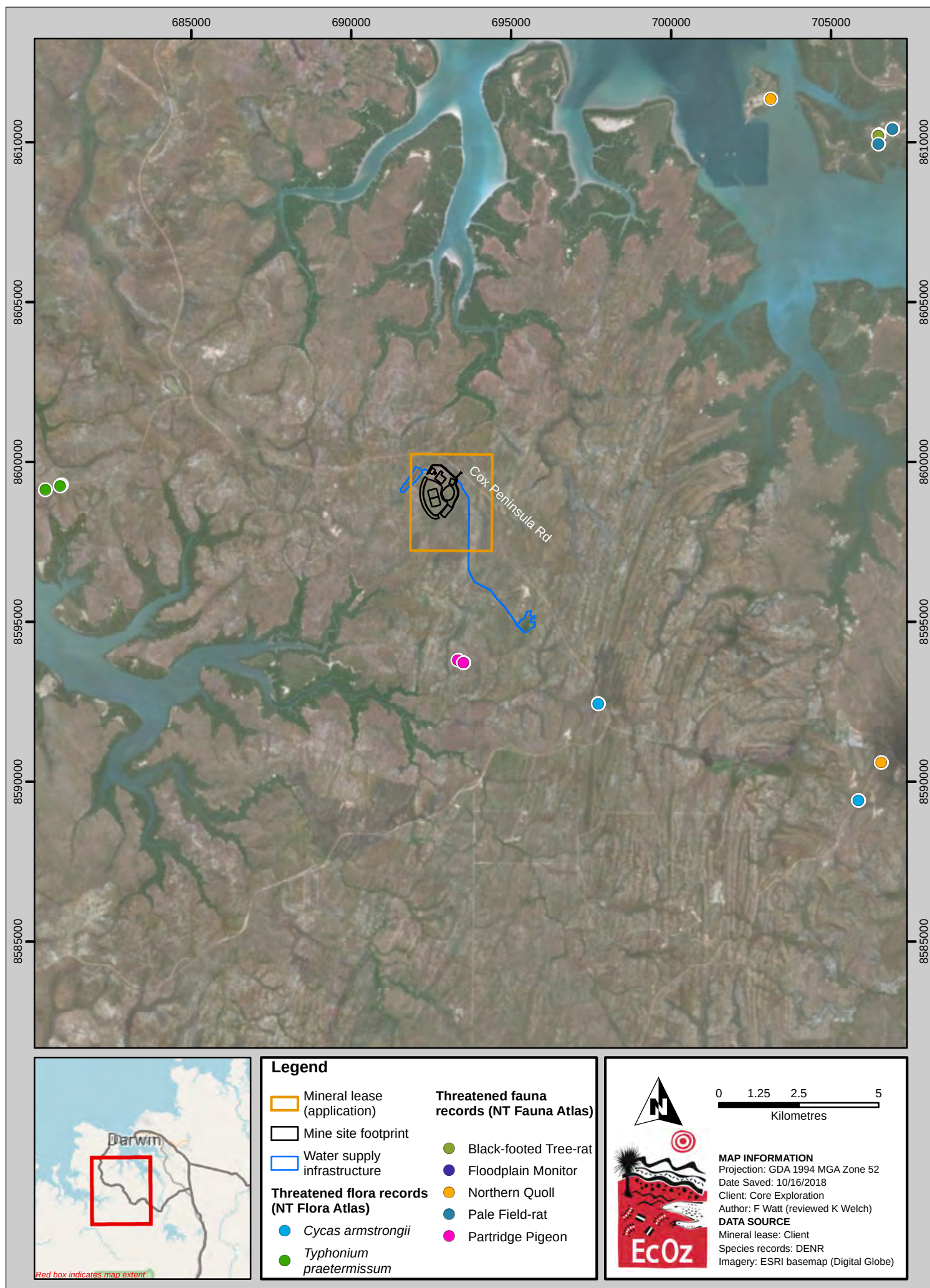
Initial examination of available threatened species search tools identified eighty-one Commonwealth and/or NT-listed threatened species that occur in the broader region surrounding the project area. A desktop assessment of species habitat requirements, known distribution and proximate records, was undertaken by qualified ecologists. The NT Fauna and Flora Atlas records of threatened species surrounding the project area are presented in Figure 5-7.

The short-list was assessed further based on species habitat requirements and the vegetation community mapping for the project footprint, to determine which species are likely to occur and therefore should be further considered in the impact assessment process. The results are summarised in Table 5-2 and the procedure used and full results are detailed in the report provided in Appendix P. Two threatened fauna species and two flora species were identified for further assessment.

Table 5-2. Threatened species with a high or medium likelihood of occurrence in the project area

Likelihood	Common name	Group	Status		Comments on habitat suitability and level of assessment required
			Cth	NT	
High	Partridge Pigeon (eastern subspecies) <i>Geophaps smithii smithii</i>	Birds	VU	VU	- Habitat suitable albeit sub-optimal due to lack of suitable food trees - Field-based assessment required
	Black-footed Tree-rat (Kimberley and mainland NT subspecies) <i>Mesembriomys gouldii gouldii</i>	Mammals	EN	VU	- Habitat suitable though sub-optimal due to high fire frequency – may be used for foraging - Field-based assessment required
Medium	Trigger Plant <i>Stylidium ensatum</i>	Plants	EN	EN	- NT Herbarium mapped suitable - Limited to 3 drainage lines that may contain suitable soils that remain wet well into dry season. - Field-based assessment required
	A herb <i>Typhonium praetermissum</i>	Plants	-	VU	- Recorded from a land unit type within ML - NT Herbarium habitat model identifies potential habitat in project area. - Field-based assessment required
	Red Goshawk <i>Erythrotriorchis radiatus</i>	Birds	VU	VU	- No unique or high value habitat compared to surrounding areas - No further assessment required
	Masked Owl (northern subspecies) <i>Tyto novaehollandiae kimberli</i>	Birds	VU	VU	
	Brush-tailed Rabbit Rat <i>Conilurus penicillatus</i>	Mammals	VU	EN	- Core habitat lacking or limited - No further assessment required
	Northern Quoll <i>Dasyurus hallucatus</i>	Mammals	EN	CR	
	Pale Field-rat <i>Rattus tunneyi</i>	Mammals	-	VU	
	Bare-rumped Sheath-tail Bat <i>Saccolaimus saccolaimus (nudiclunatus)</i>	Mammals	VU	NT	- Few tall trees suitable for roosting; may forage at night over project area - No further assessment required
	Floodplain Monitor <i>Varanus panoptes</i>	Reptiles	-	VU	- Medium likelihood due to presence of Cane toads - No further assessment required

Key: VU – Vulnerable, EN – Endangered, CR – Critically endangered, a dash indicates the species is not listed under that jurisdiction. Cth – Commonwealth, NT – Northern Territory.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ18086 - Grants Project - EIS\01 Project Files\Chapter 5 maps\Figure 5-7. Threatened species surrounding the Grants Project.mxd

Figure 5-7. Threatened species records from the NT Flora and Fauna Atlas

Stylidium ensatum

The project area contains areas mapped by the NT Herbarium as potentially suitable habitat for *Stylidium ensatum* (see Figure 5-8). This species inhabits margins of drainage areas in damp heavy clay or peaty soil, (Cowie & Westaway, 2012), that remain wet well into the dry season. Plants grow in the early dry season, and are best able to be detected between June-July when flowering and fruiting occurs. Targeted surveys for the species were undertaken in June 2018. The complete survey report is provided at Appendix R.

Existing land unit and vegetation mapping, and satellite imagery were examined to identify areas of potentially suitable habitat to be targeted for on-ground investigation. Dry season satellite imagery was analysed to identify areas of higher moisture content within the broader project region. The locations identified through this process provided targeted search areas for on-ground investigation, and were considered in conjunction with potentially suitable vegetation communities and mapped land units. This desktop analysis was intentionally broad to incorporate areas downstream of the water supply dams and mine site that could be impacted by any alteration of hydrological processes.

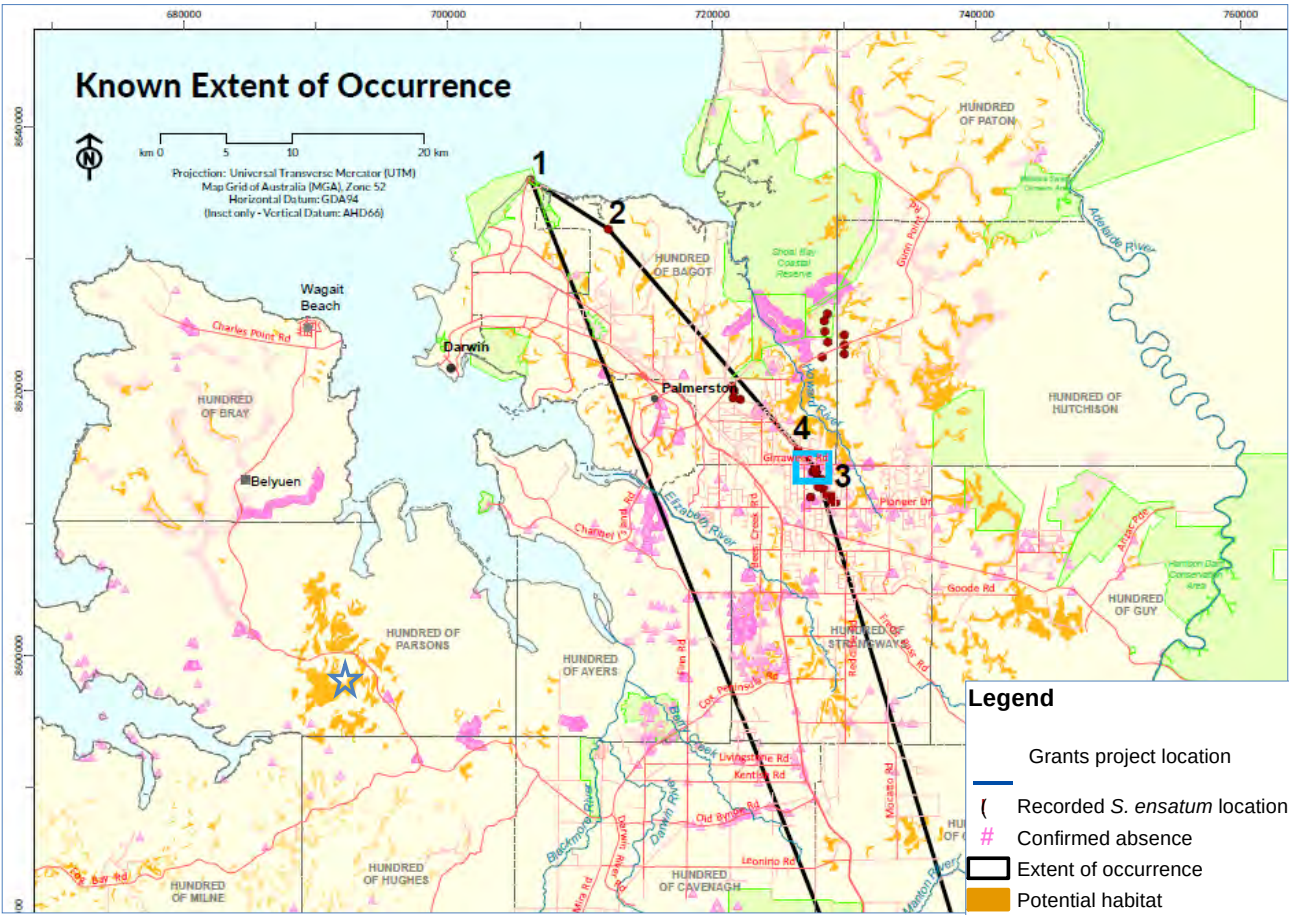
Three higher likelihood areas for *S. ensatum* occurrence were identified and surveyed. Surveys were undertaken by staff trained in surveying for and the identification of threatened plants in the NT. A known population of the species in the Darwin region was visited immediately prior to the surveys to check detectability, which was found to be good. Searches were undertaken within the higher likelihood areas, with potentially suitable locations targeted for more intensive on-ground investigation. Relevant features used to determine potentially suitable locations on-ground were:

- Shallow inundation or saturated soils in the mid dry season
- Over-storey consisting of *Lophostemon lactifluus*, *Pandanus spiralis* and/or *Melaleuca* spp.
- Ground layer incorporating grasses and herbs that occur in poorly drained habitats
- Relatively open over-storey.

Figure 5-9 depicts the areas surveyed and survey effort (GPS tracks).

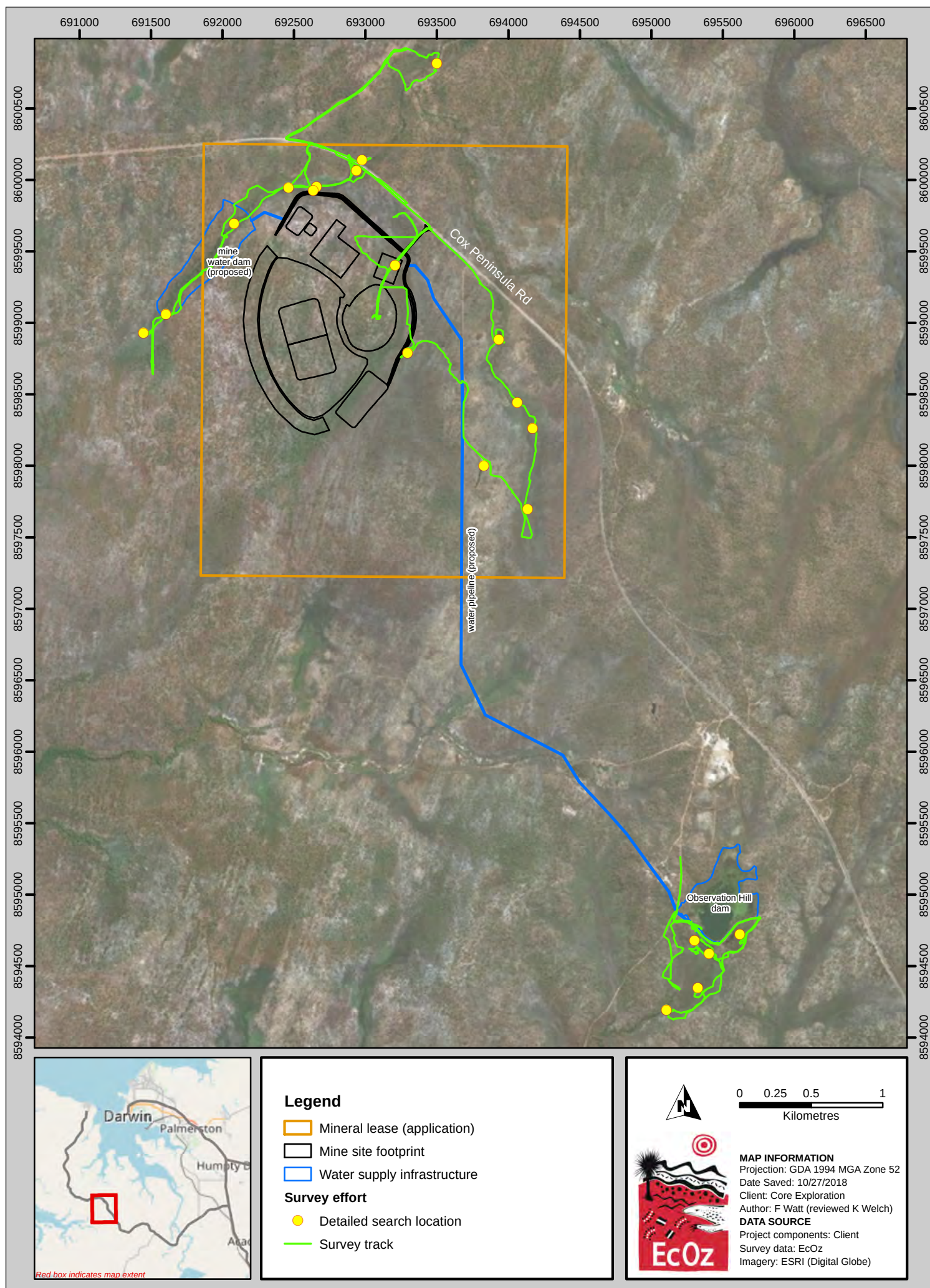
No *Stylidium ensatum* plants were found in the survey areas; three non-threatened species of *Stylidium* were found. Suitability of sites for *Stylidium ensatum* was determined as low or none. Rocky areas with skeletal soils (i.e. well-drained) occupy much of the project area; alluvial drainage flats in the area are seasonally saturated but were mostly dry at the surface in June and therefore do not provide suitable habitat for the species. The pools encountered along creek lines and at several locations within the drainage flats comprised deep water pools (> 30 cm and generally more) and were unsuitable habitat. Riparian corridors were either dry in the case of *Melaleuca* and *Eucalyptus alba* woodlands and open forests, or comprised creek line pools that were too deep for the species. Some patchily distributed wet season seepages were present adjacent to drainages; these were searched, but no *S. ensatum* were found.

Despite searching in potentially suitable sites at an appropriate time of year, *S. ensatum* was not found in the survey area. Previous floristic surveys undertaken in areas around the project area at an appropriate time of year also have not recorded the species (see Figure 5-8 for locations of previous surveys with no records). Extremely high fire frequencies in the area are possibly a factor detrimental to the survival of this species and decrease the likelihood of its occurrence.



Source: Threatened species of the Greater Darwin Region – *Stylidium ensatum* (DLRM, 2016)

Figure 5-8. Known extent of occurrence of *Stylidium ensatum*



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 5 maps\Figure 5-9. Stylidium ensatum survey areas.mxd

Figure 5-9. Stylidium ensatum survey areas

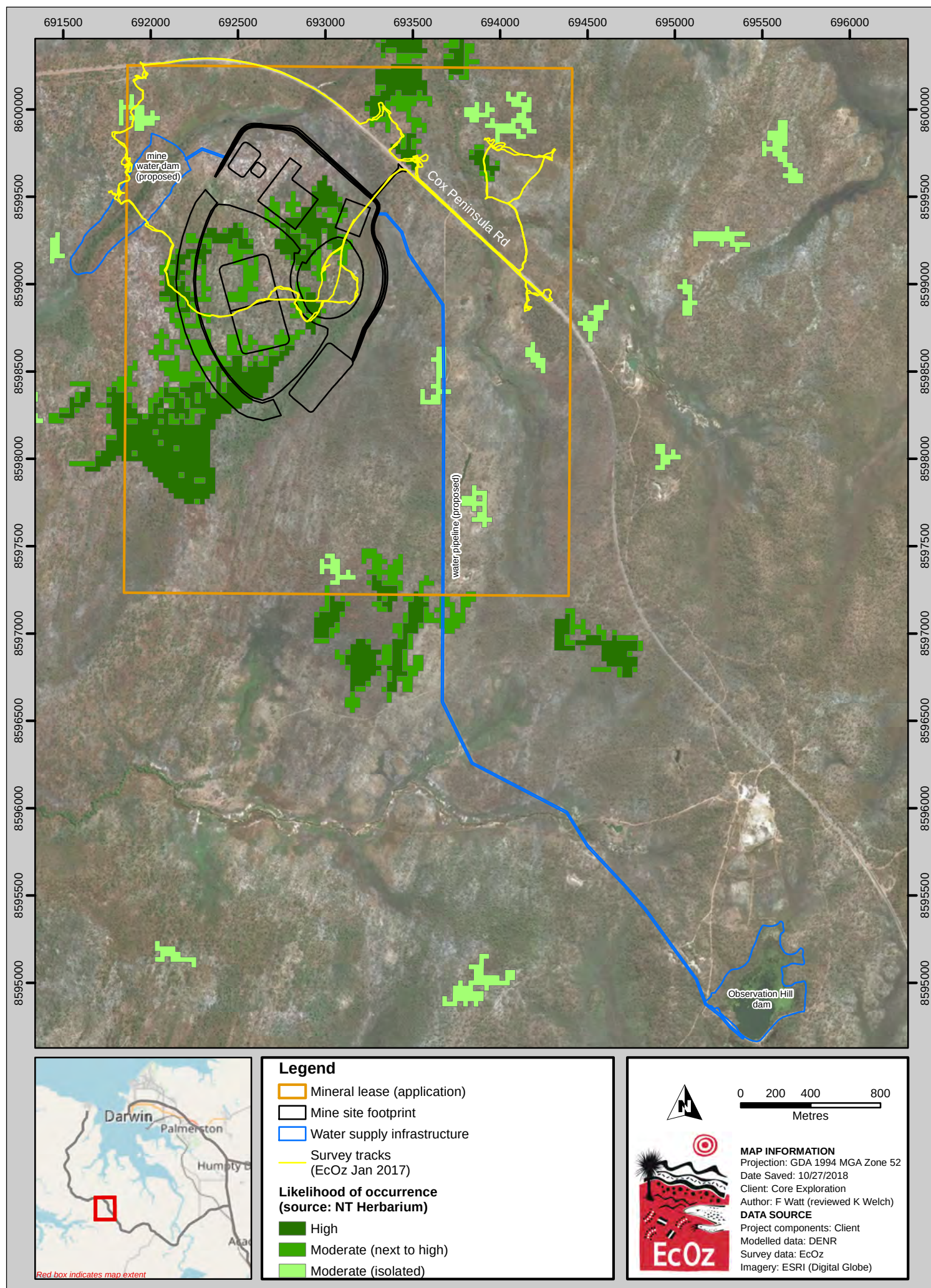
Typhonium praetermissum

Endemic to the NT, *Typhonium praetermissum* is a perennial herb recorded from a small number of locations within the greater Darwin region. It has been found growing in open woodland habitats with red-brown clay soil, and in shallow soil, often with a gravelly lateritic cap (Westaway & Cowie, 2012). The plant is seasonally dormant, detectable only in the wet season when leaves emerge from the underground corm. It has not been recorded in proximity to the project area; however, it has been recorded from land unit 2a1, which occurs in the ML. The species is most likely to occur along the margin of this land unit, where the eroding low rise creates a gravelly surface adjacent to a low lying wetter area.

The NT Herbarium has modelled suitable habitat for *T. praetermissum* within the greater Darwin region based on land unit mapping (DENR, in press) (Figure 5-10). Prior to release of the current habitat mapping, EcOz Environmental Consultants undertook surveys for *T. praetermissum* in potentially suitable habitats within the project area that were identified based on land unit mapping and inspection by a botanist with experience in surveying for the species. The surveys were conducted in January 2018 when plants were known to be visible in other known populations in the Darwin region. No *T. praetermissum* were detected in the surveys. Survey tracks are shown on Figure 5-10 and the complete survey report is provided at Appendix Q.

The outcomes of desktop study and field surveys indicate that it is unlikely that a population of *T. praetermissum* occurs within the disturbance footprint. However, it is noted that there are some gaps in the field survey coverage when compared to the most current habitat modelling released in 2018¹. Therefore, in-lieu of having complete survey data, in order to assess the potential for the proposal to have a significant impact on *T. praetermissum*, the EIS ToR require 'a comprehensive assessment of the regional status' of the species. This assessment is provided in section 5.2.4.

¹ Previously available habitat modelling did not map any areas of suitable habitat within the project area.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ18086 - Grants Project - EIS\01 Project Files\Chapter 5 maps\Figure 5-10. Modelled habitat for T praetermissum.mxd

Figure 5-10. Modelled habitat for *Typhonium praetermissum*

5.1.4 Introduced and invasive species

There are two introduced plant species previously recorded within 10 km of the project area (NR Maps NT 2018) – only one of these (Lantana) is a listed weed species. Introduced plant species that have been previously recorded in the region are listed in Table 5-3.

Field surveys determined that weeds density is low across the ML. Although the area has historically been used for exploration and resource extraction, weeds have generally not established. There was one small patch of Annual Mission Grass along the existing access track from Cox Peninsula Road to the mine site. Annual Mission Grass was also observed along Cox Peninsula Road near the project area. Mission Grass and Gamba Grass are generally the most problematic weeds in the region and are the species of most concern for the proposal area.

Table 5-3. Introduced flora species within the region

Species	Observed during survey	Weed Management Act Classification ²	Weed of National Significance
Records from NR Maps NT			
Lantana <i>Lantana camara</i>	-	B/C	Y
Cynodon <i>Cynodon radiatus</i>	-	-	-
<i>Ruellia tuberosa</i> - - -	-	-	-
Other introduced species with potential to occur in or near the project area			
Mission grass - perennial <i>Cenchrus polystachios</i>	-	B/C	-
Mission grass - annual <i>Cenchrus pedicellatus</i>	Y	-	-
Gamba grass <i>Andropogon gayanus</i>	-	B/C	Y
<i>Euphorbia heterophylla</i>	-		-
Coffee bush <i>Leucaena leucocephala</i>	-		-
Sicklepod senna <i>Senna obtusifolia</i>	-	B/C	-
Flannel weed <i>Sida cordifolia</i>	-	B/C	-
Paddy's lucerne <i>Sida rhombifolia</i>	-	B/C	-
Red natal grass <i>Melinis repens</i>	Y	-	-

There are no records of introduced fauna within 10 km of the project area. However, the following introduced fauna are known to occur in the region:

- Domestic Pigeon (*Columba livia*)
- Asian House Gecko (*Hemidactylus frenatus*)
- Pig (*Sus scrofa*)
- Dingo (*Canis lupus*)
- Cat (*Felis catus*)
- Black Rat (*Rattus rattus*)
- Cane Toad (*Rhinella marina*).

² Schedule of weed classes: **A – to be eradicated**
B – Growth and spread to be controlled
C – Not to be introduced to the Northern Territory
All Class A and Class B weeds are also Class C weeds.

Cane Toads and feral cats were observed on site during the field surveys. The drainage lines provide suitable habitat for pigs and there was possible pig disturbance observed across the seasonally inundated areas.

5.2 Assessment of impacts

The impact and risk assessment process (Chapter 4) identified the following potential impacts to flora and fauna:

Construction/operations phase

- Direct loss of fauna/flora habitat associated with land clearing and dam construction.
- Reduction in habitat quality in surrounding areas due to noise and dust emissions.
- Loss of *Stylidium ensatum* habitat.
- Loss of *Typhonium praetermissum* habitat.
- Indirect impacts to sensitive vegetation types due to altered surface water flow regimes.
- Introduction and spread of weeds.
- Increased predation/competition associated with the introduction of invertebrate pest species or attraction of pest and vermin to waste disposal areas
- Wildlife interactions with haul trucks and/or tailings.
- Downstream flooding of terrestrial habitats following dam wall failure.

Rehabilitation/closure phase

- Fauna habitat values not restored due to poor rehabilitation outcomes
- Fauna interaction with tailings in open TSF cells as a result of unforeseen early closure
- Proliferation of weeds in rehabilitation areas.
- Downstream flooding of terrestrial habitats following dam wall failure.

The sections below discuss the likelihood of impacts occurring and the consequences in terms of impacts to biodiversity and ecological integrity.

5.2.1 Direct loss fauna/flora habitat

The total area of vegetation/habitat that will be lost is approximately 181 ha. A breakdown of the area of each is provided in Table 5-1. None of the vegetation types are considered rare or threatened. The majority of the disturbance will occur in land unit 2a1, which supports *Eucalyptus* woodland and open woodland vegetation communities. These communities are the most widespread land cover type in the Greater Darwin region (Hempel 2003). For each of the land units that occur within the disturbance footprint, the loss associated with the proposal equates to <1% of the extent mapped within the Greater Darwin region.

Loss of these *Eucalyptus* woodland habitats is expected to have a limited impact to fauna because the area is relatively small and the affected habitat types are well represented in the surrounding areas, with no other industrial development in close proximity that would deter use of these habitats. Habitat values within the disturbed area may return to some extent in the years' post-closure as the disturbed areas will be rehabilitated. However, as rehabilitation success on mine sites is highly variable it is expected that some reduction of habitat value will be a permanent feature of the disturbance footprint.

The land clearing associated with the proposal is not expected to have a significant impact on flora and fauna. Core will implement the Vegetation Clearing Procedure (Appendix S) to ensure that potential impacts are minimised by clearing within approved areas only and using methods that will prevent off-site impacts. The procedure also addresses topsoil removal and storage methods that will maximise preservation for use in rehabilitation of the site. The Mine Closure Plan (Appendix D) provides a strategy and work plan with the objective that rehabilitation areas are comprised of a "self-sustaining native vegetation groundcover, comparable to that of the surrounding ecosystems." Successful rehabilitation would further reduce impacts to flora and fauna; however, if rehabilitation were to fail, due the small area of affected habitat, the proposal is still unlikely to have any significant impact.

5.2.2 Reduced habitat quality due to noise and dust emissions

A reduction in fauna habitat quality in the immediate vicinity of the mine site will occur due to noise emissions from machinery and equipment, which will operate 24 hours during operations, and blasting which will occur 3 times per week. Dust deposition on plants will also occur within a short distance around the disturbance footprint. These impacts are not expected to alter species composition or abundance because the project area does not provide core habitat for any threatened fauna species, and no sensitive habitats are present (such as wetlands or roost sites). Any temporary displacement of fauna would be into surrounding habitats of similar quality. The quality of habitat in the area of the ML outside of the mine site disturbance footprint is expected to return within months' post-closure.

Noise and dust emissions are not expected to have a significant impact on flora and fauna. Core will implement dust and noise controls to minimise potential impacts. Monitoring will be undertaken to ensure that impacts are confined to within the ML.

5.2.3 Loss of *Stylidium ensatum* habitat

Preliminary assessment of the proposal by the NT EPA concluded that impacts to this species could result from direct removal of habitat and loss of individuals/populations, and indirect impacts from altered surface water flows and introduction/spread of weeds. That assessment was based on NT Herbarium modelling of the occurrence of suitable habitats in the region. Subsequent surveys, targeting potentially suitable habitats within and downstream of the project area, did not locate the species, as outlined in Section 5.1.3. The level of confidence associated with the surveys is considered high as the timing and target habitats were identified based on current knowledge of the species ecology, and a known population of the species was visited by the field ecologists on the day of the survey to confirm that the species would likely be detectable if it was present. Based on the survey findings, the proposal is very unlikely to impact *Stylidium ensatum* and no specific mitigation measures are required to protect the species.

5.2.4 Loss *Typhonium praetermissum* habitat

The outcomes of desktop review and field surveys indicate that it is unlikely that an important population of *Typhonium praetermissum* occurs within the project disturbance footprint. However, as acknowledged in section 5.1.3, there are some gaps in the field survey coverage when compared to the most current habitat modelling released in 2018. Therefore, to assess the potential for the proposal to have a significant impact on the species, the precautionary principle has been applied and it assumed that the species could be present in the areas within the disturbance footprint that are mapped as suitable habitat.

The *Matters of National Environmental Significance: Significant impact guidelines 1.1* were used to assess potential impacts to *Typhonium praetermissum*. The guidelines provide a list of impacts that would be considered to have a significant impact on a vulnerable species. For each of these impacts, Table 5-4 assesses if there is a real chance or possibility that it would occur as a result of the proposed activities.

Table 5-4. Assessment of potential for significant impact to *Typhonium praetermissum*

Significant impact criteria	Possibility that impact would occur
Lead to a long-term decrease in the size of an important population	The project footprint and affected areas of habitat are small compared to the mapped regional occurrence of potentially suitable habitats. Surveys undertaken in the project footprint at an appropriate time of year by ecologists with previous experience in surveying for this species, did not locate any plants. Therefore, it is reasonable to assume that if <i>T. praetermissum</i> plants were to occur within the unsurveyed parts of the project footprint, the numbers of plants affected would be a small part of the local sub-population and not critical for breeding/dispersal or maintaining genetic diversity. It is unlikely that clearing of the project footprint would lead to a long-term decrease in the size of a population.
Reduce the area of occupancy (AoO) of an important population.	In the absence of complete survey data, it is assumed that the mapped area of suitable area of habitat within the project area is occupied by the species, the worst-possible impact is that the project could reduce the AoO of the species by 37 ha or 0.04 % of the total suitable habitat within the Darwin region. It is unlikely removal of this area would reduce the AoO.
Fragment an existing important population into two or more populations	The project area is within the Extent of Occurrence (EoO) of the Darwin population of <i>T. praetermissum</i> , which consists of eight widely dispersed sub-populations. Removal of a small amount of mapped suitable habitat is unlikely to fragment the population of this naturally fragmented species.
Adversely affect habitat critical to the survival of a species	The areas of high (17 ha) and moderate (20 ha) likelihood habitat within the project footprint are unlikely to be critical to the survival of the species. If the species were to occur in the disturbance footprint, it is reasonable to assume that it would also occur in suitable habitats immediately adjacent to the disturbance footprint in which the species will continue to persist. As a result no sub-population would be removed from the Darwin population.
Disrupt the breeding cycle of an important population	The project may impact individuals scattered within suitable habitat in the disturbance footprint only. Clearing will be within a discrete area and not expected to have any impacts outside the disturbance footprint, including to the movement or function of pollinators. Therefore, the project is unlikely to impact on the breeding cycle of a population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	If <i>T. praetermissum</i> did occur in the project footprint, the worst-possible impact is that the proposal will reduce the area of suitable habitat for <i>T. praetermissum</i> in the greater Darwin region by 37 ha or 0.04%. Of the high likelihood habitat, 0.02% will be removed; 0.11% of adjacent moderate likelihood habitat, and 0.02% of isolated patches of moderate likelihood habitat will be lost. This small amount of potentially suitable habitat relative to that mapped in the greater Darwin region, is unlikely to be of sufficient size that the population will decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction of non-native grasses, particularly Gamba and Mission Grasses, may deleteriously impact the species through changes in fire regimes (Westaway and Cowie 2012). There are few weeds recorded in the project area; however, observations of vegetation condition made by qualified ecologists indicate that frequent bushfires are already a feature of the landscape. Weed management measures including monitoring will be undertaken throughout the project operations and closure phase (see section 5.2.6) to minimise the potential for weeds becoming established.

Significant impact criteria	Possibility that impact would occur
Introduce disease that may cause the species to decline	Nil; there are no know diseases which affect the species
Interfere substantially with the recovery of the species.	Nil; there is no recovery plan for this species

Although the project will remove some areas mapped as potential suitable habitat for the species, it is the opinion of the ecologists who have surveyed the area, that the habitats are not characteristic of those that support the species. Given the small area of affected habitat, even if the species were to occur, the number of plants that would be removed from the population is unlikely to cause a decline of the population.

5.2.5 Indirect impacts to sensitive vegetation types due to altered water flow regimes

Field surveys did not identify any sensitive vegetation types within the disturbance footprint. However, riparian and mangrove vegetation occurs in areas downstream that could be affected if the proposal were to substantially alter surface water or groundwater flows. The potential impact of the proposal on flow regimes has been modelled by suitably qualified hydrologists and hydrogeologists. Complete reports are provided at Appendix H and I, and impacts are discussed in detail in Chapter 7. The potential impacts to flora and fauna are discussed below based on this information.

West Arm catchment – riparian vegetation

Reduction in flow downstream of the mine site, is predicted to be 30-40% in November and December, reducing to less than 5% in February and March. The riparian vegetation patch located on the ML is not expected to be impacted by reduced flows as the ephemeral drainage line that supports the patch is in a different sub-catchment to that affected by the mine site. The riparian vegetation in the portion of the West Arm catchment downstream of the mine site is relatively sparse, which is typical of streams with highly ephemeral flows. This vegetation type is adapted to low/no-flow conditions. However, applying the *NT Water Allocation Planning Framework* guideline that 80% of flow should be maintained for beneficial uses, it is possible that the modelled reduction in early season flow could alter the quality and/or species composition of the riparian zone. This change is unlikely to result in the loss of any riparian vegetation as the streams will continue to receive surface water flows through the peak of the wet season, which will fill the temporary waterholes around which riparian species occur.

West Arm catchment – mangroves

The nearest mangroves are approximately 1.7 km downstream of the mine site, at the upper tidal limit of West Arm. The first freshwater flushes are important for mangrove community health and any alteration to the quality and/or species composition would be greatest on the hinterland margin, which has the greatest diversity of freshwater-dependent species (Kristen Metcalfe, Eco Science NT, pers. comm. Sept 2018). It is possible that the modelled reduction in early season flow could alter the quality and/or species composition of the hinterland mangrove zone (refer Figure 5-6). Any impact is expected to be very localised as the community will continue to receive some early freshwater inputs from stream flows (60-70% of natural flow) and also from overland flows within the larger part of the catchment that is not affected by the mine site. The reduction in total wet season freshwater input to the upper mangroves has been modelled at 7.5% for an average wet season. Impacts are not expected to be significant because natural flushing of the system will still occur over the wet season, and the system is likely to have some resilience to changes in flow timing due to its reliance on ephemeral flows with a high level of natural variability.

Charlotte River catchment – riparian rainforest

Reduction in surface water flow in the Charlotte River catchment downstream of the OHD is predicted to be around 30% in November and December, and 20-25% for the remainder of the wet season. The modelled reduction in flow to the watercourse exceeds the 20% threshold applied in the *NT Water Allocation Planning Framework*, and it is possible that this change could alter species composition and/or diversity within the riparian zone. Any impact is expected to be limited to the three kilometre section of watercourse above the point of discharge to Charlotte River, as further downstream the reduction in flow decreases to around 3%.

The riparian rainforest community that occurs along a one kilometre section of the watercourse, is expected to persist with reduced flows. This vegetation is naturally adapted to highly variable stream flows and also appears to be sustained by groundwater to some extent, which is not expected to be altered by the proposal. Further, the OHD has been in place since the 1980's and the reduction in early season flow over that time (which will not change with the current proposal) has not resulted in the loss of riparian rainforest vegetation. The increased reduction in flow associated with raising the dam wall and pumping water, will only affect in the late wet season months (February to April), as the dam will no longer over flow until March (whereas previously it overflowed in February) and the amount of overflow will be reduced. The potential for future mining development in this catchment on Core's EL's is noted. The cumulative impacts of any future development on flows in this area would need to be considered as part of future approvals processes

To minimise potential impacts to riparian and mangrove vegetation communities, through the project design phase Core has incorporated a range of measures that will provide for greater re-use of water within the mine site. The current site water balance model indicates that a portion of the project water supply can be met from dewatering of the pit and decant water returned from the TSF, which means less water will need to be pumped from the off-site dams at certain times. Also, surface water that falls onto the site will now be captured, treated and released through sediment dams, which will further reduce the impact on surface water flows downstream. The % reduction in flows discussed above present a worst-case scenario and is not expected to have a significant impact on any sensitive vegetation communities.

The project Water Management Plan provided at Appendix C includes details of all measures that will be implemented to minimise impacts to flow regimes and water quality so that environmental values, including terrestrial flora and fauna, are protected.

5.2.6 Introduction and spread of weeds

Any introduction and spread of weeds by machinery and equipment has the potential to reduce habitat quality in the surrounding area due to competition with native species. The project area currently has low levels of existing weed infestation; however, Gamba and Mission grasses are key weeds of concern. Experience on mine/extractive sites in the region shows that these grassy weeds are easily introduced and once present are likely to proliferate in disturbed areas. Without management, weed infestations could be expected to persist in the project area following mine closure.

Core will implement a weed management program prior to and during construction/operations, and measures to ensure the plant, equipment and materials that are brought onto site are declared 'weed free'. Weed monitoring and control are addressed in the Mine Closure Plan. Weeds are not expected to cause a significant impact to flora and fauna values; however, without effective management, the increased bushfire risk associated with grassy weeds could further degrade habitat quality in the area surrounding the ML, which is already affected by frequent bushfires.

5.2.7 Uncontrolled bushfires

Reduced habitat quality is also possible as a consequence of uncontrolled bushfire resulting from the operation of mine equipment or burning of stockpiled vegetation during site clearing. As these are one-off events and site surveys found pre-development habitats to be heavily impacted by fire, significant impacts to flora and fauna are unlikely. Further, no significant habitat or threatened species values are present in surrounding areas that would be impacted by a bushfire event.

5.2.8 Increased predation/competition by pest species and vermin

Pest species not already present in the area, such as invasive species of ants and mosquitos, could be introduced to the area on materials imported from off-site. The origin of materials is currently unknown; however, infrastructure for the project will be trucked from interstate. If pest species are introduced, without management these species can spread into the surrounding areas. Although this is considered a very unlikely event, Core will implement measures to ensure that equipment and materials delivered to the site are inspected for the presence of pest species.

Increased predation/competition with native wildlife by pest species, such as rats, cats and dingoes attracted to the project area by access to domestic waste, is unlikely to occur at levels that would cause a significant impact to fauna. Due to the location close to Darwin, an on-site landfill will not be required. All putrescible waste from the mine site will be stored in covered bins and removed from site regularly by a licenced waste contractor. Further, machinery movements onsite are likely to deter pest animals from the area during operations.

5.2.9 Wildlife interaction with haul trucks and/or tailings

Death of wildlife resulting from interactions with tailings is considered unlikely given waste characterisation work indicates no chemical contaminants of concern will be present in the tailings. Further, the TSF will be co-located in the WRD; machinery movements from 24 hour/day operations are likely to deter fauna from the area. In the event of early closure, Core is committed to ensuring the TSF is made safe and stable, which will include minimising risks to fauna. The TSF will be monitored constantly during operations. If fauna is observed being attracted to the ponds, deterrence measures will be considered and included in future revisions of the EMP.

Haul truck movements will be limited to ten return trips per day, which is not a significant increase in existing traffic. As the potential impacts are very limited, no specific management measures are deemed necessary.

5.2.10 Downstream flooding inundates habitats

All water storage designs have been derived according to the dam consequence categories assessed by civil engineers in accordance with the ANCOLD guidelines (ANCOLD, 2012). At the feasibility stage, the consequence categories have been conservatively rated as 'significant' based on the impact of a dam failure to the business and the environment. Accordingly, emergency spillways for the dams have been designed to pass a 0.1% AEP event. Failure of dam walls is a very unlikely event. Any impacts from flood waters would be over a short period of time, and habitats would be expected to recover quickly once floodwaters recede. Downstream flooding is very unlikely to have a significant impact on flora and fauna.

5.3 Mitigation, management and monitoring

Measures to minimise and manage potential impacts to terrestrial flora and fauna were identified through the project risk assessment with the objective of reducing all risks to levels that will ensure that the NT EPA's objective for terrestrial flora and fauna is met. The sections below summarise the key mitigation measures that will be implemented during the construction/operations and rehabilitation/closure phases.

5.3.1 Construction and Operations

The EMP (Chapter 10) documents the following mitigation measures to be implemented during the construction and operations phase:

- Implementation of a Vegetation Clearing Procedure to:
 - o Ensure clearing is within approved areas only and uses methods that will prevent off-site impacts.
 - o Ensure topsoil removal and storage methods maximise preservation for use in rehabilitation.
- Implementation of an Erosion and Sediment Control Plan (ESCP) to minimise erosion of cleared areas and stockpiles, so that off-site impacts to aquatic environments are prevented.
- Dust suppression by water carts to minimise emissions from the mine site and covering of truck loads to avoid dust emissions along the haul route.
- Weed surveys, mapping and controls to ensure existing weed infestations are controlled prior to commencement of clearing and for the duration of operations.
- Weed hygiene and inspection procedures to minimise the potential for introduction of new weed species.
- Pest inspections to ensure no new pest species are introduced on plant and equipment. Domestic waste management will be of a standard that ensures existing pest/vermin species do not proliferate in the area.
- Establishment of firebreaks around stockpiles and work areas, and maintenance of fire response capability to minimise the risk of uncontrolled bushfires.

To address section 4.1.1.4 of the EIS ToR, a Vegetation Clearing Procedure has been prepared (Appendix S). The procedure covers clearing of the mine site and the water pipeline corridor. As no threatened species were recorded during targeted surveys, no species-specific management plans are required.

The project Water Management Plan (Appendix C) includes details of all measures that will be implemented to minimise impacts to flow regimes and water quality so that environmental values, including terrestrial flora and fauna, are protected.

The EMP and associated sub-plans detail objectives, monitoring procedures and performance indicators, as well as corrective actions and reporting requirements. These measures include:

- Weekly inspection (using GPS) of vegetation clearing to confirm clearing is within the approved footprint.
- Weekly inspection of erosion and sediment controls during the wet season.
- Visual monitoring of dust emissions to ensure no visible dust is leaving the ML.
- Monthly weed surveys and follow-up control.
- Incidental observations of pest species
- Weekly inspections of fire response equipment.

5.3.2 Rehabilitation and Closure

The mine closure plan provided at Appendix D provides detail on maximising the success of rehabilitation following closure of the project. It provides a strategy and work plan with the objective that rehabilitation areas are comprised of a “self-sustaining native vegetation groundcover, comparable to that of the surrounding ecosystems.” The plan provides for weed survey and control across the mine site to achieve the following completion criteria:

- Density of weed species is less than that of reference sites.

- No declared weed species not previously recorded in the mining lease is present.

Vegetation monitoring and weed monitoring/control in the rehabilitation areas will occur until completion criteria are met and the site is relinquished.

5.4 Statement of residual impact

The outcomes of the environmental risk assessments, indicate that the environmental impacts associated with the proposal are expected to pose an inherently low to moderate risk to terrestrial flora and fauna. The key reasons for this are:

- The project disturbance footprint is relatively small and impacts only common vegetation types that are well represented in surrounding areas.
- On-ground surveys have confirmed that the threatened plant *Stylidium ensatum* does not occur and a combination of desktop review and on-ground surveys indicated that significant impacts to the threatened plant *Typhonium praetermissum* are unlikely to occur.

The potential for the proposal to introduce and spread weeds, based on past experience on other mine sites, is likely, and without good management could pose a high risk to biodiversity values. The potential for cumulative impacts associated with weed introduction and spread was noted in the risk assessments. A program of weed survey, mapping and control is described in the EMP for the construction/operations phase and in the mine closure plan. Effective implementation of these controls by Core would decrease this risk; however, because this has been difficult to achieve on other mine sites across the NT, the residual risk remains high.

It is possible that the >20% modelled reduction in early season surface water flows downstream could alter species composition in riparian and hinterland mangrove areas. Whilst these vegetation types are broadly classified as sensitive to changes in hydrological regimes, the communities downstream of the project area are naturally adapted to highly variable ephemeral flows. For this reason, the level of impact to these vegetation types is expected to be limited and not at a level that would alter biodiversity or ecological integrity. If the project is approved, the final dam sizing, spillway heights and proposed water extraction regime will be subject to further assessment by the Department of Environment and Natural Resources (DENR) as part of the application process for obtaining a permit under the *Water Act*, which is expected to be a requirement following passing of the proposed amendments to this act to include mining activities. The proposed controls will minimise potential impacts and the subsequent review of final designs by DPIR and DENR through the permit process, will ensure that the impact is within acceptable limits.

In conclusion, the proposal is not expected to cause significant impacts to terrestrial flora and fauna. This assessment is based on an adequate level of ecological field survey data and modelling of worst-case impacts to hydrological regimes that support flora and fauna values. There are no significant information gaps that would be likely to affect or significantly alter the outcomes of the risk assessment. The proposed mitigation and management measures are expected to ensure that the NT EPA objective for protection of terrestrial flora and fauna is met.

5.5 References

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GRANTS LITHIUM PROJECT
Draft Environmental Impact Statement

Chapter 6
Terrestrial
Environmental
Quality

6 TERRESTRIAL ENVIRONMENTAL QUALITY

Terrestrial environmental quality refers to the chemical, physical, biological and aesthetic characteristics of land and soils. NT EPA's objective related to terrestrial environmental quality is to:

Maintain the quality of land and soils so that environmental values are maintained.

The objective recognises the essential link between soil quality and protection of the ecological and social values that good soil quality supports.

This chapter describes potential impacts to land-uses and environmental values within and around the Grants Lithium Project area that could occur as a result of land and soil disturbance. The ways in which the quality of the soils present at the site could affect mine site rehabilitation and closure are also considered (i.e. suitability of topsoil as a growth medium for rehabilitation). The mitigation and management measures that Core will implement to avoid and/or reduce impacts to land and soils are summarised from the Mine Closure Plan (Appendix D). At the end of the chapter, a statement of residual impact is made detailing the extent to which the proposed mitigation and management measures will address potential impacts to ensure that the NT EPA's objectives for this environmental factor are met.

The content of this chapter has been developed specifically to address Section 4.1.2 of the EIS ToR, and has been informed by baseline surface and sub-surface (waste) materials characterisation studies (Appendix E).

6.1 Existing environment and values

This section describes and maps the landforms and soil types that occur in the project area, based on the land unit mapping, field-based soil characterisation and results from analysis of surface and sub-surface soil/rock samples collected from the project area. The occurrence of potentially problematic soils that may require specific management approaches is also discussed. To provide context for the assessment of impacts, land-uses and environmental values around the project area that rely on maintaining soil quality are identified.

6.1.1 Land units

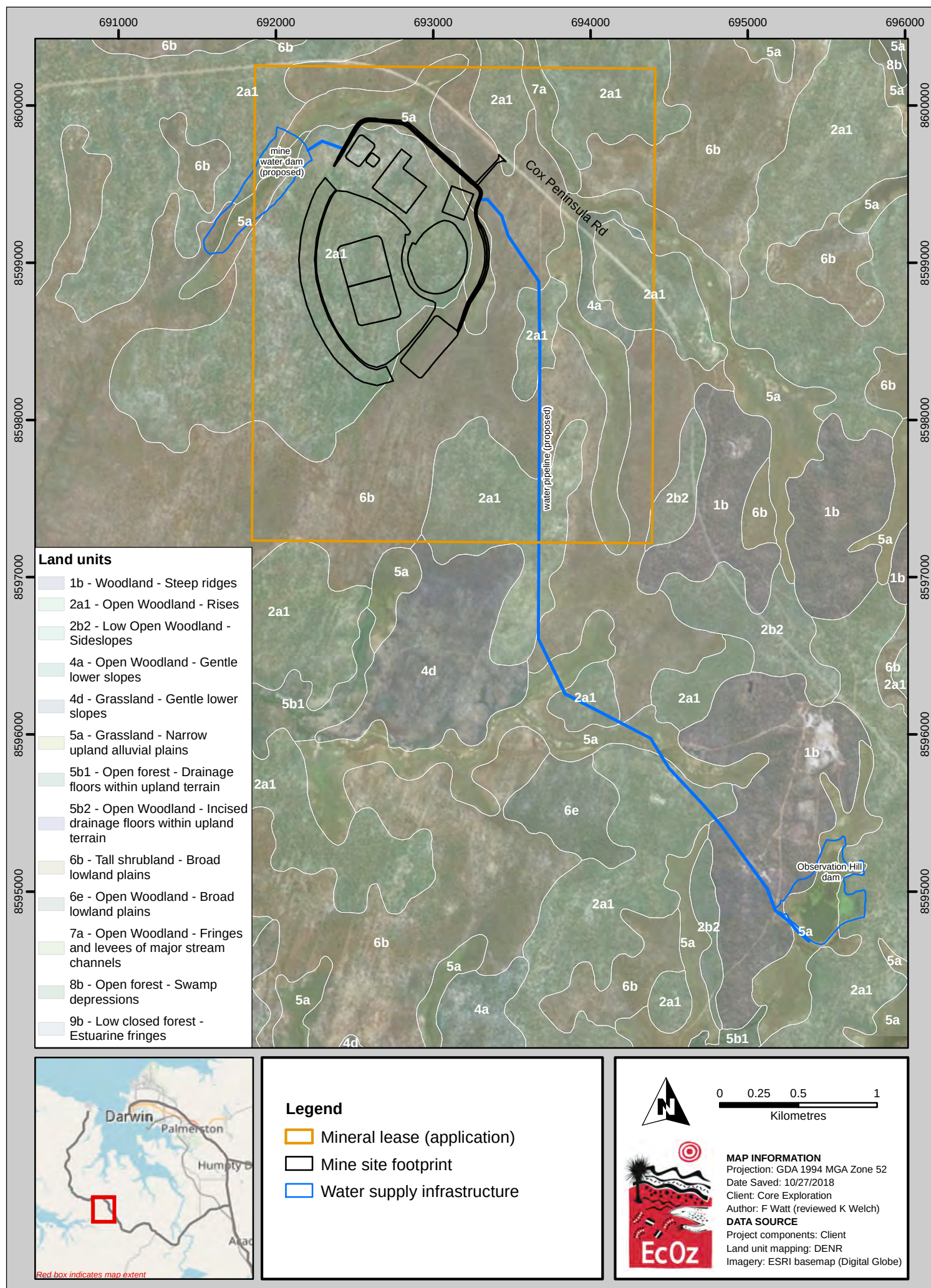
Land unit mapping available for the Greater Darwin Region (1:25:000 scale) was used as the basis for characterising the landforms and soils that occur in the project area. Each land unit on the ML was ground-truthed and characteristics were generally found to align with the descriptions attached to the land unit mapping (refer Appendix P for survey results). The land units mapped across the project area are shown in Figure 6-1 and described in Table 6-1.

The project area broadly comprises lowland plains and rises, intersected by drainage systems and alluvial plains. The land is generally flat with slopes less than 5%, except for a short section of steep ridges traversed by the water pipeline, where slopes may approach 10-40%. The proposed mine site occurs predominately on land characterised as low rises with gravelly well-drained soils (land unit 2a1). A small area of the pit, WRD and inundation bund are located on broad drainage floors (land unit 6b) and the inundation bund and off-site dams occur predominately on narrow upland alluvial plains (land unit 5a). Both land unit 6b and 5a are classified as having a 'severe level of seasonal water logging'.

The proposed mine site dam and Observation Hill dam (OHD) are located on narrow upland alluvial plains (land unit 5a), which are associated with ephemeral drainage lines. The water pipeline corridor traverses mainly low rises with gravelly well-drained soils (land unit 2a1) and broad drainage floors (land unit 6b). Short sections of the route traverse steep ridges (land unit 1b) and narrow upland alluvial plains (land unit 5a).

Table 6-1. Land units within the project area

Land unit	Landform	Gradient	Soil description	Seasonal waterlogging	Area (ha)			
					Mine site	Off-site dams	Water pipeline	Total
1b	Steep ridges	10-40 %	Leptic Rudosol. Stony shallow lithosols, uniformly coarse to medium textured. Very stony and gravelly.	Nil to low	-	2	1	3
2a1	Low rises and associated upper slopes	0.5-4 %	Leptic Rudosol. Gravelly lithosols, usually shallow with some moderately deep occurrences. Loamy sand or sandy loam surface to sandy clay loam subsoil. 20-40% gravels in surface, 30-60% gravels in subsoil	Nil to low level	121	9	2	132
6b	Broad drainage floors and creek margins.	<1.5 %	Tenosolic Oxyaquic Hydrosol. Shallow to moderately deep siliceous and earthy sands, minor sandy massive earths. Coarse textured sands to sandy loams. 0-10% gravel in surface, 5-40% gravel in subsoil.	Severe level, inundation for extended periods	14	2	2	18
5a	Narrow alluvial plains within upland terrain	<1.0 %	Chromosolic Redoxic Hydrosol. Hardsetting apedal mottled yellow duplex soils. Fine sandy loam or loam overlaying light clay to medium clay subsoil. Minor subsoil ferruginous gravels.	Severe level, inundation for extended periods	12	15	<1	28
4a	Gentle lower slopes (plains)	0.5-1.5 %	Petroferric Redoxic Hydrosol. Deep mottled grey massive earths with lateritic gravel, occasionally moderately deep, and some moderately deep siliceous sands. Sandy loam to light sandy clay loam surface grading through sandy clay loam to light clay at depth, siliceous sands have a uniform loamy sand profile often over hard laterite. 10-30% ferruginous gravel in subsoil, occasionally cemented to form gravel pan at 80-100cm.	Moderate to high	Within ML but not within disturbance footprint			
7a	Fringes and levees of major channels.	0.5-2 %	Brown Kandosol. Deep hard-setting yellow massive earths. Sandy loam or light sandy clay loam grading to sandy clay loam or light clay.	Severe level extended periods	Within ML but not within disturbance footprint			



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ18086 - Grants Project - EIS\01 Project Files\Chapter 6 maps\Figure 6-1 Land units of the project area.mxd

Figure 6-1. Mapping of land units in the project area

6.1.2 Soil characteristics

Sampling and analysis of the surface soil characteristics across the proposed mine site disturbance footprint was undertaken for the purposes of:

- Estimating the quantity and quality of the soil resource (topsoil and subsoil).
- Characterising the baseline growth medium attributes and nutrient status.
- Evaluating potential risks associated with salinity, wind erosion and water erosion.

The sampling methods, parameters analysed and results are summarised below from the complete report provided at Appendix E.

Sampling

Seventeen soil samples were collected from the two main soil groups that occur within the mine site disturbance footprint; Rudosols and Hydrosols. Sample locations were chosen to provide good spatial coverage of the disturbance footprint and an indication of soil variation along the slope gradient from west to east. The majority of samples (11) were collected from areas of Rudosol soils (land unit 2a1) as this soil type covers more than 73 % of the disturbance footprint. Six samples were collected from Hydrosol soils that occur with landunits 5a and 6b. Sample locations are shown in Figure 6-2.

Samples were analysed for the parameters recommended in the *Draft Guideline - Materials Characterisation – Baseline Data Requirements for Mining Proposals* (WA Department of Mines and Petroleum 2016) (see Table 6-2).

Table 6-2. Parameters analysed for baseline soil characterisation.

Source: WA Department of Mines and Petroleum (2016)	
Parameter	Relevance
Particle size distribution (PSD)	Augments field texture classing. Defines the proportion of sands, silts and clays within the soil medium. Particle size distribution informs the assessment of erosion and sodicity risks (where there is a high Exchangeable sodium percentage (ESP) but % clay is <10%, then Sodicity is a low risk).
Bulk density	Required for estimation of water holding capacity and inference of plant available water capacity (PAWC).
Aggregate stability	Stability of the soil structure units when immersed in water. Instability may be indicated by slaking or dispersion. A soil with a low aggregate stability is likely to be compact and poorly structured or be susceptible to tunnelling erosion.
Water repellence	A natural condition of the soil preventing it from wetting up. Water repellence results from waxy organic compounds coating soil particles. Sandy soils (<5 % clay) are most susceptible to water repellence. Clayey sandy soils can help to alleviate water repellence.
Electrical conductivity	The accumulation of water soluble salts. It is a measure of salinity.
pH	pH characterises the chemical environment of the soil and guides the suitability of soils for growth of particular species. The soil's pH affects the availability of various nutrients, toxic elements and chemical species to plant roots.
Exchangeable cations	The cation exchange capacity (CEC) of a soil is the measure of the soil's capacity to hold important cations such as calcium, magnesium, sodium and potassium. ESP is used to calculate sodicity. $ESP = 100 \times \text{exchangeable sodium (cmol/kg)} / CEC.$ If sodium makes up 6% or more of the total cations present ($ESP > 6$), then the soil is classed as sodic. Susceptibility to dispersion will depend on ESP, but also be affected by EC, exchangeable Mg, and clay amount and mineralogy, so competent interpretation of data by a suitably qualified person is advisable.

Source: WA Department of Mines and Petroleum (2016)

Parameter	Relevance
Organic carbon	An indicator of soil nutrient store, it can also affect water retention and biological processes. Organic carbon supports microfauna and microflora in the soil.
Total nitrogen	Total nitrogen baseline information.
Available phosphorus	A measure of the phosphorous that is available for plant uptake. Phosphorous is required for photosynthesis and respiration.
Available potassium	A measure of the potassium that is available for plant uptake. Potassium is needed for a wide range of important processes within the plant including cell wall development, flowering and seed set.
Available sulphur	A measure of the sulfur that is available for plant uptake
Total metals	Baseline measure of naturally occurring metals.

Laboratory tests were performed by Australian Laboratory Services, a National Association of Testing Authorities accredited facility. The sampling methods, data analysis and results are documented in Appendix E.

Soil characteristics

Key soils characteristics are summarised in Table 6-3.

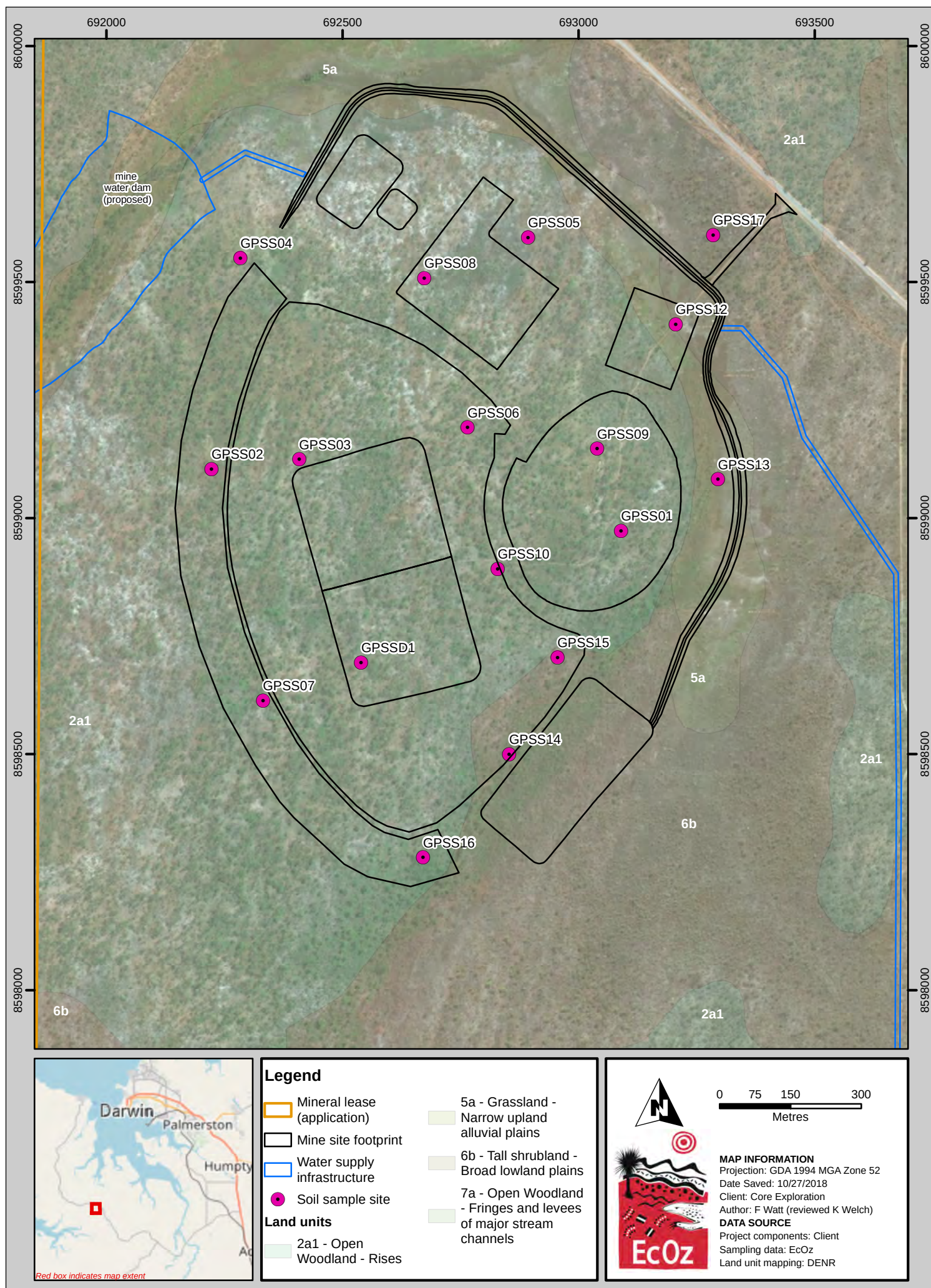
Table 6-3. Summary of soil characteristics

Soil characteristics
Particle size distribution
Soil textures may be described as sandy-loams, sandy-clay-loams and gravelly-sands. Soils are comprised of more than 10 % clay.
Bulk density
Whilst not specifically measured in the laboratory, the physical descriptors of the soils and PSD have been used to provide an indication of bulk density. Soils have a dominant sand and gravel content and consequently will have bulk densities in the range 1.3 g/cm ³ to 1.7 g/cm ³ . Root growth is restricted when bulk density exceeds 1.6 g/cm ³ and thus could be an issue for rehabilitation success.
Water holding capacity
Water holding capacity of sand is lower than other soils types and could affect rehabilitation success. This indicated low water holding capacity is backed up through determination of soil cation exchange capacity (CEC), which is low for soils from the site (0.2 meq/100g to 2.4 meq/100g). Soils with a low (< 10 meq/100g) CEC have low water holding capacities and are prone to leaching and nutrient loss which may be offset by maintaining organic matter in these soils.
Nutrients and total organic carbon
All samples had a sulfur concentration below 10 mg/kg, which is below the range of preferred levels for plant growth (10-20 mg/kg). Similarly, nitrate (NO ₂ + NO ₃ as N) concentrations (maximum 1.2 mg/kg) and phosphorus concentrations (maximum 13 mg/kg) were below the preferred levels for plant growth (> 10 mg/kg and 20 – 30 mg/kg respectively). Only one sample had a total organic carbon (TOC) concentration (2 mg/kg) at the preferred level (>2 mg/kg); 12 samples had a total organic carbon concentration between 1 and 2 with 16 having a concentration below 1 mg/kg. Potassium concentrations in all samples are within the desired levels for plant growth. The concentration of these nutrients fluctuate with soil and weather conditions over very short periods of time.

Soil characteristics
Salinity
EC of soil samples varies between 0.002 dS/m and 0.025 dS/m, averaging 0.009 dS/m and are considered suitable as a growth medium.
Structural stability
Emerson aggregate test The Emerson aggregate test (EAT) gives a semi-quantitative assessment of the structural stability of a soil and is used to indicate erodibility by water. The site soils fall in the following Emerson classes: • Class 3 – dispersive: 5 % of samples (sandy loams from Land Unit 5a and 2a1): These samples occur in areas where disturbance, if any, will be minimal. • Class 4 - carbonate or gypsum present with slaking but no dispersion upon wetting: 70 % of samples (sandy loam and sandy clay loams: from 2a1 and 6b. • Class 8 - no slaking, no swelling: 25 % of samples (gravelly sands from Land Unit 2a1). Exchangeable sodium percentage Exchangeable sodium percentage (ESP) is a measure of the proportion of sodium ions relative to other cations – referred to as sodicity. Sodicity degrades soil properties by weakening the bonds between soil particles. 60 % of the soil samples were classified as sodic, and 46 % were classified as moderately to highly sodic.
Heavy metals
Heavy metal concentrations in the soils are well below the Investigation Levels for Areas of Ecological Significance (ASC NEPM) and with the range of preferred levels for crop/plant growth.

6.1.3 Sub-surface materials characteristics

The sub-surface materials (waste rock) characterisation program undertaken for the project is described in Chapter 2 Section 2.9.1 from the complete report at Appendix E. The results indicate there is a low risk of acid, saline or metalliferous drainage (AMD) and Naturally Radioactive Materials (NORM) present. There are some materials with dispersion potential, with the highest occurrences in the eastern portion of the pit shell from surface to 5 m depth and from 8-54 m depth across the whole pit shell. Where this material occurs in the shallow parts of the pit it is a potential source of construction materials and therefore further detailed geotechnical testing and assessment is required to characterise physical characteristics stability. Material from the deeper parts of the pit shell will be placed in the centre of the WRD and therefore dispersive characteristics in these materials is not of management concern.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 6 maps\Figure 6-2 Soil sample sites and land units within the mineral lease.mxd

Figure 6-2. Location of soil sample sites used for materials characterisation

6.1.4 Environmental values and land-uses

For the project area, the key environmental values supported by the land and soils are summarised below:

Seed banks that are important to maintaining biodiversity.

The biodiversity values of the project area are described in Chapter 5 (Section 5.2). No important or sensitive terrestrial flora or fauna values have been identified. However, maintaining the soil seed bank will be important to achieving the closure objectives for the mine site.

Water quality in the downstream ephemeral watercourses and marine waters of West Arm

The project area is located in the West Arm catchment of Darwin Harbour, which has declared beneficial uses under the *Water Act*. The beneficial uses of water within the project area and downstream receiving environment are detailed in Chapter 7 of this EIS. Ecological values are described in Chapter 5, section 5.1

In summary, the ephemeral nature of the freshwater flows, limits the potential for beneficial uses associated with agriculture, rural stock watering or domestic supply. Aquatic surveys undertaken by GHD (2017) found the aquatic habitats are typical of low order watercourses in the NT. These types of habitats are common around the western side of Darwin Harbour and do not have any significant value in terms of supporting species that are range restricted or threatened. The watercourses do support a narrow band of riparian vegetation that protects stream banks from erosion. Wet season flows discharge into the hinterland mangrove communities of West Arm, which are a significant vegetation type that could be sensitive to hydrological and/or water quality impacts.

The key environmental values of marine receiving waters of West Arm relate to the intact mangrove environments present on the western side of Darwin Harbour. The cultural importance of West Arm is not publically documented; however, it is assumed the area has cultural value to local Aboriginal people. West Arm is also a popular recreational fishing area.

Groundwater quality in the aquifer beneath the project area.

The Burrell Creek Formation forms the principal aquifer beneath and in the immediate surrounds of the project area. The aquifer characteristics derived from desktop review and groundwater modelling are detailed in Chapter 7 of this EIS. The underlying aquifer is categorised as a fractured and weathered rock aquifer with minor groundwater resources (NRETA, 2008). There are no other groundwater users with 12 km of the ML and no groundwater dependent ecosystems have been identified.

The Berry Springs Dolostone aquifer is located around 22 km east of the project area. There is limited connection between the surrounding Burrell Creek Formation and the Berry Springs Dolostone aquifer.

6.2 Assessment of impacts

The impact and risk assessment process (Chapter 4) identified the following potential impacts to land and soils:

Construction/operations phase

- Loss of soil structure and seedbank in topsoil stored for use in rehabilitation
- Soil erosion due to alteration of surface water flows and increased run-off from disturbed areas
- Erosion of stream banks downstream of dam walls/spillways
- Contamination of land and soils by acid mine drainage (AMD) from WRD/TSF
- Contamination of soils by hydrocarbons from fuel storages.

Rehabilitation/closure phase

- Soil erosion caused by rehabilitation failure and landform instability
- Stockpiles left in-situ leach contaminants to surrounding land/soils
- Contamination of land and soils by AMD from WRD/TSF.

The sections below discuss the likelihood of impacts occurring and the consequences to environmental values that rely on good soil quality, which for this proposal primarily relate to downstream surface water quality and groundwater quality.

6.2.1 Loss of soil structure and seedbank

Loss of soil structure and contained seedbank essential to achieving good rehabilitation outcomes, could occur if the topsoil is inappropriately removed and stockpiled during site clearing and preparation. The initial site clearing and construction is scheduled to occur in the dry season of 2019. The top 200 mm of soil will be stripped from the disturbance footprint and stockpiled to the south west of the WRD. Soil will be stockpiled for one to three years prior to use in rehabilitation.

Loss of soil structure can impact rehabilitation success particularly through sodic soils forming crusting layers. Soils within the disturbance area generally characterised as sandy loam, sandy clay loam or gravelly sand. The soil sampling results indicate potential for slaking, hard setting and erosion when wet. The majority of soils within the disturbance footprint were characterised as being prone to hard-setting. In order to counteract the effect of low Cation EC, high ESP and potential for slaking, ameliorants including organic matter, nutrients and calcium sulphate (gypsum) may need to be added prior to rehabilitation. The requirement for soil improvement and relevant ratios of additives, will be determined during rehabilitation trials, which will commence at the end of the first year of operations.

Inappropriate and/or longer-term storage of topsoil can lead to the loss of seedbank contained within the soil, which will affect natural regeneration of species local to the area. The longevity of the seed will be affected by the state in which topsoil is stockpiled. The Vegetation Clearing Procedure (Appendix S) and the Erosion and Sediment Control Plan (ESCP) (Appendix F), include details of the specific management measures which will be implemented during stripping and stockpiling of topsoil in order to maximise the value of the soil resources for use in rehabilitation. These procedures are expected to ensure that at least some of the seedbank remains viable and will provide for initial establishment of vegetation in the rehabilitation areas. Where required, rehabilitated areas will be reseeded with a suitable mix of local species.

The Mine Closure Plan (Appendix D), documents methods for monitoring rehabilitation outcomes. Both during the rehabilitation trials and post-closure. Monitoring at appropriate frequencies should ensure that issues with soil structure and/or reinstatement of native vegetation, are identified and addressed.

6.2.2 Soil erosion

Soil loss and erosion hazard has been calculated for each of the site components in accordance with the *Best Practice Erosion and Sediment Control Guidelines* (IECA, 2008). Details of the calculations and results are provided in the ESCP (Appendix F). The TSF and WRD are the only site components assigned a 'very high' erosion hazard rating. The WRD is assigned a 'moderate' erosion hazard rating and the remainder of the site components were assigned a 'very low' rating. Erosion risk for the site relates to rainfall and is rated as 'extreme' for the months of December to March, 'high' for April, October and November, and 'very low' for the rest of the year. The sections below discuss the causes and potential severity of soil erosion associated with the proposal.

Alteration of surface water flows and increased runoff

Exposed mine site surfaces will be most susceptible to erosion by rainfall during the first wet season of operations. The potential for erosion will be minimised by adopting appropriate design criteria for infrastructure components (i.e. water storages, culverts, drainage, spillways and WRD and stockpile slopes will be suited to high rainfall conditions experienced at the site) and stabilising cleared areas as soon as practicable following clearing and construction. Proposed methods and controls are detailed in the Vegetation Clearing Procedure (Appendix S) and the ESCP (Appendix F).

The inundation bund and WRD will alter surface water flows around the mine site, diverting some flows to the north and preventing inundation of the mine site from the south. The bund will be constructed during the dry season and revegetated once constructed; however, there is likely to be exposed outer surfaces during the first wet season post construction. Water flows and rainfall during this wet season, could erode the outer surface of the bund. In the worst case, failure of the bund could allow inundation and/or release of sediment laden water from the mine site. The ESCP details management measures to reduce the risk of erosion, which will involve covering with hydromulch complete with grass seed, and the use of jute matting to stabilise the surface of the external batter.

Within the mine site, erosion of exposed surfaces will occur as a result of stormwater flows. The entire area of the mine site internal to the inundation and topsoil bund has been designed to drain to an internal stormwater drainage network. The sizing, design and operation of sediment dams is detailed in the ESCP.

The installation of the water supply pipeline and maintenance access track, will require clearing and earthworks along a 10 m wide and 6 km linear corridor, which if not appropriately managed, could alter local surface water flow paths and cause erosion. The water pipeline traverses some short sections of broad drainages and steep slopes with higher erosion risk. The Vegetation Clearing Procedure (Appendix S) details measures that will be implemented to minimise alteration of flow paths, so that erosion potential is reduced. During the initial clearing and excavation, vegetation, topsoil and spoil will be stockpiled temporarily along the edge of the corridor. Following placement of the water pipeline into the trench, the spoil will be backfilled and topsoil reinstated to promote natural regeneration of groundcover species. The ESCP details erosion and sediment controls for the pipeline corridor and access track. A progressive ESCP will be developed to provide details of site-specific controls required in areas of high erosion risk.

The ESCP prescribes that erosion management measures will be inspected at-least weekly during operations, within 24-hours of expected rainfall, and as soon as reasonably practical after receiving significant rainfall events (i.e. >10 mm in 24 hr period). Environmental objectives and targets for erosion are outlined in the site EMP (Chapter 10). Where monitoring identifies that environmental objectives and targets are not being achieved, corrective actions will be enacted. Where significant erosion is recorded, a CPESC will be engaged to advise on suitable controls.

Experience on other mine sites indicates that erosion is likely to occur within the mine site. Effective implementation of the controls proposed in the vegetation clearing procedure and ESCP, are expected to limit the extent of erosion to within the disturbance footprint and prevent the movement of significant amounts of sediment off-site.

Post-closure landform instability and erosion

Post-closure, landform instability could lead to erosion. Potential causes include inappropriate placement of dispersive waste materials, unconsolidated tailings in the TSF, pit wall failure/slumping, inappropriate rehabilitation works and/or poor drainage design. Early unforeseen closure could increase the likelihood and severity of erosion depending on the circumstances and timing. Potential impacts associated with each of these issues are discussed below.

Management of dispersive waste materials

The materials characterisation work undertaken for the project identified some materials within the pit shell that have dispersive characteristics. Dispersive materials are a concern where they occur in the shallow parts of the pit shell that will be used as a source of construction materials for the WRD annulus, TSF and other site infrastructure. One-third of the shallow waste rock samples are indicated to have some dispersion potential. Materials with dispersive characteristics that occur within the deeper parts of the pit will be placed directly within the WRD without reworking, and therefore are not a concern for structural stability of the landform.

Dispersive materials may not provide an effective substrate for vegetative rehabilitation/stabilisation and on exposure to rainfall are likely to increase turbidity in run-off. Further geotechnical test work will be undertaken to develop construction materials specifications, sources and required treatments. This work is expected to ensure that materials used to construct the WRD annulus, TSF and other site infrastructure will provide for long-term geotechnical stability of the post-closure landform. The characteristics of the materials available on site will also inform the final landform designs. Where materials have dispersive characteristics, the final landforms will require reduced slopes and batter angles to minimise erosion potential.

Tailings consolidation and TSF closure

Landform instability could also occur as a result of uneven consolidation of tailings in the TSF. As the TSF will be contained within the WRD landform, any closure issues could impact long-term stability and lead to erosion. A staged closure plan for the TSF is included in the Mine Closure Plan (Appendix D). To ensure a stable foundation for placement of the TSF cover layer, tailings will need to be monitored in advance of placement. This will include monitoring of the pore pressure build up from rapid loading (with push in piezometers) and monitoring bearing strength of the tailings (with shear vane testing equipment). Monitoring of tailings during cover construction may indicate a change to the construction method is required, for example slowing the placement to allow pore pressure dissipation, or ability to increase cover layer thickness if tailings strength is sufficient to support this. Prior to commencement of TSF closure works, the Mine Closure Plan will be updated to reflect the program of works required to close the as constructed facilities. This plan will be subject to review and approval by DPIR. Subject to development and implementation of a final closure plan that is acceptable to DPIR, the TSF is not expected to be a major cause of instability in the WRD landform.

Pit wall failure/slumping

The WRD/TSF is outside the calculated zone of instability around the pit edge. The Mine Closure Plan includes details of the zone of instability calculations. Subject to effective implementation of the plan, landform instability due to failure slumping of the pit wall is unlikely to contribute to erosion.

Inappropriate rehabilitation methods and/or drainage design

Inappropriate rehabilitation methods and poor drainage design could lead to failure of the rehabilitation and subsequent erosion. The Mine Closure Plan (Appendix D) provides details of the proposed final landform designs and how each component of the mine site will be rehabilitated. Experience on other mine site indicates that, rehabilitation success is highly variable and even with good management, some erosion of the post-closure landform can be expected to occur and therefore will need to be managed.

Erosion of the outer western and northern face of the WRD and/or the abandonment bund are the key areas of concern with respect to potential off-site release of sediments. Any erosion of the southern face of the WRD or other components, is unlikely to result in any off-site movement of sediments, as the abandonment bund will act as a barrier and the site will drain internally to the open pit. The ESCP assigns the WRD a 'moderate'

erosion hazard rating, based on the preliminary design details. The final land form and drainage designs, in combination with rehabilitation outcomes, will be the key factors that determine the severity and extent of erosion. These final designs are pending; however, the conceptual designs are considered adequate for the purpose of assessing potential impacts.

The Mine Closure Plan provides closure objectives for each component of the mine site (referred to as closure domains) and a works program for achieving these objectives. As noted above, the closure concepts provided in the plan are based on feasibility stage designs and therefore the plan will need to be updated as more detailed design work is completed. However, the concepts are not expected to change to the extent that would result in a significantly increased risk of erosion. The works program, when implemented effectively, is expected to provide for adequate stabilisation of the site and prevention of off-site movement of sediments.

Progressive rehabilitation of the WRD commencing towards the end of the first year of operations will be used as a rehabilitation trial. Monitoring the success of the rehabilitation and adapting methods to address any identified issues will improve rehabilitation outcomes and therefore reduce the likelihood and extent of erosion. The Mine Closure Plan describes the monitoring program that will be implemented to monitor vegetation re-growth, erosion and any resultant impacts to downstream water quality downstream. The plan also identifies possible contingency measures that will be used to stabilise the landform and minimise movement of sediments into the surrounding environment. The adaptive management approach described in the Mine Closure Plan, when implemented effectively, is expected to provide acceptable rehabilitation outcomes.

Based on the above information, it is very likely that erosion will occur during the rehabilitation and closure phase. The monitoring and mitigation measures described in the Mine Closure Plan, in combination with a progressive ESCP's that address specific closure issues, are expected to ensure that erosion is detected and addressed early so that it remains localised and is unlikely to result sediment movement into surrounding watercourses.

Early unforeseen closure

Due to the short mine life and the economics underpinning the project, the likelihood of early closure is considered low. However, early closure is likely to pose an increased risk of erosion as landforms will not be stabilised or rehabilitated. As a result, potential impacts to land and soils could be more severe. The level of risk will depend on the timing and current status of the site when closure occurs. Closure early during the life of mine and/or during the Wet season poses the greatest risk of more severe erosion that could lead to off-site impacts. Risk assessment and mitigation is expected to be addressed in a Care and Maintenance Plan, which is a legal requirement under the *Mining Management Act*. Closure works would then either be undertaken by Core or by DPIR using the security bond.

6.2.3 Stream bank erosion

Erosion of stream banks downstream of the dam spillways could occur when the dams overflow. Event based overflows of the mine site dam (MSD) are expected to occur in January and February, continuous overflow in February to early March and event based overflows again from late March into early April. The Observation Hill Dam (OHD) is modelled to overflow in March only.

Preliminary designs are available for the OHD and MSD walls and spillways are pending. These designs are being prepared by GHD in accordance with the ANCOLD Guidelines (ANCOLD 2012). As protection of the dam wall from erosion is a key component of dam design, and the current OHD dam does not appear to cause erosion of streambank downstream, the proposed dams are not expected to significantly increase erosion of streambanks. To mitigate potential impacts of erosion, in accordance with standard practice, the construction engineering drawings for the dam walls and spillways will include any erosion and sediment control requirements.

It is likely that there will be minor erosion of the newly constructed dam walls in the first rainfall events after construction; however, due to the design features described above, this erosion is not expected to continue and is unlikely to cause adverse impacts to water quality downstream (refer Chapter 8).

6.2.4 Contamination

Contamination of land and soils could occur through fuel or waste material leaks and spills resulting in hydrocarbon contamination, or through mine drainage releases (e.g. acid mine drainage).

Hydrocarbon contamination

Hydrocarbon contamination of land and soils could be caused by leaks and spills from diesel fuel storages. Diesel will be stored on site in above-ground tanks, and all plant and equipment will be refuelled on site in the refuelling area located within the MOC, which will comprise an impervious surface and storm-water drainage pits with oil-water separators. Hazardous waste storage areas for waste oils, lubricants, batteries and tyres could also be a source of hydrocarbon or other chemical contamination. Storage areas will be covered and within containment bunds, and the volumes of waste stored are expected to be relatively small due to the site being close to off-site waste disposal facilities. The use of other chemicals on site is limited to the processing additive 'ferrosilicon' and flocculants used in the tailings thickener, sediment dams and water storages; these materials are described in Chapter 2 (section 2.8.3). Storage and handling of these materials will be controlled in accordance *Work Health and Safety Regulations* and, under normal conditions of use, are unlikely to be released to the environment.

The project design comprises above-ground fuel tanks and designated refuelling and waste storage areas which, combined with the short mine life, minimises risks associated with diffuse pollution over time, and also the risks associated with failure of the fuel storage tanks and containment bunds. Storage and handling procedures that minimise risks to people and the environment are prescribed under the *Australian Standard AS1940 Storage and handling of flammable and combustible liquids* and the *Dangerous Goods Act*. Adoption of these measures onsite will minimise the likelihood of major contamination incidents occurring. However, as is the case with all industrial activities, spills are still likely to occur and will need to be contained.

A fuel or chemical spill will either soak into the soils or run off into the storm-water drainage network, where it will be captured in the sediment dams. Any residual hydrocarbon contamination in the soils post-closure would also soak into the surrounding soils. The volume of hydrocarbons stored on-site is relatively small and contamination would be limited to the soils within the disturbance footprint. Any contaminated soils resulting from hydrocarbon spills, will be excavated and remediated on site. The EMP includes monitoring of fuel storages for leaks/spills, and spill response procedures. Effective implementation of these measures should ensure that any soil contamination is limited to within the immediate areas around fuel storage and refuelling areas, and does not result in any measureable impacts to surface or groundwater quality. Further discussion of potential water quality impacts is provided in Chapter 8, section 8.2.5.

Stockpiles left in-situ leach contaminants

In the event of early closure, it is possible that stockpiles of mined ore, product and rejects will remain on the ROM pad. The materials characterisation work undertaken for the proposal indicates there is a very low risk of AMD associated with the ore (and waste). Therefore, the stockpiles are not expected to leach contaminants of concern. Closure works would then either be undertaken by Core or by DPIR using the security bond. As indicated above, in the event of early closure, risk assessment and mitigation is expected to be addressed in a Care and Maintenance Plan, which is a legal requirement under the *Mining Management Act*. As part of this plan all stockpiles would be either stabilised in-situ or removed to the WRD.

Acid mine drainage

A significant issue often associated with mining activities relates to the potential for production of Acid Mine Drainage (AMD), which can result in acidic, metalliferous or saline discharges to the surrounding land and

soils. This situation has occurred on many mine sites in the NT and is an ongoing concern to the government due to the resultant long-term remediation requirements. Accordingly, to inform assessment of potential impacts associated with AMD, the EIS ToR (section 4.2.1.4) requires a waste rock characterisation program to be undertaken to the satisfaction of the DPIR.

The waste rock characterisation work undertaken for the project indicates there is a low risk of AMD (see section 6.1.3). The sampling effort was deemed adequate for the purpose of indicating areas of risk that may require further assessment. In accordance with the recommendations of the TSF design team from GHD, confirmatory test work on tailings will be undertaken as part of the processing plant trials, which will inform final detailed design of the TSF. Core will also undertake an ongoing operational waste rock sampling to confirm the waste rock and leachate characteristics (refer EMP - Chapter 10). The project WRD design allows contingency for material with any potential to cause acid or metalliferous drainage (i.e. the fresh phyllite) to be selectively placed within the centre of the WRD, which will be surrounded by waste rock from the shallower parts of the pit as a buffer, and the annulus constructed of low permeability materials. If these types of materials are identified, the need for capture and treatment of any seepage from the toe of the WRD would need to be considered and addressed in future revisions of the Mine Closure Plan.

Based on the above information, it is unlikely that AMD will be produced at the site. In the event that ongoing characterisation work identifies materials that could produce acidic or metalliferous drainage, the volumes are expected to be small and there are adequate contingencies available to minimise and manage any contaminated drainage impacts to surrounding land and soils. Further discussion of potential water quality impacts is provided in Chapter 8, section 8.2.4. The Water Management Plan (Appendix C) includes a surface water and groundwater monitoring program that will provide for early detection of any contaminated mine drainage issues.

6.3 Mitigation, management and monitoring

Measures to minimise and manage potential impacts to land and soils were identified through the project risk assessment with the objective of reducing all risks to levels that will ensure that the NT EPA's objective for the terrestrial environmental quality factor is met. Key mitigation measures are referred to in the above discussion of potential impacts. The sections below summarise the features of the project design that avoid or minimise impacts to land and soils, and measures that will be implemented during the construction/operations and rehabilitation/closure phases to further reduce risks.

6.3.1 Design

Integration of the TSF within the WRD landform is a key aspect of the project design that will minimise potential impacts to land and soil. The TSF will be encircled by the WRD, and at the end of the mine life, the waste rock will be pushed into the desiccated tailings, creating a stable platform on which the final WRD landform can be constructed. Integrated landforms are considered a best-practice approach that limits environmental risks associated with uncovered tailings. The integrated landform also provides for secondary containment in the event of TSF wall failure or overtopping.

The encirclement of the site by the inundation bund and topsoil bund/WRD combined will divert water flows to the north and prevent inundation from the south. These structures will limit ingress of surface water into the mine, allowing for water within the site to be more effectively managed, which reduces the risk of erosion.

6.3.2 Construction and operations

Prior to commencement of construction, further geotechnical test work will be undertaken to develop construction materials specifications, sources and required treatments. The characteristics of the materials available on site will inform the final landform designs. Where materials have dispersive characteristics, the final landforms will require reduced slopes and batter angles to minimise erosion potential. This work is

expected to ensure that designs and materials used to construct the WRD annulus, TSF and other site infrastructure, will provide for long-term geotechnical stability of the post-closure landform. This study will also ensure that materials with dispersive characteristics are not used in exposed surfaces where they would be susceptible to dispersion by rainfall.

To minimise the risks associated with erosion during initial land clearing, activities will be undertaken in accordance with the Vegetation Clearing Procedure (Appendix S). The procedure details the management measures that will be implemented during stripping and stockpiling of topsoil in order to maintain soil structure and seedbank for use in rehabilitation. It also includes procedures for ensuring that vegetation, topsoil and spoil stockpiles are managed to limit impacts on surface water flows, and reduce erosion risk.

The ESCP provided at Appendix H, combined with the engineered designs for mine site components, will be the key measures used to avoid erosion and movement of sediments off-site into the surrounding receiving waters. The ESCP provides erosion and sediment control measures for the site based on the relationship between erosion hazard (calculated for each site component) and erosion risk (based on rainfall). The controls are shown in Figure 6-3. As required of the EIS ToR, the ESCP has been prepared by a Certified Practitioner in Erosion and Sediment Control (CPESC). In accordance with the guidance provided in the ESCP, progressive ESCP's will be developed and implemented as required at each stage of the mining operations. These plans will provide erosion control measures based on seasonal erosion risk and conforming the *Best Practice Erosion and Sediment Control Guidelines* (IECA, 2008).

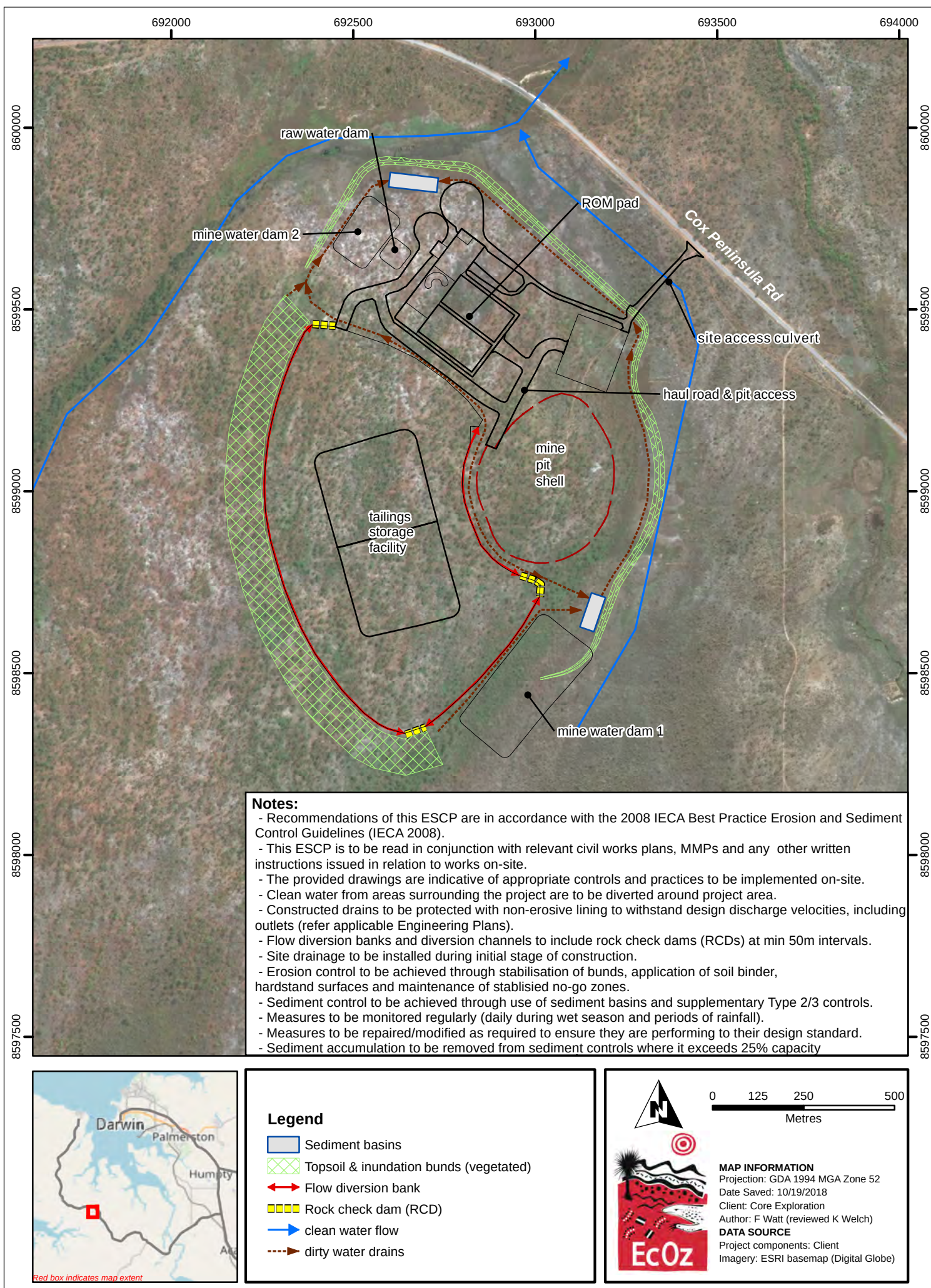
6.3.3 Rehabilitation and closure

Rehabilitation failure and landform instability are key issues that could lead to erosion during the rehabilitation and closure phase. To mitigate and manage potential impacts to land and soils, a Mine Closure Plan has been included in the EIS (Appendix D). The plan details how the site will be rehabilitated to achieve final land use objectives, and includes completion criteria and performance indicators for monitoring rehabilitation outcomes.

The Mine Closure Plan describes a progressive approach to rehabilitation. The outer walls of the WRD and the inundation bund will be rehabilitated progressively to minimise the exposure of bare earth in these landforms. Progressive rehabilitation will also be used as a rehabilitation trial, with the outcomes used to inform changes to rehabilitation methods for the remaining disturbance areas at the end of the mine life. The requirement for soil improvement and relevant ratios of additives, will be determined during rehabilitation trials. Methods for monitoring of vegetation and erosion, and triggers and contingency actions for improving rehabilitation outcomes, are provided in the plan. If erosion that is rated significant or higher on the severity scale is detected anywhere within the project footprint, a CPESC will advise on the appropriate control actions.

The rehabilitation and closure phase risk assessment included in the Mine Closure Plan, identifies and assesses potential impacts to each of the NT EPA's environmental factors during the rehabilitation and closure phase. The risk assessment is based on the closure concepts and the assumptions made in assessing risks have been documented in the risk register. The risk assessment considers potential legacy issues associated with early unforeseen closure as required of the EIS ToR. The risk assessment will be updated as the final landform designs are developed and the closure program is finalised.

Feedback from the EIS process will be used to finalise the closure objectives and updated the risk assessment if required. If the proposal is approved, an updated version of the Mine Closure Plan will be submitted for review and endorsement by DPIR as part of the mining authorisation process under the *Mining Management Act*.



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Figure 6-3. Erosion and sediment control plan site layout

6.4 Statement of residual impact

The environmental risk assessment process determined that the greatest impacts to land and soil associated with the proposal relate to soil erosion from cleared areas and constructed landforms, in particular the WRD. Without effective management, there is an inherently high risk of erosion causing impacts to land and soil. The proposal poses an inherently low risk of soil contamination either by hydrocarbons or other hazardous materials, or from AMD.

The key measures proposed to reduce the likelihood of erosion and off-site release of sediments, are good engineering design and materials selection, and implementation of the ESCP. The upcoming geotechnical program will identify sources of construction materials and will ensure that materials with dispersive characteristics are not used in construction of the WRD annulus, or other exposed surfaces. The geotechnical program will be undertaken by suitably qualified consultants. The ESCP has been prepared by a CPESC in accordance with the *Best Practice Erosion and Sediment Control Guidelines*. These measures combined are expected to maximise the long-term geotechnical stability of the constructed landforms and provide for good erosion and sediment control outcomes when effectively implemented.

The Mine Closure Plan provides closure objectives for each component of the mine site and a works program for achieving these objectives. The closure concepts provided in the plan are based on feasibility stage designs, and will be updated as more detailed design work is completed. The closure objectives will be finalised using feedback from the EIS process. Addressing these information gaps is not expected to significantly alter the outcomes of the risk assessment. The closure concepts, management framework and monitoring program provided in the Mine Closure Plan are reasonably expected to provide for adequate stabilisation of the site and prevention of off-site movement of sediments, when implemented effectively. The residual risk has been rated as high until the final design details are available to better inform assessment and management of the risk. The requirement for the final plan to be authorised by the DPIR under the *Mining Management Act* provides an addition layer of regulatory scrutiny and oversight beyond the EIS process, and should ensure that the risk is reduced to as low as practicable.

Unexpected early closure of the mine could increase the risk of landform instability and erosion; however, due to the short mine life and the economics underpinning the project, the likelihood of early closure is considered low. In any event, risks should be adequately identified addressed through implementation of a Care and Maintenance Plan, which is a requirement pursuant to the *Mining Management Act*. The bond – required as part of the mining authorisation process – will provide for stabilisation of the site. These measures are expected to decrease the likelihood of significant erosion and off-site impacts; however, the uncertainty associated with early closure scenarios means the risk remains high.

The above measures combined are expected to ensure that any impacts to land and soils are identified early and addressed so that erosion is limited to within the disturbance footprint and immediate surrounds. The proposal is not expected to result in movement of significant amounts of sediment off-site into downstream watercourses. Potential water quality impacts associated with erosion and sedimentation are further discussed in Chapter 8.

6.5 References

References cited in this chapter are listed below.

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GRANTS LITHIUM PROJECT

Draft Environmental Impact Statement

Chapter 7

Hydrological Processes

7 HYDROLOGICAL PROCESSES

Hydrological processes refer to the occurrence, distribution, connectivity, movement and quantity of surface water and groundwater. The NT EPA's objective for this environmental factor is to:

Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

This objective recognises the fundamental link between hydrological regimes and the environmental values they support. Values can include water-dependent ecosystems, amenity, cultural values, recreational, public drinking water, and agricultural and industrial use of water. There is also an integral link between hydrological processes and maintaining water quality, which is discussed separately in Chapter 8.

This chapter describes the hydrological regimes of the catchments and watercourses within and downstream of the Grants Lithium Project area, and the groundwater aquifer that lies beneath. The values in the area that rely on groundwater and surface water flows are identified/mapped, and the ways in which the proposed mine could alter flows and affect these values are discussed. The mitigation and management measures that Core will implement to avoid and/or reduce impacts to groundwater and surface water are summarised. At the end of the chapter, a statement of residual impact is made detailing the extent to which the proposed mitigation and management measures will address potential impacts to ensure that the NT EPA's objectives for this environmental factor are met.

The content of this chapter has been developed specifically to address Section 4.2.2 of the EIS ToR (refer Appendix A), and has been informed by baseline assessment and modelling of surface water and groundwater (Appendix H and Appendix I) and by the project Water Management Plan (Appendix C) that is a requirement for authorisation of mining activities under the *Mining Management Act*.

7.1 Existing environment and values

This section describes the existing surface water and groundwater hydrological processes within and downstream of the project area, and the beneficial uses of these resources.

7.1.1 Surface water

The hydrological conditions of the project area have been investigated by a combination of site assessments and modelling of baseline catchment conditions. Complete reports are provided at Appendix H and key information is summarised below.

Rainfall and evaporation

The project area is located in the wet-dry tropics. The Wet season is typically from November to April, and the Dry season from May to October. The closest Bureau of Meteorology (BoM) rain gauges to the project area that have consistent long-term data (at least 20 years) are:

- Darwin River Dam (Station No. 14183); 24 km south-east of project site
- Territory Wildlife Park (14264); 22 km east
- Wagait Beach (14238); 22 km north
- Dum in Mirrie (14277); 32 km west

Mean monthly rainfall and evaporation recorded at these gauges is graphed in Figure 7-1.

Monthly rainfall averages at all four are very similar; they are considered representative of project site rainfall. Typically, January and February are the wettest months, with monthly average rainfall totals between 335 and

448 mm. June, July and August are the driest months, when usually no rain falls. Average annual rainfall for these sites ranges between 1622 mm (Darwin River Dam) and 1827 mm (Territory Wildlife Park).

The nearest available mean monthly pan evaporation data is for Darwin Airport BoM station (No. 14015). Maximum evaporation occurs in October, and minimum in February (pan evaporation data from World Meteorological Organisation <http://data.un.org/>). Average annual pan evaporation is 2688 mm, which exceeds average annual rainfall by at least 860 mm. Average monthly rainfall significantly exceeds evaporation during the Wet season months March, whereas average monthly evaporation significantly exceeds rainfall during the late Wet season, and throughout the Dry season and early Wet season.

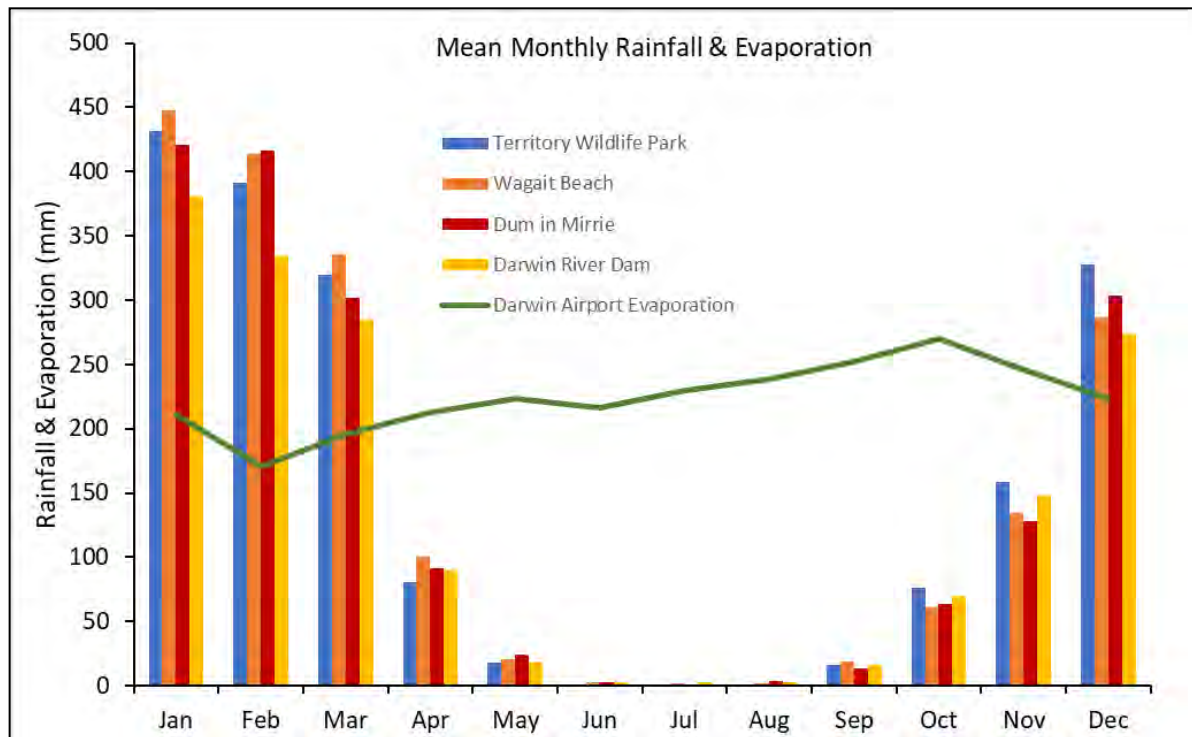


Figure 7-1. Mean monthly rainfall and pan evaporation for closest BoM sites with reliable data

Catchments and drainages

Catchment boundaries and drainage lines within and surrounding the project area are shown in

The topography of the project area is relatively flat and stream slope gradients are less than 1%. The highest elevation is 35 mAHD in the south of the ML along the Darwin Harbour / Bynoe Harbour watershed, and the lowest is 10 mAHD where drainage lines flow under the Cox Peninsula Road (derived from National Digital Elevation Model 1 Second Shuttle Radar Topography Mission: <http://www.ga.gov.au/elvis/>).

The majority of ML31726, and the entire mine site disturbance footprint, are located in the West Arm catchment of Darwin Harbour. The proposed mine site intersects two stream catchments, which form the headwaters of the West Arm catchment. The area of 'Catchment 2' is 7.2 km² and 'Catchment 5' is 6.4 km².

Minor drainage lines to the south and north of the proposed mine site, flow north through culverts beneath the Cox Peninsula Road, and meet approximately 1 km downstream. Downstream of this confluence, the watercourse maintains some small pools into the Dry season. A further 1 km downstream, the watercourse discharges into a mangrove-lined tidal inlet of, West Arm. The minor drainage lines that originate in the south-west corner of ML31726, outside of the mine site disturbance footprint, flow south-west into a tidal inlet of Bynoe Harbour.

The existing Observation Hill dam (OHD), proposed to supply a portion of mining water requirements, lies within the Charlotte River catchment of Bynoe Harbour. The dam is situated at the headwaters of a drainage line that flows south and discharges into the lower reaches of the Charlotte River, approximately 3 km downstream. The ephemeral watercourse downstream of the OHD has a well-defined channel starting from a point around 1 km downstream of the dam wall. Late-Dry season (October 2017) site inspection of this watercourse observed pools but no visible flows downstream of the dam wall.

Stream flows

Stream flows for each of the sub-catchments intersected by the mine site and OHD have been modelled for low, average and high rainfall years (Appendix H). Graphs showing the baseline monthly stream flow discharges for sites downstream of the mine site and of OHD are provided in section 7.3 for an average rainfall year. The graphs show that very limited flows occur in the early Wet season months of November and December. During January and February flows become more sustained, with peaks in discharges occurring in response to rainfall events. Flows peak in late February and March, before decreasing through late March. In an average year, flows cease in early April, when the watercourses downstream of the mine site become a series of pools that gradually dry out.

There is significant variation in stream flows over low, average and high rainfall years. During a low rainfall year, stream flow discharges from the mine site affected catchment total 8,725ML, compared to 16,560ML for an average rainfall year and 28,482ML for a high rainfall year. The stream flows in an average year are 52% more than during a low rainfall year and 58% less than during a high rainfall year. These variations have been taken into consideration when developing a sustainable water supply for the project, and also when considering potential impacts to downstream flows, which varies slightly (but not significantly) depending on rainfall (refer section 7.3).

Wetlands

No permanent wetlands are located within or surrounding the project area. Some seasonally inundated areas are patchily distributed through the ML. A site survey undertaken by EcOz Environmental Consultants in June 2018 (refer Appendix R) recorded shallow pools remaining in the drainage lines to the north and south of the mine site footprint, and also wet areas downstream of OHD, including some deep pools near the foot of the dam wall, which appear to remain wet as a result of seepage. These areas support sedges and herbs in the ground layer during the wet and early dry season, but mostly dry out later in the dry season.

Reservoirs

OHD is located 5 km south-south-east of the mine site and was built by a previous operator that mined tin and tantalum in the area in the 1980's. The dam wall is of earth construction, approximately 10m wide at the top. The current dam spillway height is 30mAHD and the modelled capacity of the dam is 364 ML. Figure 7-3 shows the estimated bathymetric surface of OHD.

There are also a number of pit lakes in the area that have formed following past open pit mining activities. The location of these surface water features is also shown in Figure 7-3.

Beneficial uses

The project and surrounding catchment are largely undeveloped vacant crown land, with only minor disturbances such as the sealed Cox Peninsula Road, unsealed access tracks, historic mining pits and dams, and mineral exploration activities. There are no residences, farms or industry within the catchment areas upstream or immediately downstream, and no commercial or domestic uses for which surface water is currently being extracted. Berry Springs, a small township and rural residential area 22 km east of the project, is the closest area of intensive land-use; mainly horticulture and some cattle grazing. This area is located in the Middle Arm catchment of Darwin Harbour and does not receive surface water flows from the project area.

The project area lies within the Darwin Harbour Region declaration of surface water beneficial uses under the NT *Water Act* (NT Government Gazette No. G27, 7 July 2010). This declaration states that in relation to waterways within the Darwin Harbour Region:

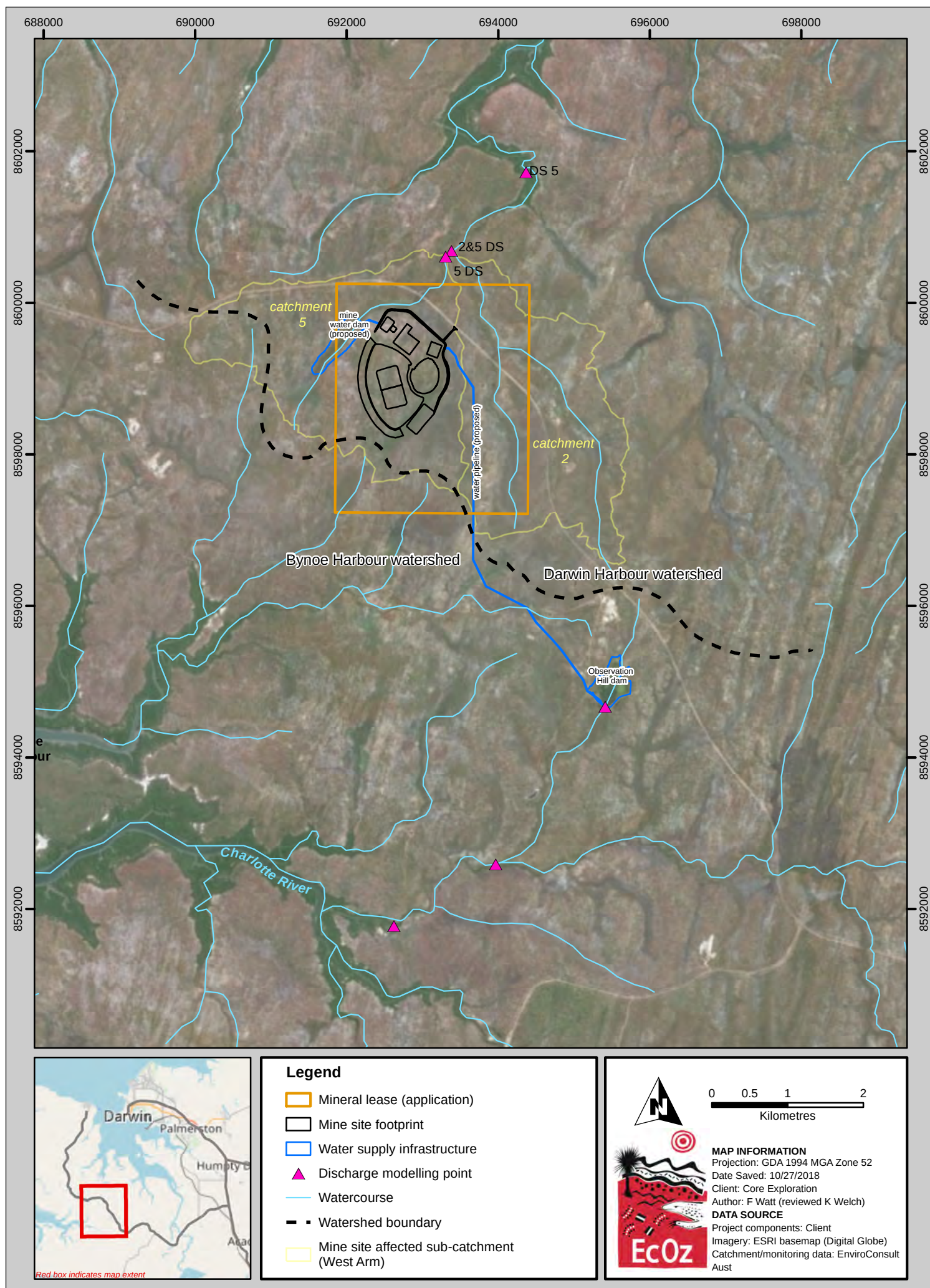
The protection of environment, cultural (aesthetic, recreational and cultural), agriculture and rural stock and domestic to be the beneficial uses of water that apply to all natural waterways in the Darwin Harbour catchment, including all named and unnamed springs, creeks, rivers, lakes, lagoons, swamps or marshes.

Table 7-1 lists the declared beneficial uses and describes the relevance to the project area.

In relation to management and control of surface water extraction, the project area lies within the Darwin Rural Water Control District declared under the NT *Water Act*. Pursuant to Section 41 of the Act, a permit is required to construct a dam. Under section 45, a licence is required to take surface water. At the time of writing, mining activities were exempt from this requirement; however, an amendment to the Act to encompass mining is expected in early 2019. Core is anticipating having to apply for these permits in order to construct and extract water from dams.

Table 7-1. Darwin Harbour beneficial uses and relevance to project area

Declared Beneficial Use		Relevance to project area
Freshwater	Agriculture	There are no agricultural land uses associated with the project area. The land tenure is vacant crown land. Future agricultural development is possible; however, there is no current indication that this is likely to occur.
	Environment	The macroinvertebrate and fish communities recorded in freshwaters downstream of the mine site are considered typical of low order watercourses in the NT (GHD, 2017). No important or sensitive aquatic habitats have been identified. The freshwaters support a narrow band of riparian vegetation that protects stream banks from erosion. The freshwater flows discharge into the hinterland mangrove communities of West Arm, which are a significant vegetation type according to the <i>NT Land Clearing Guidelines</i> .
	Cultural	As the freshwaters downstream of the mine site are ephemeral, potential cultural and social values are limited. Aquatic surveys undertaken by GHD (2017) recorded small fish species typical of low-order watercourses but did not identify the presence of typical food species.
	Rural stock and domestic	The surface water downstream of the project area is not used as a water supply. The groundwater aquifer beneath the project area is also not used as a water supply; the nearest registered bore is 12 km away.
Saltwater	Aquaculture	There are no aquaculture land uses in the West Arm catchment.
	Environment	Darwin Harbour is recognised as a Site of Conservation Significance that supports a range of estuarine, freshwater and terrestrial environments including extensive areas of tidal mudflats and one of the largest and most diverse areas of mangroves in the Northern Territory. The key environmental values of West Arm relate to the intact mangrove environments
	Cultural	The cultural importance of West Arm is not publically documented; however, it is assumed the area has cultural value to local Aboriginal people. It is an important recreational fishing area.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 7 maps\Figure 7-2 Surface water catchments of the project area.mxd

Figure 7-2. Map of surface water catchments, drainages and reservoirs

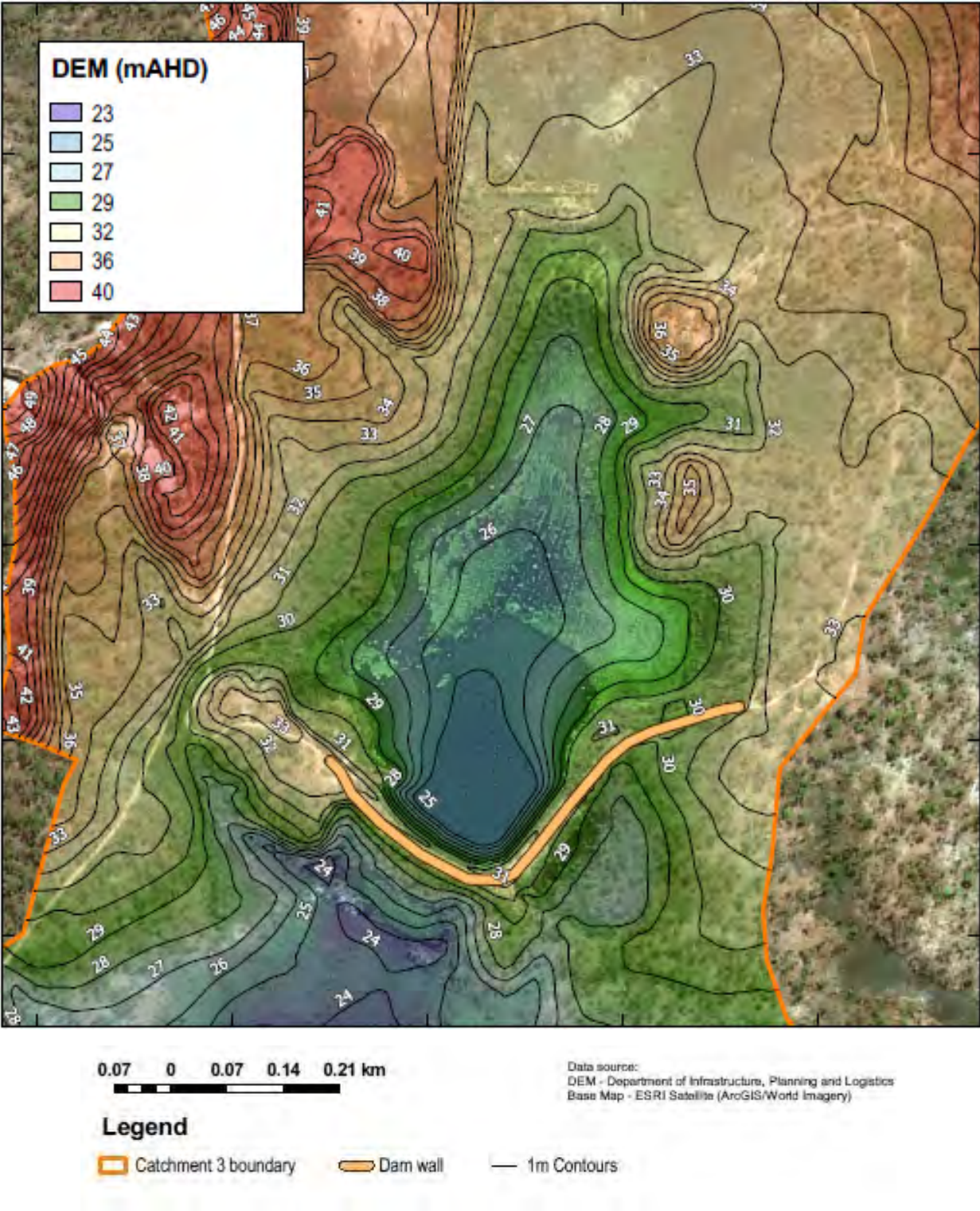


Figure 7-3. Observation Hill dam bathymetry

Source: EnviroConsult Australia Pty. Ltd. (2018)

7.1.2 Groundwater

The aquifer/s that occur beneath the project area have been investigated by drilling of monitoring bores (GHD, 2017) and developing a hydrogeological model for the project area (Knapton and Fulton, 2018). The preliminary groundwater investigation undertaken by GHD (2017) involved the drilling and construction of six monitoring bores, hydraulic testing (recovery and slug tests) and water quality sampling. Bore details are provided in Table 7-2 and locations are shown in Figure 7-4. The complete groundwater modelling report is provided in Appendix I. Based on the classification scheme presented by Barnett et al. (2012), the groundwater model developed for the project area is deemed to be Class 2, which is suitable for "providing estimates of dewatering requirements for mines and excavations and the associated impacts".

Table 7-2. Groundwater monitoring bore details

Bore ID	RN	Depth (m)	Screened interval (m)	Screened formation	Details
GWB01	040093	160	88-154	Fresh BCF	Deep bore in proposed pit shell, representative of groundwater inflows to the pit.
GWB03	040096	63	50-62	Fresh BCF	Deep bore located on site of proposed WRD, up-gradient of proposed pit (W side).
GWB06	040097	18	6-12	Clay-highly weathered shale	Shallow bore in surface aquifer; paired with deep bore GWB07; both up-gradient of mine footprint (SE side). Note: This bore is contaminated with cement and cannot be used to assess water quality; only groundwater levels.
GWB07	040098	63	49-61	Fresh BCF	Deep bore in BCF fractured rock aquifer; paired with shallow bore GWB06, both up-gradient of mine footprint (SE side).
GWB08	040095	60	47-59	Slightly weathered to fresh BCF	Deep bore in BCF fractured rock aquifer; paired with shallow bore GWB10, both down-gradient of mine footprint (N side).
GWB10	040094	12	0.5-6	Laterite	Shallow bore in surface aquifer; paired with deep bore GWB08; both down-gradient of mine footprint (N side).

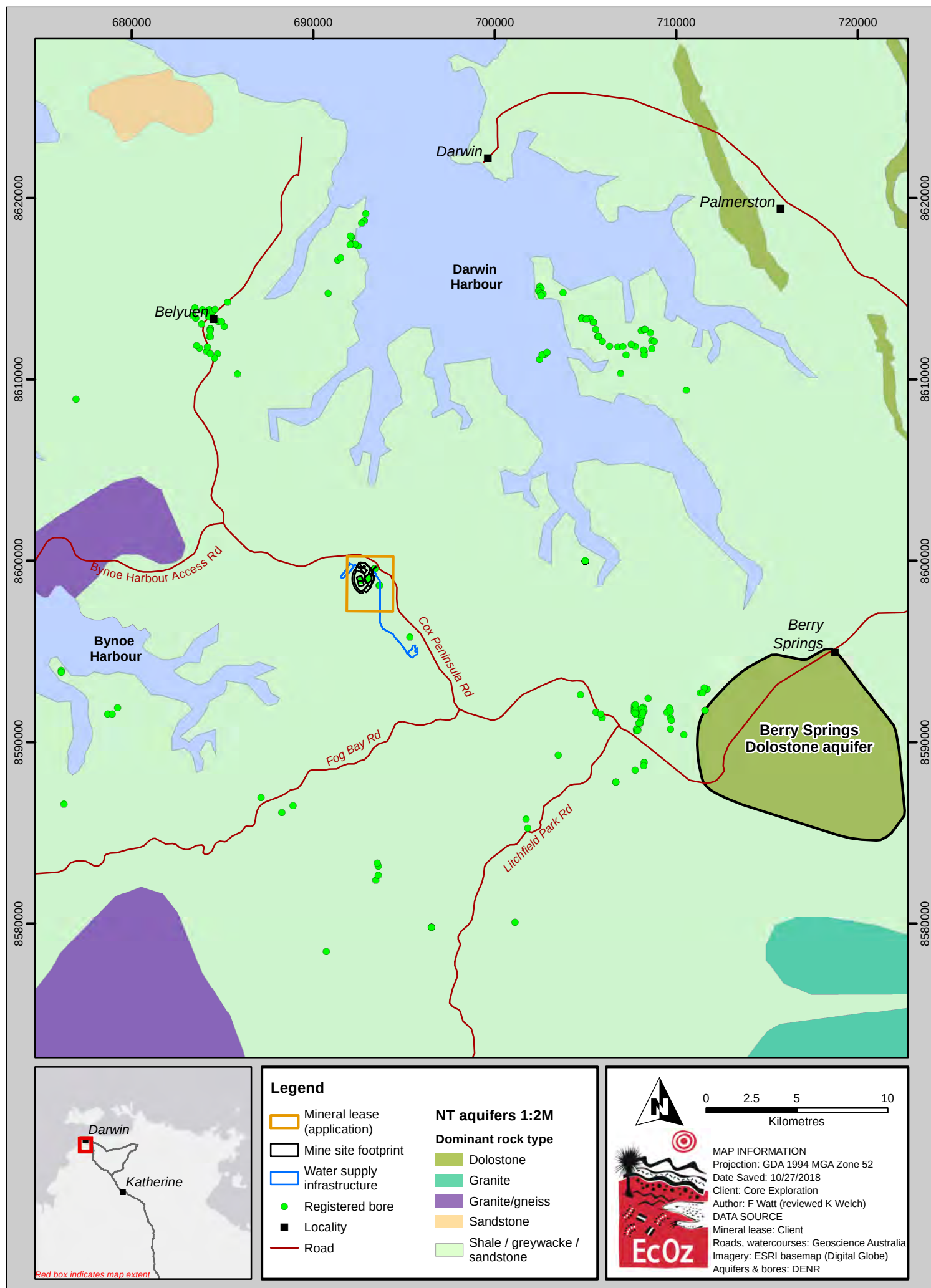
RN – unique bore registration number assigned to the bore, corresponding to statement of bore form.

Local and regional aquifers

The substrate and underlying geology of the area around the proposed mine footprint comprises a thin surface layer (less than 5 m thick) of Cainozoic sediments – mainly laterite gravel, sand and clay – that are underlain by Proterozoic Burrell Creek Formation (BCF) comprising shales, siltstones, and strongly foliated phyllite. The shallow Cainozoic sediments have potential for minor aquifers in areas with thicker alluvial cover (i.e. along drainage lines) or where the laterite profile is more extensive. The BCF hosts the principal aquifer beneath and in the immediate surrounds of the study area. It is categorised on the *Cox Peninsula Hydrogeology Map* (NRETA, 2008) as a fractured and weathered rock aquifer with minor groundwater resources.

Typical bore yields are less than 0.5 L/s, largely due to the lack of primary porosity and open fracturing within the BCF. This mapped category has the lowest groundwater resource potential in the Greater Darwin region. Higher yields have been recorded in the BCF where drilling intersects fracture zones or bands of quartz veining. Groundwater is typically intersected within and at the base of the weathering zone. The un-weathered BCF is less permeable, though groundwater intersections have been observed where drilling intersects discrete fracture zones within the formation.

The Berry Springs Dolostone aquifer is located around 22 km east of the project area. There are current concerns regarding over-extraction from this aquifer, and water allocation is subject to the *Berry Springs Water Allocation Plan 2016-2026* (DLRM, 2016). The BCF fractured rock aquifer beneath the project area has no connection to the Berry Springs Dolostone aquifer. The location of regional aquifers is shown in Figure 7-4.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 7 maps\Figure 7-4 Regional aquifers and groundwater monitoring bores.mxd

Figure 7-4. Map of regional aquifers and registered bores (within 20km radius)

Depth to water tables

Groundwater levels, referred to as standing water levels (SWL), have been recorded continuously since June 2017 by loggers that are installed in each bore. SWL have also been measured manually during water quality sampling rounds. SWL showed seasonal variation, peaking at the end of the Wet season in late January/early February 2018 and dropping through the Dry season until August 2018 (Figure 7-5).

SWL in the BCF aquifer ranged from 0.3 to 2.0 metres below ground level (mBGL) in the Wet season, and 4.0 to 6.5 mBGL in the Dry season. This equates to a seasonal fluctuation in the BCF aquifer of between 3.3 and 4.5 m, with the largest change in the deep bore GWB01. Levels in the shallow laterite aquifer (GWB10) ranged from artesian (flowing on the surface) during the Wet season, to around 2.7 mBGL in the Dry season.

All groundwater levels are highly responsive to rainfall, with spikes following individual rainfall events in the early Wet season, sustained levels close to ground level during the wettest months of the Wet season, and a steep drop in levels once Wet season rains finish (Figure 7-6).

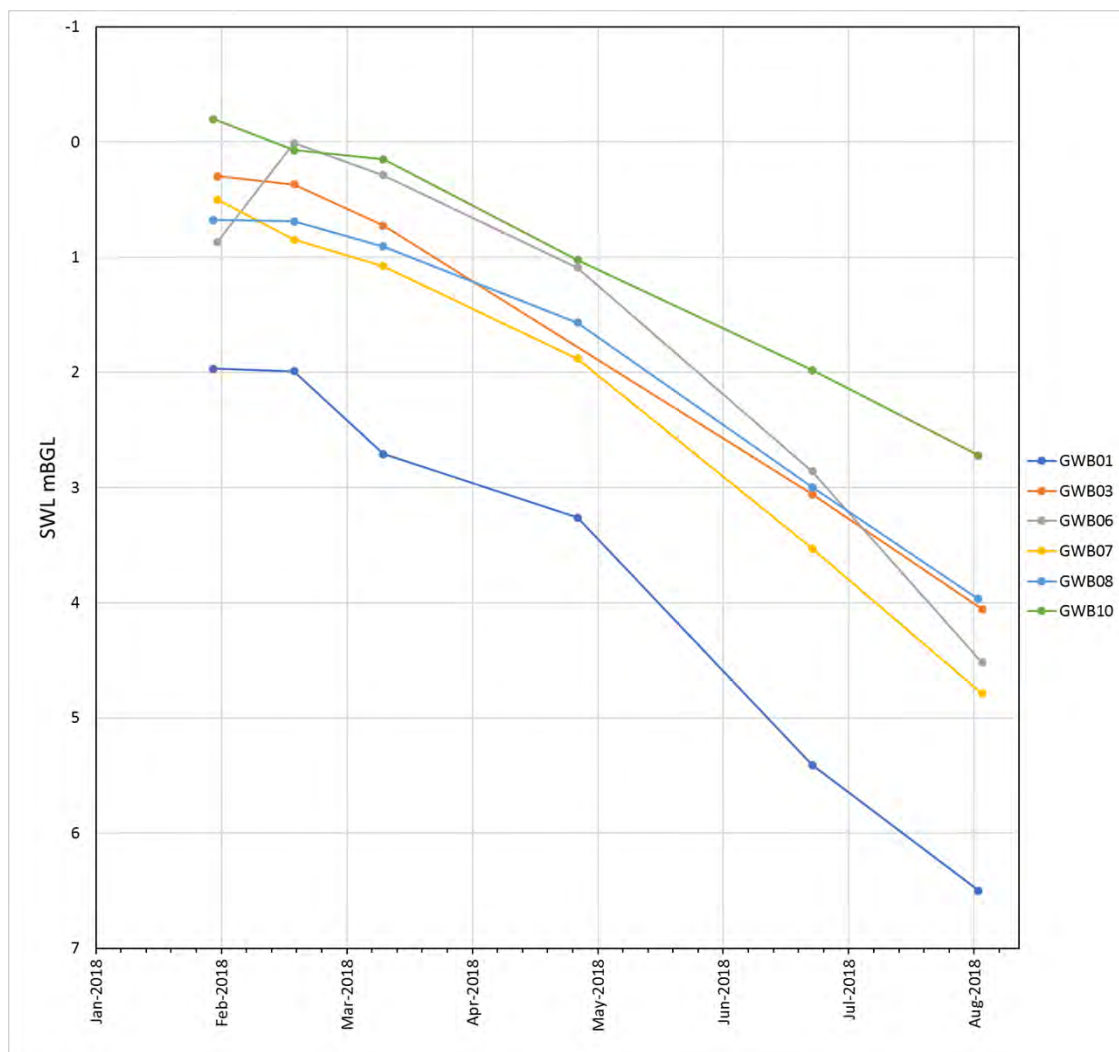


Figure 7-5. Graph of standing water levels measured in the six groundwater monitoring bores

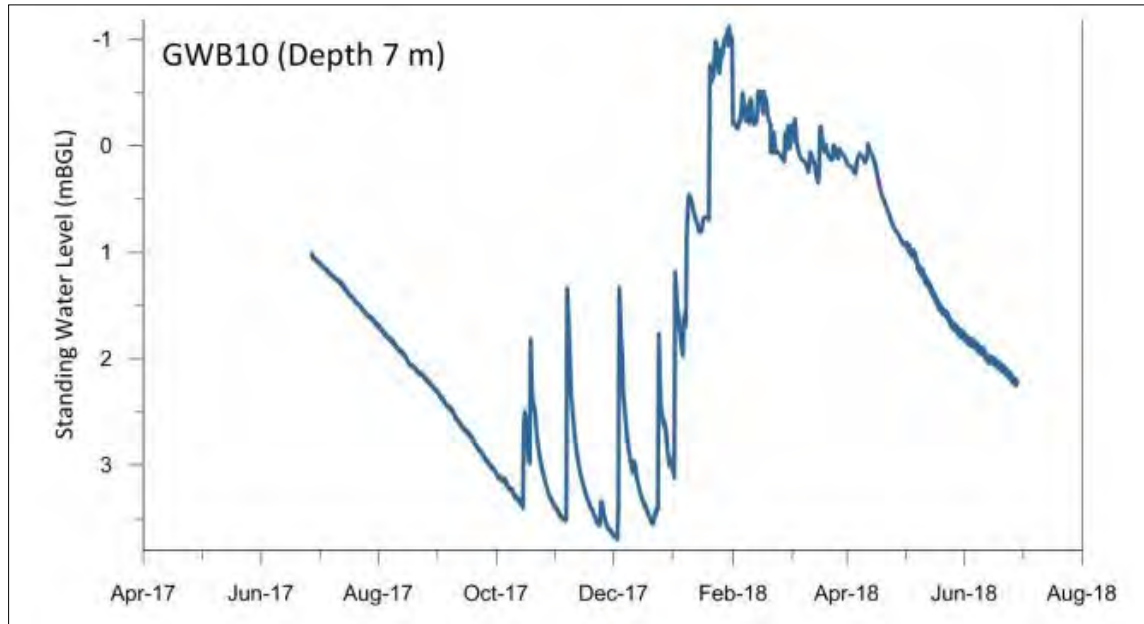


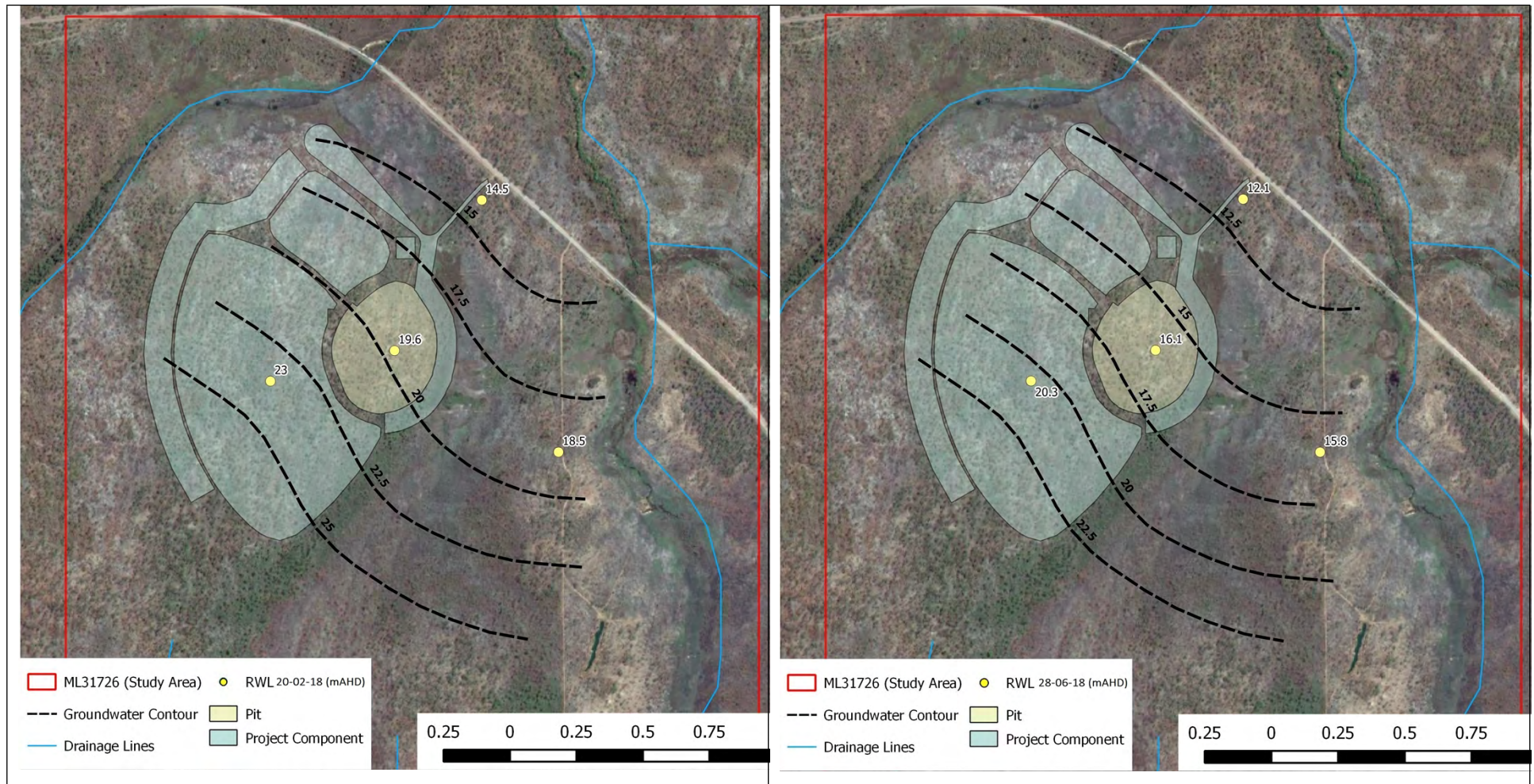
Figure 7-6. Hydrograph for shallow laterite aquifer from logger installed in Bore GWB10

Groundwater flows and volumes

Wet season and Dry season groundwater contours (potentiometric surfaces) for the project area were created from the SWL monitoring and accurate bore height survey data. Groundwater flow direction is north to north-east across the site (Figure 7-7). Groundwater flow pattern does not change seasonally. There is insufficient bore data to determine regional groundwater flow directions. However, the water-table aquifer typically represents a subdued reflection of the land surface, so it can be expected that regionally, groundwater will flow to the north toward Darwin Harbour, and locally groundwater will flow from the more elevated rises toward the lower-lying incised drainage lines.

The ease with which groundwater can move through the geological formation which hosts the aquifer is described by the hydraulic conductivity (K). Where hydraulic conductivity is high, water will flow through the aquifer easily, and the converse when hydraulic conductivity is low. Slug tests and recovery tests undertaken during establishment of the monitoring bores found the:

- Thin surface laterite aquifer has a moderately high K ranging between 0.068 and 1.7 m/day
- Weathered zone has a moderate K ranging between 0.022 and 0.16 m/day
- Fresh BCF has the lowest K ranging between 0.003 and 0.024 m/day.



RWL – rest water level, ater level in a borehole that has not been recently pumped, nor affected by nearby pumping. Numbers associated with groundwater contours are in mAHd

Figure 7-7. Map of potentiometric surfaces relative to mAHd during Wet season (left) and Dry season (right).

Source Knapton & Fulton (2018)

Surface connections

Given the low hydraulic conductivity of the aquifer beneath the proposed mine site, groundwater discharge to surface features in the region around the project area is likely to be minimal. Evapotranspiration and diffuse discharge are likely the dominant groundwater discharge mechanisms (Knapton and Fulton, 2018). Discharge to ephemeral drainage lines will also occur but, volumes are expected to be small due to the low hydraulic conductivity of the aquifer. Comparisons of baseline surface water quality with groundwater quality confirm this for the drainage lines upstream and downstream of the mine footprint (see Water Management Plan).

OHD is likely a source of recharge to the groundwater aquifer. Baseline surface water quality downstream of Observation Hill Dam indicates a degree of groundwater inputs (see Water Management Plan). Prior to construction of the dam, the area now occupied by the dam would also have been a source of wet season diffuse recharge. The presence of the dam potentially contributes to extended recharge of the aquifer into the dry season. The extent of this recharge is not known.

Existing users

The BCF fractured and weathered rock aquifer beneath the project area is a poor groundwater resource, with bore yields typically less than 0.5 L/s. Given this, there is limited use of this aquifer for domestic, stock or agricultural water supply. All existing bores and groundwater users within 15 km of the proposed pit were identified using NRMmaps (DENR 2018a); results are summarised in Table 7-3. The closest groundwater users (active bores) are located on the Cox Peninsula Road approximately 13 km east. The only registered bore in the vicinity is the abandoned production bore RN023177 located 4 km to the south-east of the proposed pit and 600 m north of OHD. The bore was drilled in the 1984 as a water supply for the Greenex Observation Hill tin and tantalite treatment plant.

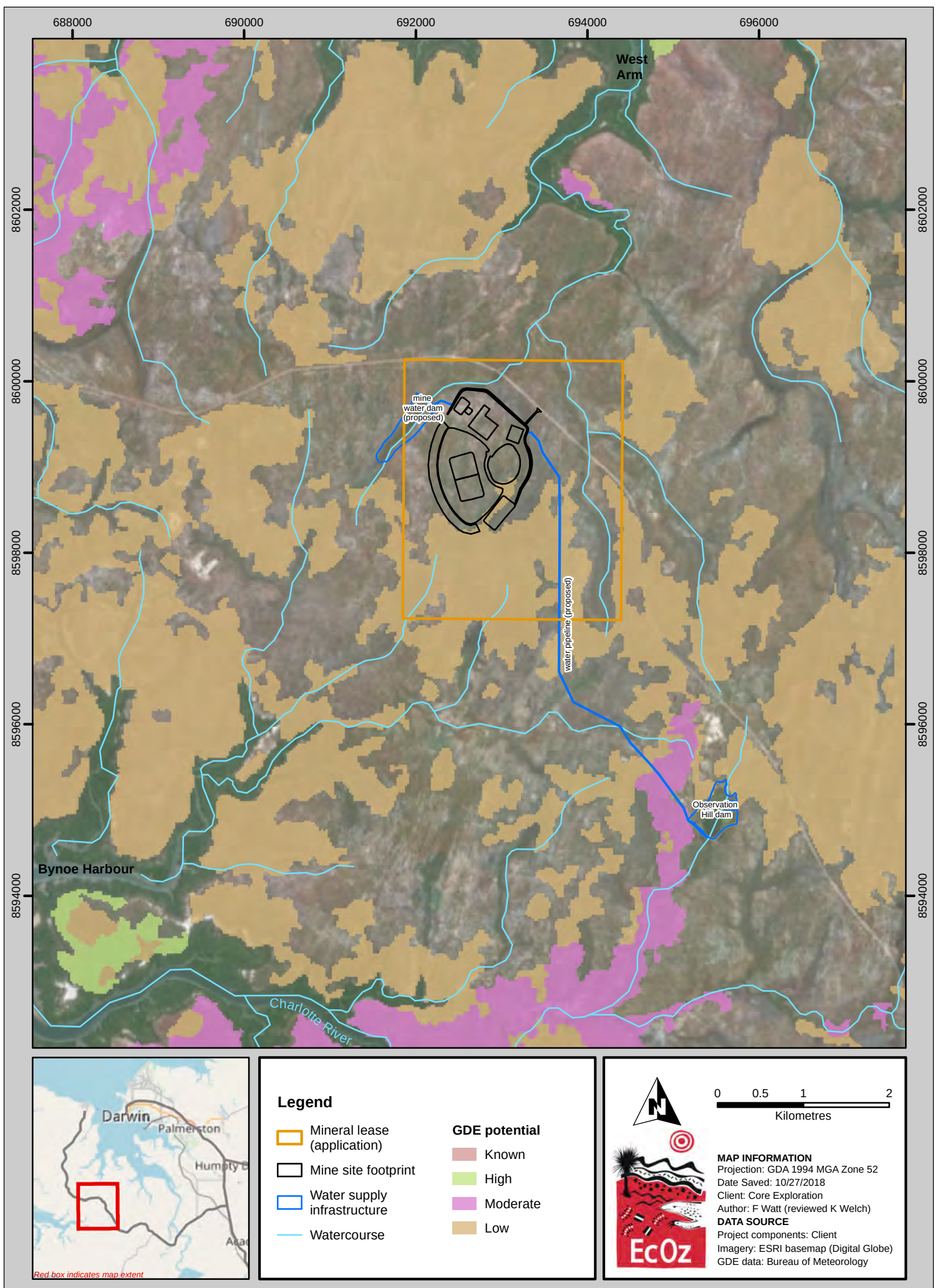
Table 7-3. Registered bores in the vicinity of project area

Bore ID	Easting GDA94Z52	Northing GDA94Z52	Distance from pit (km)	Use	Comment
RN023177	695330	8595810	3.9	Production	Abandoned Greenex mine bore
RN038217	688884	8586501	13.2	Production	Domestic
RN024936	704730	8592610	13.3	Production	Domestic
RN021574	685830	8610310	13.4	Investigation	NTG investigation bore
RN024254	687130	8586960	13.4	Production	Dogs Mine Bore
RN036421	688271	8586122	13.8	Production	Domestic

Groundwater dependent ecosystems (GDE)

Knapton and Fulton (2018) reviewed *The Groundwater Dependent Ecosystems Atlas* available through the BoM website (<http://www.bom.gov.au/water/groundwater/gde/map.shtml>). Figure 7-8 shows the occurrence of terrestrial GDE mapped at a national scale. There is a medium potential GDE located 2 to 3 km north of the proposed mine site; however, this is on the northern side of the tidal inlet, which would form a no-flow boundary that prevents connection to groundwater moving north from the project area. The low hydraulic conductivity of the aquifer, combined with the desktop information, indicates that GDEs are unlikely to occur within the area of the ML.

In relation to Observation Hill Dam, a moderate potential GDE is mapped up-gradient (west and north-west) and down-gradient along the drainage line that receives overflows from the dam. Late-Dry season (October 2017) site inspections of the watercourse found pools but no visible flows at a point starting around 2 km downstream of the dam wall. The well-developed riparian vegetation at this point indicates some level of assistance from groundwater in supporting this vegetation community throughout the dry season; however, there is no evidence of spring-fed surface water flows.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ18086 - Grants Project - EIS\01 Project Files\Chapter 7 maps\Figure 7-7. Potential GDEs in the project area and surrounds.mxd

Figure 7-8. Map of groundwater dependent ecosystem potential

7.2 Project water demand and supply

Details of the project water requirements and proposed sources of supply are provided in Chapter 2. In summary, forecast peak daily water demand for the mine site is 2.02 ML per day. This volume represents the greatest anticipated daily water requirement and is considered a conservative estimate. Water sources for the mine will comprise:

- Water pumped from two off-site dams; the existing OHD and the proposed new mine site dam.
- Groundwater/rainfall in-flows to the pit, which will be dewatered to an onsite storage (MWD 1).

A monthly water balance was developed for the life of mine in accordance with the *Minerals Council of Australia Water Accounting Framework*. Predicted make-up water volumes range from around 30 ML/month in the first month of mining when groundwater inflows are minimal, to less than 1 ML per month during the peak of the Wet season (Jan/Feb). After month two, the average volume of make-up water required per month is 1.5 ML.

Whilst the water balance indicates that a large portion of the project water supply may be met by re-use of water onsite (i.e. pit dewatering and decant water return from the TSF), these volumes are indicative. To ensure water security for the project in the event of lower-than-average rainfall years or less than forecast groundwater inflows or reuse volumes, the proposal includes extracting water from off-site dams.

Details of the project water supply infrastructure are provided in Chapter 2 Section 2.5. The reduction in surface water flows as a result of the proposed use of dams to supply the mine site water requirement was modelled as part of the site hydrological studies and has been used as the basis for the discussion of impacts presented in section 7.4.

7.3 Modelled changes to surface water flows

There will be some alteration of surface water flows in the affected sub-catchments of West Arm and Charlotte River due to changes in flow paths caused by the presence of the mine site infrastructure and construction of water supply dams. Flows occur naturally in these systems in the months of November to April, with no flows for the remainder of the year. Hydrological modelling was used to predict the reduction in flow that will occur in each month at points within each catchment downstream of the mine site and dams. The modelling is based on the maximum water use scenario (i.e. maximum pump rate from the dams of 2.02 ML/day) and was undertaken for average rainfall year for the OHD catchment and for low, average and high rainfall years in the mine site catchment, to provide some indication of the variation in level of impact that might occur with different rainfall conditions. The outfall locations used in the modelling are shown on Figure 7-2. Complete details on the modelling methods and results are provided in Appendix H.

Figure 7-9 graphs the modelled stream flow discharges for the pre and post mining catchment. Table 7-4 shows the modelled monthly reduction in streamflow volume at three locations downstream of the mine site infrastructure and dam, for an average rainfall year. Of note is that the modelling does not take into account releases of water to the system from sediment dams and mine site water discharges, and so the modelled reduction in flow is over-estimated.

Figure 7-10 graphs the modelled stream flow discharges downstream of the OHD for the pre and post mining conditions. Table 7-5 shows modelled monthly reduction in streamflow volume downstream of the OHD. The reduced flow in this catchment will occur as a result of increasing the surface area of the OHD, which results in increased losses to evaporation and extracting water for operational purposes (operational conditions). As this dam already exists, the reduction in flow that results from the current spillway (current conditions) has also been modelled to provide an indication of both the total impact and the increase in impact associated with the proposed use of the dam by the project.

The potential impacts to environmental values associated with the modelled reduction in flow is discussed in section 7.6.1.

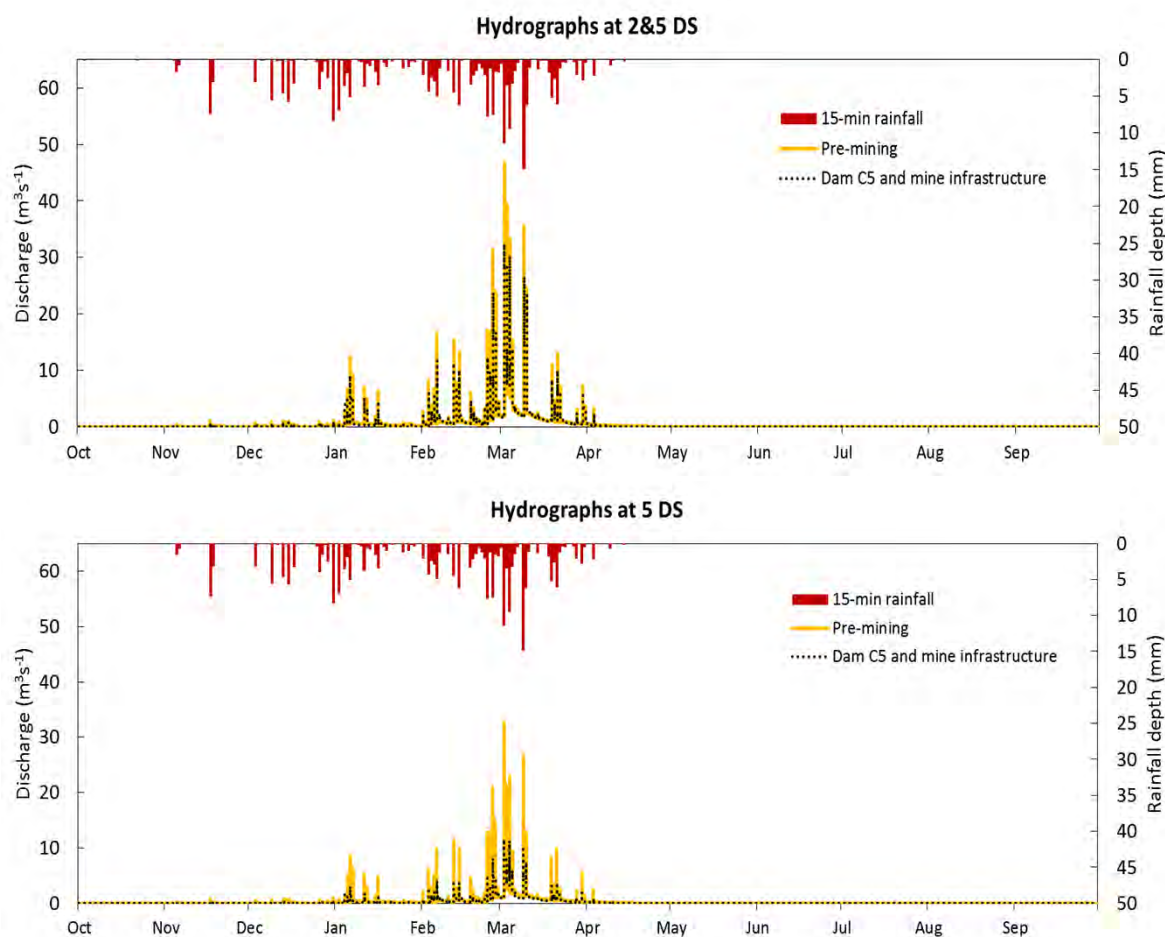


Figure 7-9. Graph of modelled stream flow discharge from mine site catchment pre and post mining (average rainfall year)

Table 7-4. Modelled monthly reduction in streamflow from mine site catchment (average rainfall year)

Outflow reference ¹	Description	Nov	Dec	Jan	Feb	Mar	Apr
2&5 DS	Confluence of stream flow from both mine site affected sub-catchments. Represents combined change in stream flow from the two mine site affected catchments.	43.7%	36.1%	27.5%	5.0%	2.5%	14.5%
DS 5	Approx. 2km downstream. Represents stream flow discharge to upper tidal limit of receiving waters.	24.1%	21.6%	19.2%	3.7%	1.8%	9.9%
DS 4	Approx. 6 km downstream. Represents stream flow discharge into upper branches of West Arm.	13.5%	10.9%	12.9%	2.6%	1.2%	6.4%

¹ Reference used in modelling report at Appendix H.

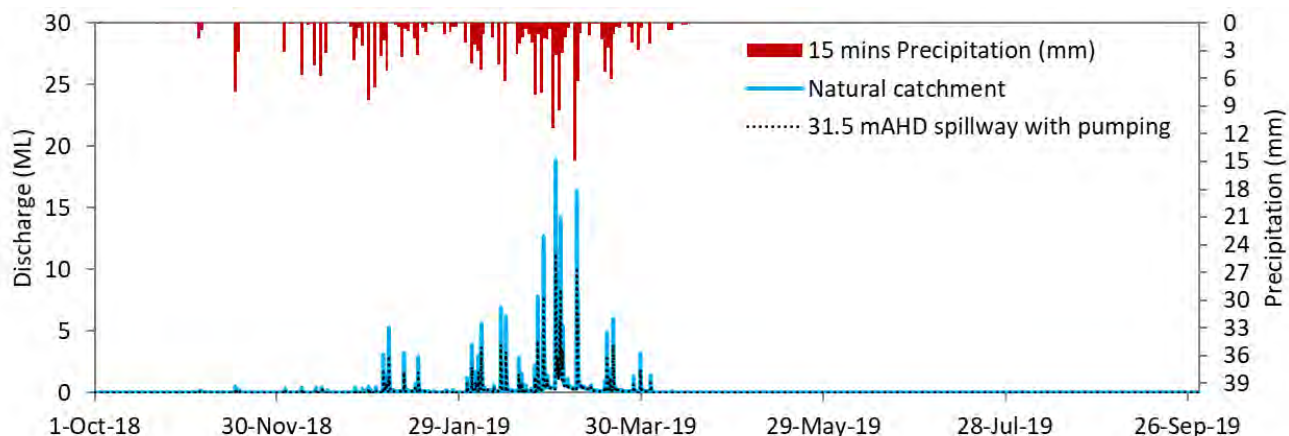


Figure 7-10. Graph of modelled stream flow discharge from Observation Hill dam catchment under natural and post mining condition for an average rainfall year

Table 7-5. Modelled monthly reduction in streamflow from Observation Hill dam catchment during in average rainfall year

Site Description	Conditions	Nov	Dec	Jan	Feb	Mar	Apr
Spillway	Current conditions	100%	100%	100%	48.6%	5.5%	24.2%
	Operational conditions	100%	100%	100%	100%	76.6%	100%
Approximately 3km downstream. Represents catchment outlet to Charlotte River.	Current conditions	30.3%	29.2%	23.3%	12.0%	1.7%	8.2%
	Operational conditions	30.3%	29.2%	23.3%	24.5%	19.6%	20.7%
Approximately 4.5 km downstream. Represents Charlotte River outlet to Bynoe Harbour receiving waters.	Current conditions	3.3%	3.3%	3.2%	1.6%	0.2%	2.1%
	Operational conditions	3.3%	3.3%	3.2%	3.2%	2.5%	2.8%

7.4 Modelled groundwater drawdown

Modelling was used to predict the extent of groundwater drawdown and/or alteration of groundwater flow directions associated with dewatering the pit during operations and allowing a pit lake to form post-closure. Complete details on the modelling methods and results are provided in Appendix I. This modelling was based on a pit depth of 150 m, which is slightly less than the proposed pit depth of 180 m. Given the results of the modelling indicate that drawdown will be limited, the increased pit depth is not expected to materially alter the model findings.

Dewatering of pit inflows is predicted to cause a drawdown of the groundwater aquifer within 1 km from the pit. Drawdown contours are shown in Figure 7-11. Drawdown within the pit shell will be to the depth of the pit (180 m). Within 100 m of the pit edge, groundwater drawdown is approximately 10 m below current levels. Outside of the mine site footprint the modelled drawdown is less than 1 m. Groundwater drawdown is not expected to impact groundwater levels outside the ML at any time during the mining operations.

Once operations end and pit dewatering ceases, groundwater levels are modelled to recover towards pre-mining levels. Drawdown contours at 70 years post-closure are shown in Figure 7-12. The water table is expected to be lowered by 20 m at the pit edge, reducing to 0.5 m at 500 m. The pit void is modelled to be a groundwater sink which will fill with water and stabilise at 7 to 8 m below the ground surface. The pit lake will act as a groundwater sink, meaning that groundwater in the immediate vicinity of the pit (within around 500 m) will flow towards the pit. This is because the total annual water loss from the pit from evaporation is greater than total annual groundwater and rainwater inputs.

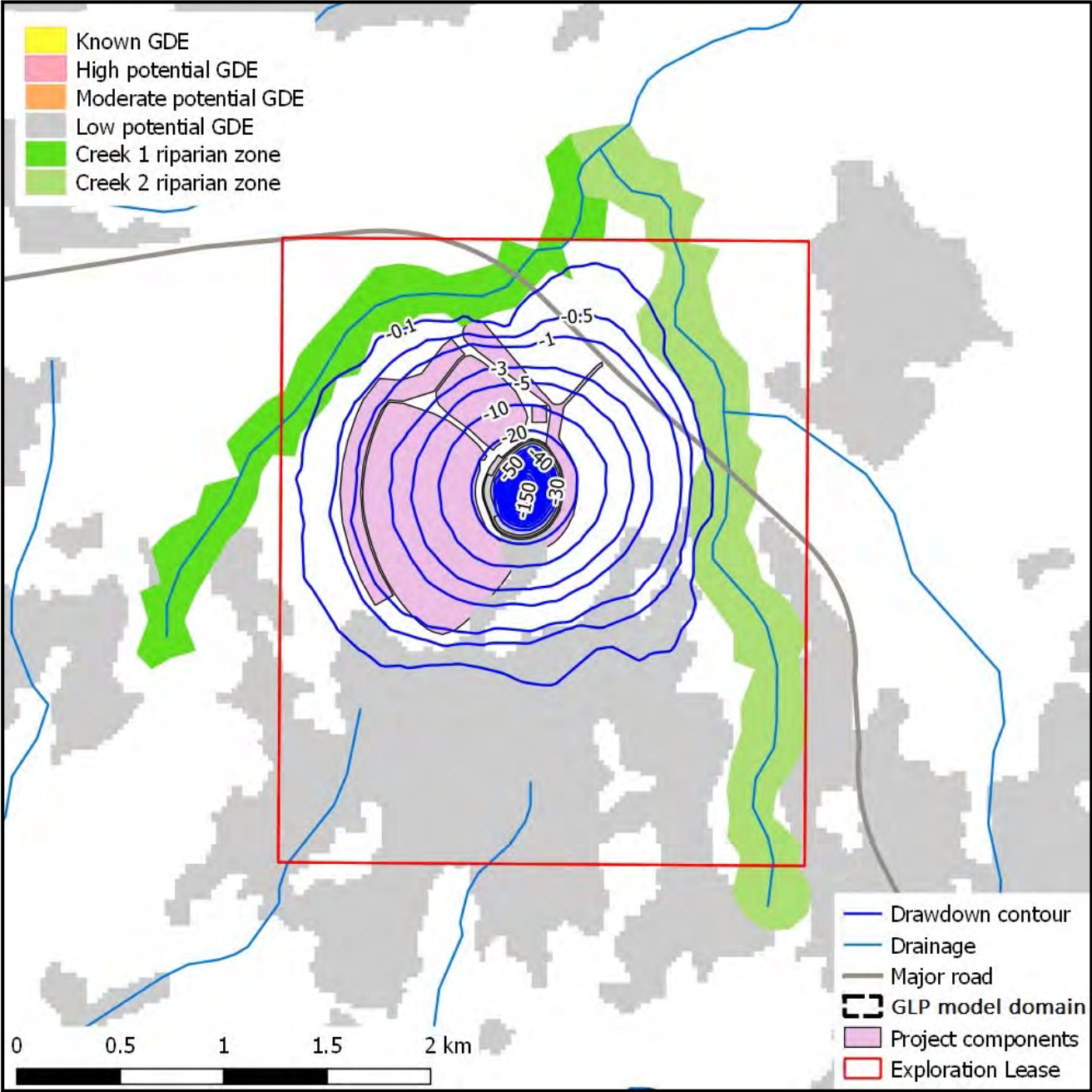


Figure 7-11. Map of groundwater drawdown contours immediately after mining

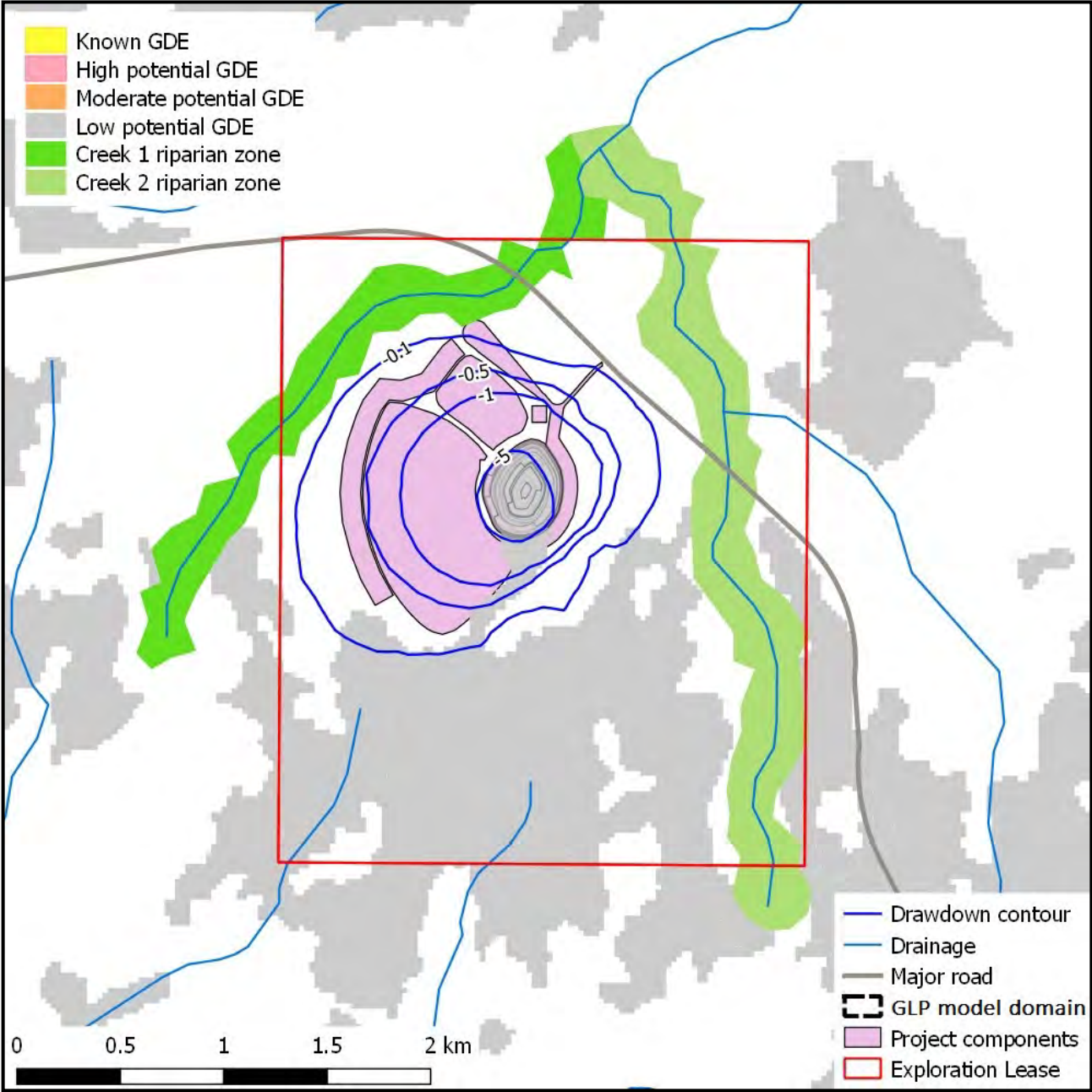


Figure 7-12. Map of groundwater drawdown contours 70 years' post- closure

7.5 Post-closure pit lake

Post-closure the pit void will fill with water over time to form a pit lake. The EIS ToR (Section 4.2.2.3) requests details of:

- “Estimated dimensions of stabilised water depth and pit edge of the mine pit lake.”
- “Predicted hydrological classification of the mine pit lake in accordance with the WA closure guidelines.”

This information is provided below from the groundwater modelling report (Appendix I).

At the completion of mining, the pit will infill over a period of approximately 50 years forming a pit-lake with a final water level of 12 – 13 mASL, which is forecast to be reached around 2070 (see Figure 7-13). The water level will be approximately 7 to 8 m below the existing land surface.

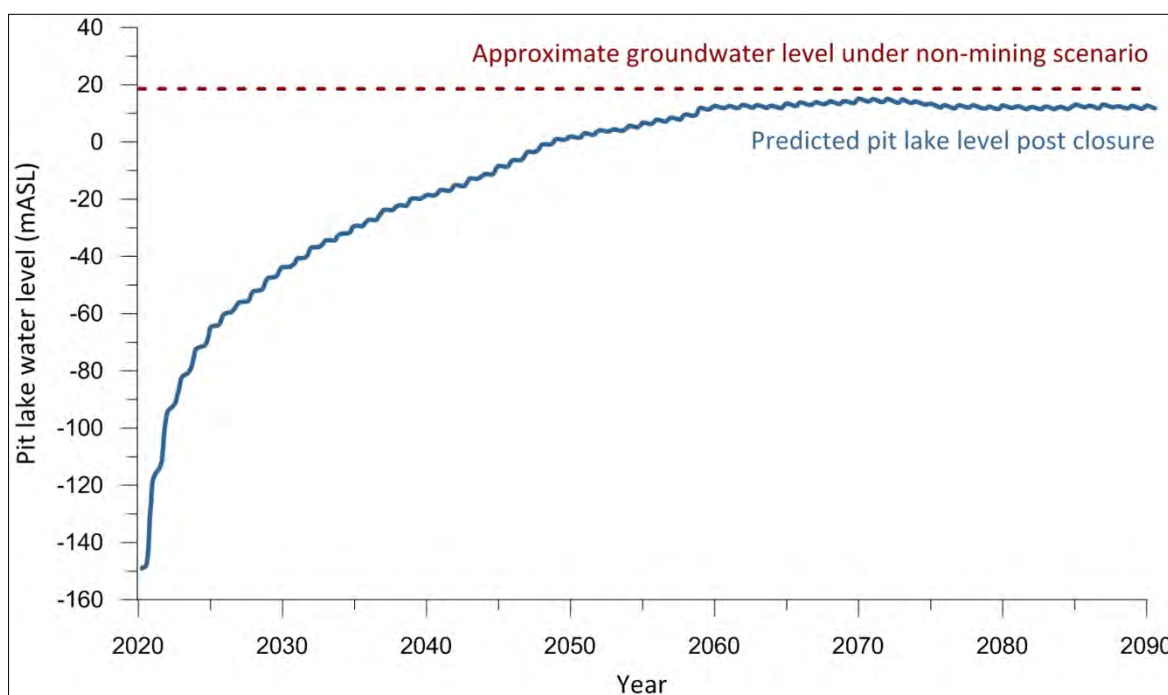


Figure 7-13. Graph of pit lake water level after mine closure in mASL (metres above sea level)

Under the modelled closure scenario, the pit lake is categorised as a groundwater sink using the classifications in the Western Australian *Interim Guidance on Pit Lake Assessments* (DMP 2018). A pit lake operating as a groundwater sink has an average lake level that is lower than the surrounding water-table, resulting in the creation of groundwater gradients toward the pit lake and groundwater discharge into the pit lake.

7.6 Assessment of impacts

The impact and risk assessment process (Chapter 4) identified the following potential impacts to hydrological processes:

Construction/operations phase

- Reduced surface water flows caused by mine site infrastructure and water supply dams.
- Changes to surface water flows caused by discharge of excess water.
- Groundwater drawdown associated with pit inflows and dewatering during mining operations.
- Flooding caused by a dam wall failure.

Rehabilitation/closure phase

- Reduced surface water flows caused by leaving dams in place.
- Groundwater drawdown associated with formation of a pit lake post-closure.
- Localised mounding of groundwater due to aquifer recharge from TSF cells.
- Flooding caused by a dam wall failure.

The likelihood of these impacts occurring and the significance (consequences) in terms of impacts to environmental values and other water users is discussed in the sections below.

7.6.1 Reduction in surface water flows

The combined impact of the mine site infrastructure and dam will change the original surface drainage and result in some reduction in flow at the catchment outlets that discharge to West Arm downstream of the mine site. The use of OHD as a water source will result in some reduction in flow at the catchment outlets that discharge to Charlotte River. The reduction in flow in both catchments is mainly due to increased losses to evaporation associated with construction of dams and water storages.

Section 7.3 provides details of the modelled monthly reduction in flows. The *NT Water Allocation Planning Framework* guideline (DENR 2018b) indicates that at least 80 % of flows at any time be maintained as water for environmental and other public benefit. This guideline has been used as the basis for assessing potential impacts to the downstream environment in each catchment, which are discussed below.

West Arm catchments

The greatest reduction in flows downstream towards West Arm is predicted to occur during the early Wet season months of November and December, when the naturally limited surface water flows are harvested by the mine site dam. At the catchment outlet approximately 1 km downstream of the mine site (point 2&5 DS on Figure 7-2), flows could be reduced by up to 44% in November, 36% in December and 27.5% in January. This reduces to between 5% and 15% for the remainder of the wet season (refer Table 7-4). As the riparian zone vegetation in this section of watercourse is naturally sparse and adapted to extended low or no flow conditions, any impact to the habitat is expected to be limited to minor changes in quality and/or species composition. These low order ephemeral streams do not have any notable habitat values and the reduction in flow is not expected to result in any impact to flora, fauna or aquatic species.

Moving further down the catchment to the point of discharge to the hinterland mangrove communities at the upper tidal limit of West Arm (approximately 2 km downstream of the mine site), the maximum modelled reduction in flow is 24% in November, dropping to 22% in December, 19% in January and less than 10% for the remainder of the wet season. The modelled reduction in flows exceeds the 20% guideline for water allocation to the environment by 2-4% in November and December. The potential impact of this reduced flow on the mangroves is discussed in Chapter 5, Section 5.2.5. In summary, any impact is expected to be very localised for the following reasons:

- The community will continue to receive some early freshwater inputs from stream flows (60-70% of natural flow) and also from overland flows.
- Natural flushing of the system will still occur over the wet season²
- The mangroves are expected to have some resilience to changes in flow timing due to reliance on ephemeral flows with a high level of natural variability.

There is no other current consumptive extraction in the sub-catchment that could be affected and, as the area is entirely within Core's exploration leases, there will not be any unforeseen future consumptive extraction in the short term. The reduction in flows post-closure will be similar to those during operations, although reductions will be slightly less because water will not be extracted for operational purposes, which will allow the dam to overflow earlier than it would otherwise.

Bynoe Harbour catchment

At the catchment outlet to Charlotte River, approximately 3 km downstream of the dam, flows could be reduced by 20-35% for most of the wet season (refer Table 7-5). The watercourses downstream of OHD, starting from a point around 2 km downstream of the dam wall, has a well-developed channel supporting riparian rainforest, which may be sensitive to reduced surface water flows (see Chapter 5, section 5.1.2). The potential impacts of reduced flows to environmental values are discussed in Chapter 5 (see section 5.2.5), which concludes that the riparian rainforest vegetation could experience some changes in species composition and/or diversity; however, the community as a whole is expected to persist.

Any impact to environmental values downstream is expected to be limited to the 1 km section of watercourse above the point of discharge to Charlotte River. The modelling results indicate that further down the catchment in the Charlotte River, the reduction in flow is less than 3.3 %, and therefore the riverine environment and mangroves in Bynoe Harbour are unlikely to be impacted. The potential for future mining development in this catchment on Core's ELs is noted. The cumulative impacts of any future development on flows in this area would need to be considered as part of future approvals processes.

7.6.2 Discharge of excess water

Discharge of excess water from the mine site is another aspect of the project that could alter surface water flows. Estimates of pit dewatering and subsequent discharge requirements are provided in Chapter 2 Section 2.12.3. Discharge of excess water from the mine site will be required during the Wet season – i.e. during times of peak flows. In the first year of mining, discharges are predicted from January to March, and in the second year discharges will be required from November to March due to the increased volumes of water entering the pit as it gets deeper. The release of excess water will be a relatively small percentage of the overall natural streamflow, apart from in November 2020 and December 2020 where the current modelled discharge requirements represent a significant portion of the natural streamflow (between 44% and 80%), which is very limited at that time of year³.

The Water Management Plan (Appendix C) addresses discharge requirements and monitoring. The plan considers that the increases in streamflow during the early-Wet season (for only two months during the whole mine life) are within the realm of natural variability. These increased volumes would easily be replicated by the occurrence of a few early-Wet season storms. Given this, it is proposed that early-Wet season releases of water be undertaken in pulses rather than as a slow continuous release, which could encourage the growth of algae and eutrophication along the drainage lines, and does not replicate natural storm activity at this time of year.

Subject to the project gaining approval, discharges from the mine site require separate authorisation by a Waste Discharge Licence under the *Waste Management Pollution Control Act*, a process which provides an additional layer of regulatory scrutiny and oversight by the NT EPA beyond the EIS process. As a result of these measures it is unlikely that discharge of excess water will significantly alter downstream surfacewater flows.

² Total wet season freshwater input to the upper mangroves has been modelled at 7.5% for an average wet season.

³ Impacts from reduced flows from surface water extraction, are assessed in isolation from the assessment of impacts from increased flows from discharge. This represents the worst-case scenario.

7.6.3 Groundwater drawdown

Details of modelled groundwater drawdown are provided in Section 7.4. Dewatering of pit inflows is predicted to cause a drawdown of the groundwater aquifer of up to 10 m within 1 km from the pit. The closest groundwater bores are more than 13 km from the mine site and will not be impacted. As the modelled drawdown cone is within ML31726, the proposal is very unlikely to constrain future consumptive land-uses. The modelled drawdown cone is not expected to impact on any surface water flows as discharge of groundwater to these drainage lines is expected to be small due to the low hydraulic conductivity of the aquifer (refer section 7.1.2).

Dewatering will cause local groundwater (within the extent of the drawdown cone) to flow towards the pit void and thus there will be a very localised change of groundwater flow direction. However, this is not expected to extend outside the extent of the drawdown cone and thus will not affect regional flow directions within the aquifer.

7.6.4 Localised mounding of groundwater

Leakage or seepage from the WRD, and particularly TSF cells, could result in recharge of groundwater under the WRD, and an associated localised mounding of groundwater (where groundwater levels are locally higher than the surrounding aquifer). Tailings will be thickened prior to disposal in the TSF, which reduces potential for large volumes of seepage, as water is removed at the thicker and returned back to the processing circuit.

The majority of water from the tailings stored in the TSFs will be returned through the under-drainage system and will be used in operations. The TSFs will be constructed of low permeability material, limiting infiltration and subsequent groundwater recharge. Seepage is estimated to be 0.1 ML per month (GHD, 2018). During operations the flow of groundwater is towards the pit, and the WRD and TSF sit above the groundwater drawdown cone, indicating any seepage will flow towards the pit.

Post-closure, once the tailings have desiccated, the TSFs will be capped with low permeable material, limiting retention of rainwater that could seep into the groundwater. The volume of water seeping from the final closed TSF to the groundwater is expected to be similar or less than during operations as the TSF will not be receiving water from pumped tailings. The final pit lake has been modelled as a groundwater sink, meaning that groundwater in the immediate vicinity, including under the WRD/TSF, will flow towards the pit.

Given the small volume of seepage and the location of the WRD/TSF within the drawdown cone, it is not expected that there will be a significant localised mounding of groundwater during operations or closure. If mounding did occur, it would be highly localised and, given its location, would not be expected to influence regional groundwater flows. The groundwater monitoring program documented in the Water Management Plan (Appendix C) will identify any changes in groundwater flows, during and post-closure.

7.6.5 Flooding caused by dam wall failure

The establishment of surface water dams to supply the project's water requirements could pose a risk of downstream flooding if spillways are not properly engineered. Both water supply dam designs have been derived according to the dam consequence categories assessed in accordance with the ANCOLD guidelines (ANCOLD, 2012). These guidelines are the accepted national standard applicable for water or tailings dams with the potential to cause loss of life or significant environmental or physical damage through operation or failure. At the feasibility stage, the consequence categories for the dams have been rated as 'significant' based on the impact of a dam failure to the business and the environment. Emergency spillways for the dams have been designed to pass a 0.1% AEP event, thus reducing the likelihood of dam wall failure.

In the very unlikely event of a dam wall failure, the watercourses downstream would receive a sudden surge in flow. Any flood water impact would be over a short period of time and would either discharge to the receiving waters of West Arm or evaporate, and as a result is not expected to impact any environmental values.

7.7 Mitigation, management and monitoring

Core has contributed significant resources in the design phase to gathering baseline data to inform development of the mine site water management system. As a result, the proposal incorporates design elements that seek to avoid or minimise potential impacts to surface water and ground water flows as follows:

- On-site water storages maximised so that TSF decant and pit dewatering can be re-used, which decreases make-up water supply required from off-site dams and also minimises off-site discharge requirements.
- Surface water dams have been included to ensure a sustainable water supply for the project across low, average and high rainfall years.
- Dam walls and spillways design and built in accordance with ANCOLD guidelines, so that the potential for dam wall failure is low.
- TSF foundation will be constructed from impervious material to limit seepage to groundwater
- TSF will be capped at closure and encased within WRD, which will avoid post-closure water management issues often associated with TSFs on mine sites.

The sections below summarise the measures that will be implemented during the construction/operations and rehabilitation/closure phases to further minimise impacts to water, and the monitoring that will be undertaken to ensure that impacts are not greater than forecast by the modelling studies described in this chapter.

7.7.1 Construction and operations

The key requirement for mitigation and management during the construction/operations phase is to maximise operational efficiencies, so that extraction of water from the dams is minimised. An operational efficiencies statement was prepared for the current water management system design (Chapter 2); the statement indicates re-use efficiency of 39 % (i.e. 39 % of water requirements comes from water reuse). Throughout operations, water re-use will be monitored and adjustments made where required to maximise efficiencies.

To address section 4.2.2.4 of the EIS ToR, a Water Management Plan is provided at Appendix C. The plan details the monitoring program that will be implemented to detect any changes to surface water and groundwater flows that are greater than forecast. The plan includes performance indicators and triggers for implementation of corrective actions to ensure that impacts are maintained within acceptable limits. Discharge of excess water from the mine site during the wet season is also addressed in the Water Management Plan.

Future revisions of the plan will include any conditions of permits issued under the *Water Act* for construction of dams and extraction of surface water and conditions of a Waste Discharge Licence under the *Waste Management Pollution Control Act*.

7.7.2 Rehabilitation and closure

A Mine Closure Plan is provided at Appendix D. The post-closure landform incorporates an abandonment bund that will divert surface water flows around the mine site. Internal drainage will flow towards the open pit. As a result, the modelled reduction in surface water flows downstream of the mine site is expected to remain similar to that during operations. Surface water and groundwater monitoring will continue post-closure to detect any variation from the modelled closure scenario.

7.8 Statement of residual impact

The outcomes of the environmental risk assessments indicate that the proposal is generally expected to pose an inherently low to moderate risk to downstream values (beneficial uses) that rely on maintaining the hydrological regimes of surface water and groundwater. The key reasons for this are:

- Due to the ephemeral nature of surface water flows and short-distance downstream to the receiving waters of West Arm, the freshwater watercourses downstream of the mine site do not have any significant environmental value in terms of supporting range restricted or threatened species.
- There are no residences, farms or industry within the catchment areas upstream or downstream, and no commercial or domestic uses for which surface water or groundwater is currently being extracted anywhere near the project area.
- Hydrological modelling indicates that:
 - o The reduction in freshwater flows into the hinterland mangrove communities and ultimately the receiving saltwater environment of West Arm, is not expected to be at levels that would impact the environmental values of West Arm or Darwin Harbour.
 - o The reduction in freshwater flows downstream of the OHD is not expected to be at levels that would impact the persistence of riparian rainforest vegetation along the section of watercourse immediately downstream, or the environmental values of the receiving waters of Charlotte River.
- Groundwater modelling indicates that drawdown impacts will occur only in close proximity to the open pit and impacts to groundwater flows will be localised. There are no groundwater dependent environmental values or other users within the affected area.

As impacts to hydrological processes have been largely addressed as part of the mine site design, there is limited requirement for construction and operational controls to reduce levels of risk. As a result, in most cases the inherent and residual risk ratings are the same, and indicate that risks have been avoided and/or reduced to as low as reasonably practicable through the design.

The potential impacts associated with reduced surface water flows downstream of the mine site is the only impact with medium level of residual risk in both the construction/operations and rehabilitation/closure phases, which is primarily due to dam sizing, extraction and discharge regimes being at the feasibility stage of design at the time of EIS submission. If the proposal is approved, the final dam sizing, spillway heights and the proposed water extraction regime will be subject to further assessment by the Department of Environment and Natural Resources (DENR) as part of the application process for obtaining a permit under the *Water Act*. Proposed discharges of water excess to requirements will be subject to separate authorisation by a Waste Discharge Licence under the *Waste Management Pollution Control Act*. These approvals processes provide an addition layer of regulatory scrutiny and oversight beyond the EIS process, and are expected to ensure that the project poses a low level of residual risk to hydrological processes.

The Water Management Plan provided at Appendix C provides a comprehensive monitoring program designed to gather information to demonstrate the project's level of impact and to detect any impacts that are greater than anticipated. This plan has been prepared by a consultant with over 15 years of experience in water management in the Top End and is being subject to review by an independent auditor. The outcomes of the review will be made public as part of the supplementary EIS and, if required, the Water Management Plan will be revised to address any deficiencies. The complete Water Management Plan, including managing and monitoring extraction and discharges, will also be subject to review and approval by DPIR as part of the authorisation process for mining activities under the *Mining Management Act*.

As described in the Mine Closure Plan, the post-closure mine site is proposed to be surrounded by an abandonment bund and the majority of the final landform will drain internally to the pit void, which will not release to the surrounding environment. The open pit will be left to form a pit lake and the TSF will be capped to minimise seepage and groundwater mounding. The closure concepts detailed in the Mine Closure Plan, are expected to pose a low to moderate level of residual risk to surface water and groundwater. The requirement for this final plan to be authorised by the DPIR under the *Mining Management Act* provides an addition layer of regulatory scrutiny and oversight beyond the EIS process, and is expected to ensure that post-closure risks to hydrological processes are within acceptable limits.

The above measures combined are expected to ensure that impacts to hydrological processes are limited to minor reduction in surface water flows and groundwater levels within and immediately downstream of the ML. The proposal is not expected to cause any measurable impact to environmental values in the receiving waters of West Arm (Darwin Harbour) and Charlotte River (Bynoe Harbour), and there are no other water users in proximity to the project area that will be affected.

7.9 References

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GRANTS LITHIUM PROJECT

Draft Environmental Impact Statement

Chapter 8

Inland Water

Environmental

Quality

8 INLAND WATER ENVIRONMENTAL QUALITY

Inland water environmental quality refers to the chemical, physical, biological and aesthetic characteristics of surface water and groundwater. The NT EPA's objective for this environmental factor is to:

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

This objective recognises the integral link between water quality, and the environmental and social values supported by good water quality. There is also a link between water quality and hydrological processes (i.e. surface water flows volumes/timing and groundwater levels/flow directions), which were discussed earlier in Chapter 7 of the EIS.

This chapter describes the baseline water quality conditions of natural surface water flows in the catchments and watercourses within and downstream of the Grants Lithium Project area, and of the groundwater aquifer that lies beneath. The values in the area that rely on good water quality are mapped and the ways in which the proposed mine could affect these values are discussed. The mitigation and management measures that Core will implement to avoid and/or reduce impacts are summarised. At the end of the chapter, a statement of residual impact is made detailing the extent to which the proposed mitigation and management measures will address potential impacts to ensure that the NT EPA's objectives for this environmental factor are met.

The content of this chapter has been developed specifically to address Section 4.2.1 of the EIS ToR issued by the NT EPA, and has been informed by baseline surface water and groundwater monitoring programs, and the project Water Management Plan (Appendix C) that is a requirement for authorisation of mining activities under the *Mining Management Act*.

8.1 Existing environment and values

This section describes the baseline water quality characteristics of the surface waters and groundwater aquifer that occur within and downstream of the project area, and the beneficial uses of these resources that rely on good water quality.

8.1.1 Surface water

Chapter 7 provides a detailed summary of the catchments and drainages that will receive surface water runoff from the project area. In summary, the majority of the lease, and the entire mine site disturbance footprint are located in the West Arm catchment of Darwin Harbour. Surface water drains north into the branches of West Arm. The minor drainage line that originates in the south-west corner of ML31726 flows south-west into a tidal inlet of Bynoe Harbour. The existing Observation Hill dam (OHD), proposed to supply a portion of mining water requirements, lies within the Charlotte River catchment of Bynoe Harbour. There are no permanent watercourses within ML31726, all drainage lines are relatively small and cease to flow early in the Dry season. The catchment boundaries and drainage lines are shown in Figure 8-1.

The baseline water quality characteristics of the surface watercourses that receive run-off from the project area are described in detail in the Water Management Plan provided at Appendix C and summarised in the sections below.

Water quality monitoring sites

Figure 8-1 shows the location of baseline surface water monitoring sites established for the project within the West Arm and Charlotte River catchments. The sites are described below.

West Arm catchment

Sites around the proposed mine footprint and within the West Arm catchment are:

- **GDS SW1** (Grants Down Stream Surface Water 1) on an ephemeral drainage line downstream of the proposed mine footprint (eastern side in sub-catchment 5b).
- **GDS SW2** (Grants Down Stream Surface Water 2) downstream of GUS SW3 and GDS SW1, where the ephemeral drainage lines on either side of the mine footprint join and flow through the culvert under Cox Peninsula Road.
- **GUS SW3** (Grants Up Stream Surface Water 3) on an ephemeral drainage line upstream of the proposed mine footprint (western side in sub-catchment 5a). During and after mining, this site will remain an upstream reference site not subject to mining impacts.

Surface water monitoring site selection was limited around the project area because drainage lines are very shallow and poorly defined (Figure 8-2). GDS SW1 and GUS SW3 do not have a distinct channel or riparian vegetation. During the Wet season, these sites are identified by where the water flows through the tall grass. Also, at GDS SW1, the water flows through a culvert under an unsealed access track.

GDS SW2 is on a well-defined channel with riparian vegetation that goes through a culvert under Cox Peninsula Road (Figure 8-2). Water typically flows at this site throughout the Wet season and into the early Dry season. Water also flows for much of the Wet season and early Dry season in the shallow drainages of GDS SW1 and GUS SW3; although ceases to flow earlier than at GDS SW2.

Charlotte River catchment

Three monitoring sites are located in the Charlotte River catchment downstream of OHD. The purpose of these sites is to investigate if historic mining of the BP33 open cut pit (now filled with water) has resulted in any water quality impacts. This pit was mined between 1997 and 1999 to recover tin and tantalum ore from a pegmatite very similar to that targeted for the Grants Project. Water quality in the BP33 pit may also indicate groundwater quality characteristics flowing into the Grants pit. These sites are also downstream of the existing Observation Hill dam, proposed as a water source for mining operations. The three sites are:

- **BP Historic Pit.** An existing pit lake from previous mining activities located 70 to 80 m west, of the ephemeral drainage line flowing from Observation Hill Dam.
- **BPUS SW1** (BP 33 Up Stream Surface Water 1). Located on an ephemeral drainage line upstream of BP 33 pit and downstream of Observation Hill Dam.
- **BPDS SW2** (BP 33 Downs Stream Surface Water 2). Located on an ephemeral drainage line downstream of BP 33 pit, BPUS SW1 and Observation Hill Dam.

The ephemeral drainage line covered by these sites is well-defined by a channel and riparian vegetation, and typically flows throughout the Wet season and early Dry season (Figure 8-3). OHD was added to the monitoring program in October 2017 following the decision to use this dam as a water source for the project.

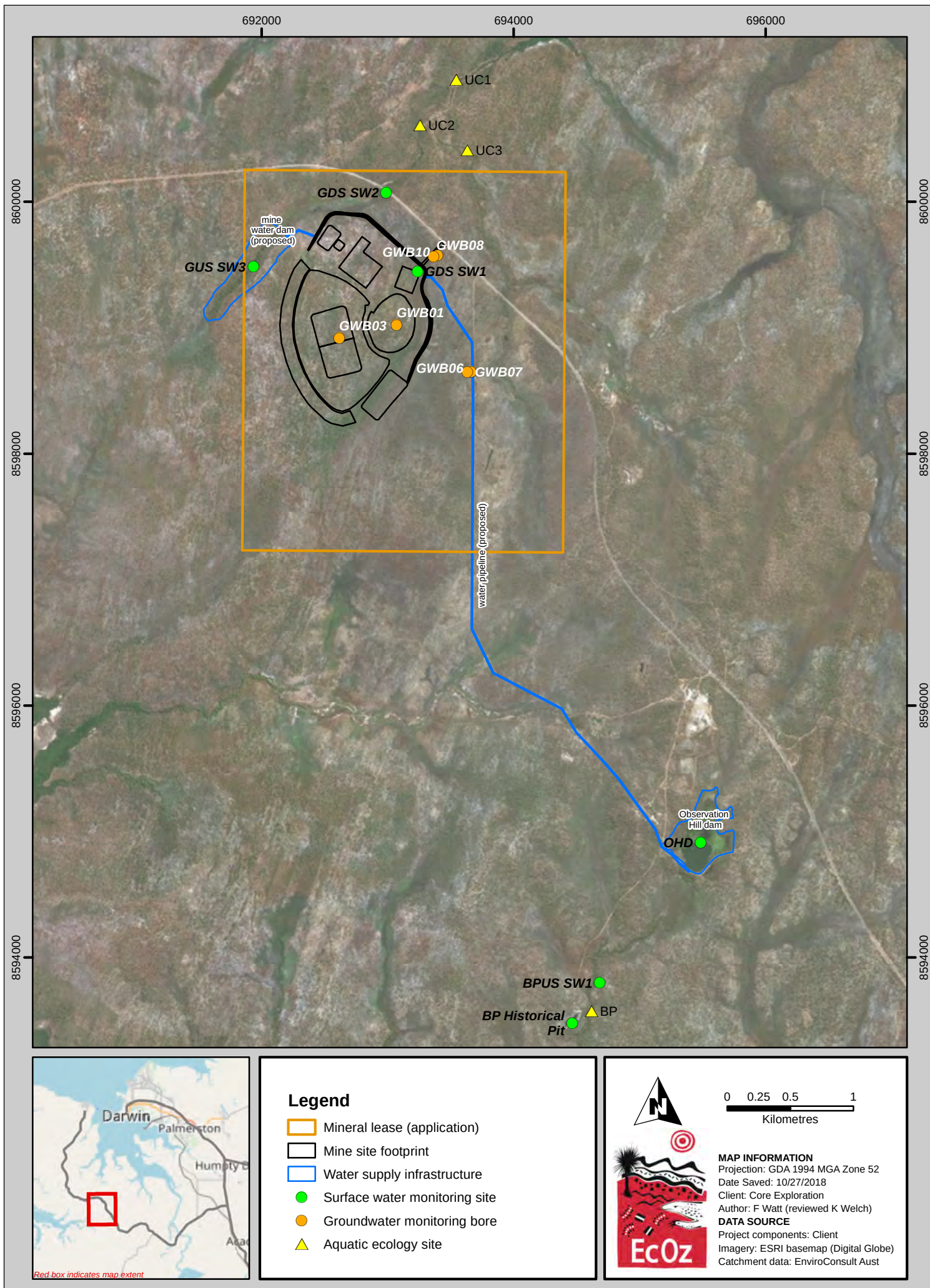


Figure 8-1 Location of baseline surface water, groundwater and aquatic ecology monitoring sites



GDS SW1



GDS SW1



GUS SW2



GUS SW2



GDS SW2



GDS SW2

Figure 8-2. Photos of surface water monitoring sites in West Arm catchment (February 2017)



BP Historic Pit



BP Historic Pit



BPUS SW1



BPUS SW1



BPDS SW2



BPDS SW2

Figure 8-3. Photos of surface water monitoring sites in Charlotte River catchment (February 2017)

Baseline sampling

The baseline surface water quality sampling that has been undertaken since monitoring began in February 2017 is outlined in Table 8-1.

Table 8-1. Baseline surface water monitoring sampling events

Date	Season	Sites sampled
15 Feb 2017	Mid Wet	All sites except OHD
19 Apr 2017	Late Wet	All sites except OHD
12 Oct 2017	Late Dry	OHD and BP Historic Pit only. All other sites dry.
31 Jan / 1 Feb 2018	Mid Wet	All sites except OHD
14 Mar 2018	Late Wet	All sites except OHD
3 May 2018	Early Dry	All sites except OHD and GDS SW1 (dry)
8 / 9 Aug 2018	Mid Dry	OHD and BP Historic Pit only. All other sites dry.

Rainfall over the 2016/17 and 2017/18 Wet seasons was above average, and flows continued at all sites into the early Dry season. Flows began to cease in May (2017 and 2018), starting with GDS SW1, which was not flowing during the 3 May 2018 monitoring round. All sites had stopped flowing by the mid Dry season (2017 and 2018), and only sites OHD and BP Historic Pit could be sampled mid to late Dry season.

Further sampling will take place over the 2018-2019 Wet season to establish baseline water quality over a period of two full Wet seasons prior to the proposed commencement of mining.

Baseline water quality analysis and reporting

Complete details and analysis of baseline water quality data are included in the Water Management Plan (Appendix C). Water quality results were compared to the *Water Quality Objectives for the Darwin Harbour Region* (NRETAS 2010). The water quality objectives for 'freshwater rivers and streams' were adopted as the most appropriate for the types of waterways receiving run-off directly from the project area. The specific objectives relating to the beneficial use of environment (aquatic ecosystems) were used because these are the most conservative.

Baseline characteristics of West Arm catchment

Baseline water quality conditions in the freshwater watercourses in the West Arm catchment downstream of the mine site, are summarised in Table 8-2 from the Water Management Plan.

Table 8-2. Summary of baseline water quality recorded in watercourses within the West Arm catchment

Parameter	West Arm catchment - baseline water quality summary
Electrical Conductivity	When flowing, water quality of the ephemeral drainage lines upstream and downstream of the mine footprint is very fresh, with low EC concentrations generally less than 15 $\mu\text{S}/\text{cm}$, and always well below the water quality objective of 200 $\mu\text{S}/\text{cm}$.
pH Dissolved Oxygen (DO)	Natural background pH varies widely between 5.41 and 8.14, and is often above or below the objective range. Similarly, DO varies widely, but remains within the objective range of 60 to 100 %, with a median DO of 80 % saturation. There is no apparent seasonal pattern or trend in the widely varying pH and DO readings. This is because these parameters are highly changeable depending on sunlight levels, the time of day, rainfall, streamflow, and aquatic plant biomass. Variability over the short term is far larger than any seasonal variability. Additionally, in regards to pH, total alkalinity measured at all sites is very low (less than 2 mg/L), which means the water has little buffering capacity to neutralise acids and stabilise pH. Low DO levels below 60 % can occur during low flow conditions as streams dry up in the absence of rainfall and fresh oxygenated run-off, resulting in a high oxygen demand being placed on the remaining small volume of water by organic matter breakdown and plant respiration.
Turbidity	Levels are generally low, even during high rainfall periods; remaining below 12 NTU and well below the water quality objective of 20 NTU.
Dissolved metals	Concentrations are below laboratory detection limits and, as such, below the water quality objectives for arsenic, cadmium, chromium, copper, lead, nickel, selenium, zinc, tin and mercury. Aluminium is above the water quality objective most of the time, with concentrations up to 0.08 mg/L. All lithium concentrations remain below 0.002 mg/L, and iron concentrations below 0.1 mg/L. There are no water quality objectives defined for lithium and iron.
Nutrients	Concentrations of Oxides of Nitrogen (NO_x) are generally naturally above the water quality objectives. In contrast, Total Nitrogen (TN) and Total Phosphorous (TP) and reactive phosphorus are generally always below the water quality objective, with the exception of some isolated spikes. Note that for the first two monitoring rounds, the laboratory limit of reporting (LOR) was higher than the water quality objective for reactive phosphorus and, as such, unless the concentration was above the LOR, it could not be determined whether the objective was exceeded or not. This was rectified in subsequent monitoring rounds, confirming that most of the time reactive phosphorus remains below the objective.
Hydrocarbons	Concentrations are always below detection limits.

In regards to assessing potential water quality impacts during mining, the following baseline water quality characteristics are highlighted:

- EC, turbidity and dissolved metals (except aluminium) are very low and well below their respective water quality objectives. Sediment and erosion controls across the site must therefore be highly effective, and the release of stormwater from the sediment dams, and release of excess water from MWD1, must ensure EC, turbidity and dissolved metals are not increased above the water quality objectives at surface water monitoring sites downstream.
- For lithium and iron, which do not have water quality objectives, downstream levels must remain below the natural background range – i.e. less than 0.002 mg/L and 0.1 mg/L respectively.

- pH and DO are naturally highly variable and it will be difficult to distinguish impacts on these parameters from the mine unless pH becomes consistently more acidic (less than 5.4) or highly alkaline (greater than 8.1), or DO becomes consistently above or below the objective range; noting that DO can become naturally low during low flow conditions.
- TPH/TRH and BTEXN concentrations are always below detection limits and should remain so during mining operations.
- The consistent pre-existing baseline exceedances of the water quality objectives for aluminium and NO_x, and occasional spikes in TN and reactive phosphorus, must be taken into consideration. The ANZECC (2000) *Guidelines for Fresh and Marine Water Quality* recommend under these circumstances to calculate site-specific trigger values based on the 80th percentile of baseline (or reference site) data.

Each year, the NT Government releases a *Darwin Harbour Region Report Card*, which summarises the results of water quality monitoring undertaken by the Aquatic Health Unit. The Report Card specific to the receiving waters of West Arm has received an “A” grading, indicating excellent water quality, for all years since the report cards started in 2009 (except for 2015 where it received a “B”). The Aquatic Health Unit considers West Arm to be relatively undisturbed with stream inflows limited to wet season run-off from a largely intact undisturbed catchment. The waterways would be considered under the ANZECC 2000 protection level classification as “slightly disturbed”.

Baseline characteristics of Charlotte River catchment

Baseline water quality conditions in the freshwater watercourses in the Charlotte River catchment downstream of the OHD, are summarised in Table 8-2 from the Water Management Plan.

Table 8-3. Summary of baseline water quality recorded in watercourses within the Charlotte River catchment

Parameter	Charlotte River catchment – baseline water quality summary
Electrical Conductivity	Water in the Observation Hill dam, BP33 pit and in the ephemeral drainage line upstream and downstream of the BP33 (also downstream of Observation Hill Dam) is always fresh, with EC concentrations generally lower than 35 µS/cm, and always well below the water quality objective of 200 µS/cm.
pH Dissolved Oxygen (DO)	Natural background pH varies widely at all four sites – ranging between 5.06 and 9.31, and often outside the objective range. DO also varies widely, but remains within the objective range with a median DO of 80 % saturation. This is because these parameters are highly changeable depending on sunlight levels, the time of day, rainfall, streamflow, and aquatic plant biomass. Variability over the short term is far larger than any seasonal variability. Additionally, in regards to pH, total alkalinity is low (less than 8 mg/L) which means the water has little buffering capacity to neutralise acids and stabilise pH. Anion, cation and alkalinity levels are higher at these sites compared to the mine footprint sites. This is because these sites receive some input from groundwater. Low DO levels can occur during low flow conditions due to organic matter breakdown and the absence of fresh oxygenated rainwater inputs.
Turbidity:	Levels are generally always low, even during high rainfall periods; remaining below 9 NTU and well below the water quality objective of 20 NTU.
Dissolved metals	Concentrations are below laboratory detection limits and, as such, below the water quality objectives for cadmium, chromium, copper, lead, nickel, selenium, zinc, tin and mercury. Aluminium is sometimes above the water quality objective at the drainage line sites (BPUS SW1 and BPDS SW2), and always below the water quality objective at the impounded water sites (OHD and BP Historic Pit). Arsenic is higher at these four sites compared to the mine footprint sites, likely as a result of groundwater inputs. The drainage line sites and OHD dam site are above laboratory detection limits (up to 0.002 mg/L), but remain below the water quality objective. The BP33 pit has higher concentrations (0.007 to 0.15 mg/L), with the highest being slightly above the

Parameter	Charlotte River catchment – baseline water quality summary
	objective. Lithium concentrations for all sites is up to 0.008 mg/L; which is also higher than the mine footprint sites. Similarly, for the higher anion and cation concentrations compared to the mine footprint sites, the source of arsenic and lithium is from groundwater inflows. Iron concentrations are always below the detection limit at the impounded water sites (OHD and BP33 Historic Pit) and relatively high (up to 0.38 mg/L) at the drainage line sites. The source of this is not known, but possibly is the result of groundwater inputs from the shallow laterite aquifer.
Nutrients	Concentrations of Oxides of Nitrogen (NO _x) are generally above the water quality objective; often up to 0.04 mg/L. Whereas TN, TP and reactive phosphorus are generally always below the water quality objective with the exception of some isolated TN, TP and reactive phosphorus spikes.
Hydrocarbons	TPH/TRH and BTEXN concentrations are generally always below detection limits.

In regards to assessing potential water quality impacts during mining, the following is highlighted:

- Given the only project-related activity in the catchment of these sites will be the extraction of water from Observation Hill Dam, physical (field parameters) and laboratory-measured parameters are not expected to change significantly from baseline levels.
- Any water quality impacts resulting from reduced surface water flows and/or reduced groundwater aquifer recharge from extraction of water from Observation Hill Dam, will likely be very subtle and not detectable over the two to three-year mine life.
- Continuation of water quality monitoring of these sites will provide further background water quality data for the region for comparison with sites downstream of the mine footprint. It would also represent background reference data if Core were to extend mining operations to within this catchment – e.g. BP33 pit.

Site-specific trigger values

As discussed above, certain water quality parameters require site-specific trigger values. The ANZECC (2000) *Guidelines for Fresh and Marine Water Quality* recommend calculating such values based on the 80th percentile of baseline (or reference site) data. Given the ANZECC (2000) methodology requires at least two years' worth of monthly data on which to base trigger values, a number of years of monitoring data will be required to develop site-specific trigger values given the ephemeral nature of the flows. In the interim, the Water Management Plan (Appendix C) provides for assessment based on comparing the baseline range of concentrations with those measured during and after mining.

Beneficial uses

The beneficial uses of the surface watercourses that receive run-off from the project area were detailed previously in Chapter 7. The project area lies within the Darwin Harbour Region declaration of surface water beneficial uses under the NT *Water Act* (NT Government Gazette No. G27, 7 July 2010). The water quality objectives that apply to these waterways under this declaration are the Water Quality Objectives for the Darwin Harbour Region Background Document (NRETAS 2010). For parameters such as metals and other toxicants, where no objective is specified, the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000) apply. The beneficial uses of downstream receiving waters that rely on good water quality are summarised below.

The environment is the main declared beneficial use relevant to the ephemeral freshwater drainage lines that receive run-off from the project area. The macroinvertebrate and fish communities recorded in freshwaters downstream of the mine site are considered typical of low order watercourses in the NT (GHD 2017). No important or sensitive aquatic habitats have been identified and aquatic values are limited by the ephemeral nature of surface water flows. The drainage lines support a narrow band of riparian vegetation that protects stream banks from

erosion and the freshwater flows discharge into the hinterland mangrove communities of West Arm, which are a significant vegetation type. There are no aquaculture activities or other water users downstream; however, the watercourses may have some social and/or cultural value when water is present during the Wet and early Dry season.

The saltwater receiving waters of West Arm in Darwin Harbour have declared 'environment' and 'cultural' beneficial uses. Darwin Harbour is recognised as a Site of Conservation Significance that supports a range of estuarine, freshwater and terrestrial environments including extensive areas of tidal mudflats and one of the largest and most diverse areas of mangroves in the Northern Territory. The key environmental values of West Arm relate to the intact mangrove environments. The cultural importance of West Arm is not publically documented; however, it is assumed the area has cultural value to local Aboriginal people. It is an important recreational fishing area.

8.1.2 Groundwater

Chapter 7 provides a detailed summary of the groundwater aquifer beneath the project area. The Burrell Creek Formation (BCF) forms the principal aquifer. It is categorised as a fractured and weathered rock aquifer with minor groundwater resources. The baseline water quality in the aquifer is described in detail in the Water Management Plan provided at Appendix C and summarised in the sections below.

Monitoring bores

Six monitoring bores were constructed on the ML(A) in 2017. Four bores were constructed in slightly weathered to fresh Burrell Creek Formation (HSU3) and two shallow bores were constructed in laterite and highly weathered Burrell Creek Formation (HSU1). Details of the bores are provided in Table 8-4 and locations are shown in Figure 8-1.

Table 8-4. Baseline groundwater monitoring bores

Bore ID	Easting	Northing	Screened interval (m)	Screened formation
GWB01	693072	8599022	88 - 154	Fresh Burrell Creek Formation
GWB03	692617	8598918	50 - 62	Fresh Burrell Creek Formation
GWB06	693634	8598649	6 – 12	Clay/highly weathered Burrell Creek Formation
GWB07	693365	8599565	49 – 61	Fresh Burrell Creek Formation
GWB08	693663	8598650	47 – 59	Slightly weathered to fresh Burrell Creek Formation
GWB10	693397	8599573	0.5 – 6	Laterite

Baseline sampling

Four groundwater sampling rounds have been undertaken on the six monitoring bores: an initial event after bore construction (June 2017), followed by Wet season sampling in January and two Dry season sampling events in May and August 2018. Further sampling will take place over 2018-2019 to establish baseline water quality and levels over a period of two full years prior to the proposed commencement of mining.

Baseline water quality analysis

Complete details and analysis of baseline water quality data are included in the Water Management Plan provided at Appendix C. Water quality results were compared to the *Water Quality Objectives for the Darwin Harbour Region* (NRETAS 2010). The water quality objectives for 'freshwater rivers and streams' are the most appropriate given the project includes provision to discharge water dewatered from the pit (comprising groundwater inflows and direct rainfall) during the Wet season when this water will be in excess to that required for ore-processing and dust suppression. The water will be discharged into a natural drainage line adjacent to the mine. The specific objectives relating to the beneficial use of environment (aquatic ecosystems) were used because these are the most conservative.

Baseline characteristics of the Burrell Creek Formation aquifer (deep)

Baseline water quality conditions in the BCF aquifer (deep), are summarised in Table 8-5 from the Water Management Plan.

Table 8-5. Summary of baseline water quality recorded in deep monitoring bores

Parameter	Burrell Creek Formation aquifer (deep) – baseline water quality summary
Electrical Conductivity	The BCF aquifer is moderately fresh, with EC concentrations ranging between 137 and 281 $\mu\text{S}/\text{cm}$. However, this EC range extends above the water quality objective applying to surface water (200 $\mu\text{S}/\text{cm}$). Groundwater from the deeper fresh BCF has higher EC, usually above the objective. In contrast, groundwater from the shallower weathered BCF zone has a lower EC that is below the objective.
pH	Groundwater pH is generally close to neutral – ranging between 6.41 and 7.52, and remaining within the water quality objective range.
Dissolved Oxygen (DO) Oxygen Reduction Potential (ORP)	As expected for water that has been out of contact with the atmosphere for a period, DO is low and oxidation reduction potential (ORP) always reduced (i.e. negative). DO would increase rapidly to within the objective range when exposed to the atmosphere in the pit and pumped to the holding dam. Likewise, ORP would become positive.
Bicarbonate alkalinity as CaCO_3	Moderate, with concentrations increasing with depth into the aquifer – i.e. deeper groundwater below 88 m is between 97 and 143 mg/L, and shallower groundwater between 67 and 107 mg/L.
Hardness as CaCO_3	Relatively low throughout the BCF aquifer (less than 42 mg/L), which is considered 'soft', and low in dissolved ions such as calcium and magnesium.
Dissolved metals	- Concentrations are below laboratory detection limits for all metals except aluminium, arsenic, zinc, lithium and iron. Nickel levels were mostly very low and below the detection limit, and always well below the objective. Similarly, aluminium and zinc concentrations are predominantly below the water quality objective and not considered elevated in the BCF aquifer. - Lithium has no water quality objective. In relative terms, lithium concentrations are much higher in the BCF aquifer compared to surface water concentrations around the mine footprint. Levels in groundwater are up to 1.73 mg/L, recorded in the mine pit bore, whereas surface waters are below 0.002 mg/L. - Iron has no water quality objective. Concentrations are up to 0.77 mg/L in the weathered BCF compared to up to 0.33 mg/L in the fresh BCF; both of which are significantly higher than surface water levels around the mine footprint (up to 0.10 mg/L). - Arsenic concentrations in the BCF aquifer are significantly elevated above the water quality objective. The median concentration for all four bores is 0.060 mg/L, which is more than 4.5 times higher than the water quality objective (0.013 mg/L). The BCF aquifer is a known 'high' risk aquifer for arsenic (see Karp 2008). The arsenic is from minerals of the BCF being mobilised into the groundwater through natural processes such as oxidation, weathering reactions, and/or biological activity.
Nutrients	Total Nitrogen concentrations in the BCF aquifer are predominantly below the water quality objective. NO_x concentrations are above the water quality objective at least 50 % of the time; however, the levels remain well within the baseline surface water range of NO_x concentrations. In contrast, TP and reactive phosphorus concentrations are always above the respective water quality objective, and also well above levels measured in surface waters, which were predominantly below the objectives. The high phosphorus concentrations appear associated with the mineralogy of the BCF; in particular, that of the more weathered zones, reducing in concentration with depth.
Hydrocarbons	Concentrations are below detection limits.

Baseline characteristics of the laterite surface aquifer

Baseline water quality conditions in the shallow laterite aquifer, are summarised in Table 8-6 from the Water Management Plan.

Table 8-6. Summary of baseline water quality recorded in shallow monitoring bores

Parameter	Laterite surface aquifer – baseline water quality summary
Electrical Conductivity	Water quality of the shallow laterite aquifer largely reflects the water chemistry expected of rainwater and stream water, showing this aquifer is closely connected to surface water. EC is low (below 26 $\mu\text{S}/\text{cm}$), and pH is relatively acidic and reflective of rainwater, which is naturally acidic in the tropical Darwin region.
pH	Groundwater pH is slightly acidic – ranging between 4.6 and 5.16, which is lower than the water quality objective range 6.0-7.5.
Dissolved Oxygen (DO) Oxygen Reduction Potential (ORP)	DO and ORP are higher than in the BCF aquifer; and indicative of an aquifer recently recharged with fresh oxygenated rainwater. Further, the negligible alkalinity, hardness and dissolved major cation concentrations in this aquifer are similar to that measured in the surface water around the mine footprint.
Bicarbonate alkalinity as CaCO_3	Low between 3 mg/L and 7 mg/L.
Hardness as CaCO_3	Low (generally less than 1mg/L), which is considered 'soft', and very low is dissolved ions.
Dissolved metals	• The laterite surface aquifer has higher concentrations of copper, lead and zinc than the BCF aquifer, and lower concentrations of arsenic and lithium (largely remaining below the objective for arsenic). Aluminium levels are comparable to the BCF aquifer however, exceed the objective more frequently because of the lower pH. Iron levels are comparable to the weathered zone BCF aquifer and higher than in the surface water around the mine footprint. • Similarly, to the BCF aquifer, all other metal concentrations are below detection limits (i.e. cadmium, chromium, selenium, tin and mercury). Nickel levels are mostly very low and always below the objective. • Copper and zinc concentrations are always above the respective water quality objective, and significantly higher than in both the BCF aquifer and surface water, which are mostly below detection limits. Lead was above the objective on one occasion. • The higher copper, lead, and zinc levels in GWB10 compared to the bores in the BCF aquifer is possibly related to the weathered laterite host rock. It is not possible to determine the reason without more data collected from other bores screened in this same aquifer. It is possible the elevated copper and lead concentrations (and a proportion of the zinc concentrations) are associated with poor bore construction.
Nutrients	TN concentrations are predominantly below the water quality objective, and NO_x concentrations are generally above the water quality objective but within the baseline surface water range of NO_x concentrations. More data is required from this bore (and other bores to be installed in this shallow aquifer) to determine the pattern of NO_x and TN concentrations. TP and reactive phosphorus concentrations are generally above the water quality objectives and also above the baseline surface water concentrations; although much lower than in the BCF aquifer, presumably from the oxidation and precipitation of phosphorus on reaction with iron and aluminium in the groundwater.
Hydrocarbons	Concentrations are always below detection limits.

In regards to assessing potential impacts to groundwater during mining, the following aspects of the baseline groundwater quality are highlighted:

- Copper, zinc, lead, TP, and reactive phosphorus are elevated in the laterite aquifer above the water quality objectives, and above the baseline surface water quality of the mine footprint area. Release of water from MWD1 (which contains a proportion of groundwater dewatered from the mine pit), must ensure the concentration of these parameters is not increased above the water quality objectives at surface water monitoring sites downstream.
- Lithium and iron, which don't have water quality objectives, are elevated (albeit to a lesser extent than the BCF aquifer) compared to the natural background surface water levels at the mine footprint site. Release of water from MWD1 must ensure the concentration of these parameters in downstream surface water monitoring sites is not increased above the natural background range; i.e. above 0.002 mg/L for lithium and 0.1 mg/L for iron.
- All other metals aluminium, cadmium, chromium, nickel, selenium, tin, zinc, mercury are below the water quality objectives or within the range of natural surface water background levels and do not pose a hazard to surface waters.
- pH in the laterite aquifer is relatively acidic but no more so than the natural acidity of rainwater in the Darwin region. DO levels are relatively low but will increase rapidly with exposure to the atmosphere and pumping from the pit prior to any release to surface waters.
- TPH/TRH and BTEXN concentrations in groundwater are always below detection limits and must remain so during mining operations i.e. no contamination of the groundwater aquifer from hydrocarbon spills or leaks on site.
- TN concentrations are mostly below the objective, and NO_x concentrations are within the same range as that of that baseline surface water of the mine footprint and do not pose a hazard if released to surface waters.

Existing users

There is very limited existing use of the regional groundwater aquifer. Groundwater modelling undertaken for the project (Knapton and Fulton, 2018) indicates that the ephemeral watercourses downstream of the mine site do not receive groundwater inputs. Registered bores and Groundwater Dependent Ecosystems in vicinity of the project area are described in Chapter 7, Section 7.1.2. In summary:

- The closest groundwater users (active bores) are located on the Cox Peninsula Road approximately 13 km east. The only registered bore in the vicinity of the project area is located 4 km to the south-east, which is an abandoned mining production bore located 600 m north of Observation Hill dam. The bore was drilled in the 1984 as a water supply for the Greenex Observation Hill tin and tantalite treatment plant.
- The Berry Springs Dolostone aquifer is located around 22 km east of the project area. There are current concerns regarding over-extraction from this aquifer and water allocation is closely managed and subject to the *Berry Springs Water Allocation Plan 2016-2026* (DLRM 2016). The BCF fractured rock aquifer beneath the project area has no connection to the Berry Springs Dolostone aquifer.
- There are no GDEs down-gradient of the mine site. An area mapped as moderate potential GDE is located up-gradient (west and north-west) and down-gradient along the drainage line that receives overflows from the dam OHD. Late-Dry season (October 2017) site inspections of the watercourse found pools but no visible flows at a point starting around 2 km downstream of the dam wall. The structure of the riparian vegetation communities and baseline surface water quality monitoring suggests that the drainage lines have some level of groundwater dependence; however, there is no evidence of spring-fed surface water flows.

8.2 Assessment of impacts

The impact and risk assessment process (Chapter 4) identified the following potential impacts to water quality:

Construction/operations phase

- Increased turbidity in surface watercourses due to erosion of exposed surfaces and from dam overflows.
- Contamination of surface watercourses and/or groundwater aquifer by mine drainage.
- Contamination of surface waters by mine water discharges.
- Hydrocarbon and other chemical contamination due to leaks and spills.
- Bacterial contamination due to leaks from the onsite wastewater management system.

Rehabilitation/closure phase

- Increased turbidity in surface watercourses due to landform instability/erosion.
- Contamination of surface watercourses and groundwater by WRD/TSF drainage.
- Contamination of groundwater by interaction with pit lake.
- Hydrocarbon contamination from old fuel tanks.

The sections below discuss the likelihood of impacts occurring and the effect on environmental and social values that depend on good water quality.

8.2.1 Increased turbidity in surface watercourses

Turbidity in the watercourses downstream of the proposed mine site and dams could be increased through erosion of exposed surfaces, discharges from sediment dams, or overflow of dams (release from spillways). The initial site clearing and construction is scheduled to occur in the Dry season of 2019, and therefore exposed surfaces will be most susceptible to erosion by rainfall during the first Wet season of operations. The potential for erosion will be minimised by adopting appropriate design criteria for infrastructure components (i.e. water storages, culverts, drainage, spillways, the WRD and stockpile slopes will be suited to the high rainfall conditions experienced at the site). Cleared areas will be stabilised as soon as practicable following clearing and construction. Proposed methods and controls are detailed in the Vegetation Clearing Procedure (Appendix S) and Erosion and Sediment Control Plan (ESCP) (Appendix F).

Erosion from exposed mine site surfaces

It is expected that surface water run-off within the mine site will contain high levels of suspended sediments. These could move off-site into the receiving waters if not adequately captured and controlled. The entire area of the mine site internal to the inundation and topsoil bund has been designed to drain to an internal stormwater drainage network. The sizing, design and operation of sediment dams is discussed in the ESCP. The dams will provide sufficient retention time for the majority of sediments to fall out; however, depending on the site conditions, the use of flocculants may be required to achieve discharge criteria.

As the baseline water quality of the receiving waters indicates naturally low levels of turbidity, it is likely that there will be temporary exceedances of baseline turbidity at discharge points from the mine site. Proposed discharge criteria and a monitoring program are provided in the Water Management Plan (Appendix C). There are no important aquatic ecosystems present in the watercourses within which some increased turbidity will be experienced, and increases in turbidity are not expected to be measurable at the point of discharge to the marine receiving waters of West Arm.

Stream bank erosion downstream of dam spillways

Turbidity in the receiving waters of the ephemeral streams downstream of the water supply dams could be increased due to erosion of stream banks when the dams overflow. Event-based overflows of the mine site dam are expected to occur in January and February, continuous overflow in February to early March, and event-based

overflows again from late March into early April. The OHD is modelled to overflow in March only. Baseline turbidity in the ephemeral watercourses downstream of the proposed dams did not exceed the ANZECC guideline value for 95 % aquatic ecosystem protection (15 NTU) at any baseline monitoring event over two years. This indicates that the current OHD does not cause increased turbidity, and also that the receiving environment has naturally low levels of turbidity.

Detailed designs for the OHD and MSD walls and spillways are pending. These designs are being prepared in accordance with the ANCOLD Guidelines (ANCOLD 2012). These guidelines are the accepted national standard applicable for water or tailings dams with the potential to cause loss of life or significant environmental or physical damage through operation or failure. As protection of the dam wall from erosion is a key component of dam design, and the current OHD dam does not appear to contribute to increase turbidity, the proposed dams are not expected to cause any sustained increase in turbidity in the downstream receiving waters. To further mitigate potential impacts, in accordance with standard practice, the construction engineering drawings for the dam walls and spillways will include any erosion and sediment control requirements. It is likely that there will be minor temporary exceedances of turbidity criteria immediately downstream of the newly-constructed dam walls in the first rainfall events after construction; however, due to the design features described above, these water quality impacts are not expected to continue and are unlikely to be measurable at monitoring sites further downstream.

Post-closure landform instability and erosion

Chapter 6 details potential impacts to land and soils associated with the proposal, and describes mitigation and management measures that will be implemented during the construction and operations phases to minimise erosion, as well as maximise future rehabilitation and closure outcomes. However, experience on other mine site indicates that, even with good management, some erosion of the post-closure WRD landform can be expected to occur. The potential impacts of this to water quality are considered below.

Any release of sediment from the eastern side of the WRD and other rehabilitated areas would predominately flow towards the pit void, and any sediments would be prevented from moving offsite by the abandonment bund. Erosion of the north-west side of the WRD or the outer face of the abandonment bund could mobilise sediments into the nearby drainage lines. Baseline turbidity within these ephemeral watercourses was low. Sediments mobilised by erosion of the WRD would be released to watercourses during rainfall events and will possibly result in temporary exceedances of water quality criteria. Subject to effective implementation of the monitoring and corrective actions described in the Mine Closure Plan, increases in turbidity are not expected to be measurable at the point of discharge to the marine receiving waters of West Arm.

Early or unforeseen closure issues

In the event of early or unforeseen closure in the first year of mining, the WRD annulus may not yet be stabilised. Potential impacts to water quality associated with erosion of the WRD are discussed above. Impacts to water quality are more likely, and could be more severe, if the WRD is not stabilised.

Uncapped TSF cells could fill with rainwater and overtop. Depending on the TSF status and period of closure, the proposed approach to making the facility stable and non-polluting will vary. If the closure is temporary, then active water management may be undertaken to minimise the risk of overtopping. However, if the closure period is indefinite, then capping of the open cells will need to be addressed. If the TSF was to overtop the spillway, the tailings slurry would be released into the internal area of the WRD annulus, where it would either evaporate or could be pumped to the pit void.

Unmanaged sediment dams could also pose a risk of sediment-laden discharges to the surrounding watercourses. During operations, water quality in the dams will be monitored and flocculant added to settle out sediments where necessary prior to release. If the site closes, these dams may discharge untreated water directly to the environment.

The risk to water quality associated with early or unforeseen closure will depend on the timing and current status of the site when closure occurs. Closure early during the life of mine and/or during the Wet season poses the greatest risk of causing measurable increases in turbidity downstream due to uncontrolled water discharges. Risk

assessment and mitigation is expected to be addressed in a Care and Maintenance Plan, which is a legal requirement under the *Mining Management Act*. Closure works would then either be undertaken by Core or by DPIR using the security bond. These measures are expected to decrease the likelihood of significant impacts to downstream water quality; however, the uncertainty associated with early closure means the risk remains high.

8.2.2 Contamination of surface water by mine drainage

Water quality in surface watercourses discharging to West Arm could be impacted by any poor quality drainage from the mine site. A significant water quality issue associated with mining activities relates to the potential for production of Acid Mine Drainage (AMD), which can result in acidic, metalliferous or saline discharges into surface water and/or groundwater. The waste rock characterisation work undertaken for the project (refer Chapter 2, section 2.9) indicates there is a low risk of acidic, metalliferous or saline drainage at the site. The sampling effort was deemed adequate for the purpose of indicating areas of risk that may require further assessment.

In accordance with the recommendations of the engineers designing the TSF, confirmatory test work on tailings will be undertaken as part of the processing plant trials, which will inform final detailed design of the TSF. Core will also undertake an ongoing operational waste rock sampling program to confirm the waste rock and leachate characteristics during mining (refer EMP Chapter 10). The project WRD design allows contingency for material with any potential to cause acid or metalliferous drainage (i.e. the fresh phyllite) to be selectively placed within the centre of the WRD, which will be surrounded by waste rock from the shallower parts of the pit as a buffer, and the annulus constructed of low permeability materials. If these types of materials are stored in the WRD, the need for capture and treatment of any seepage from the toe of the WRD would need to be considered and addressed in future revisions of the Mine Closure Plan.

Based on the above information, it is unlikely that AMD will be produced at the site. In the event that ongoing characterisation work identifies materials that could produce acidic or metalliferous drainage, the volumes will be small and there are adequate contingencies available to minimise and manage any contaminated drainage. Exceedance of water quality criteria at downstream monitoring sites is not expected to occur. The Water Management Plan (Appendix C) includes a surface water and groundwater monitoring program that will provide for early detection of any contaminated mine drainage issues.

8.2.3 Contamination of groundwater aquifer by mine drainage

Contamination of the groundwater aquifer could occur through exposure of materials in the pit walls or drainage/seepage from the WRD/TSF during operations and post-closure. As discussed above, the waste rock characterisation work undertaken for the project indicates there is a low risk of AMD. However, as the project design allows for the contingency of storing small volumes of material with elevated levels of acidity and/or metals, the groundwater model prepared for the project considered the fate of any seepage from the WRD/TSF (refer Appendix I). Figure 8-4 illustrates the predicted movement of any particles (contaminants) that enter the groundwater aquifer below the landform.

The modelling indicates that groundwater below the WRD will predominately flow towards the pit during operations (and after closure), carrying with it any contaminants. Some particle movement flows from the WRD northwards and terminates in northern section of the ML. Both the modelling and baseline surface water monitoring results indicate there is no connection between the groundwater aquifer and the surrounding ephemeral watercourses. Therefore, if any contaminants were to seep from the WRD, there is not expected to be an impact to water quality outside of the ML. If the WRD/TSF was producing contaminated seepage, this would be detected in the routine samples taken from the pit and/or monitoring bores as part of the site water quality monitoring program described in the Water Management Plan (Appendix C).

As a result of the low risk of AMD and monitoring programs that provide for early detection of water quality issues, the proposal is unlikely to significantly impact groundwater quality. In the event that minor exceedances of water quality criteria for groundwater do occur, the potential impacts are limited by a lack of surface water/groundwater connectivity and the absence of other groundwater users in proximity to the project area.

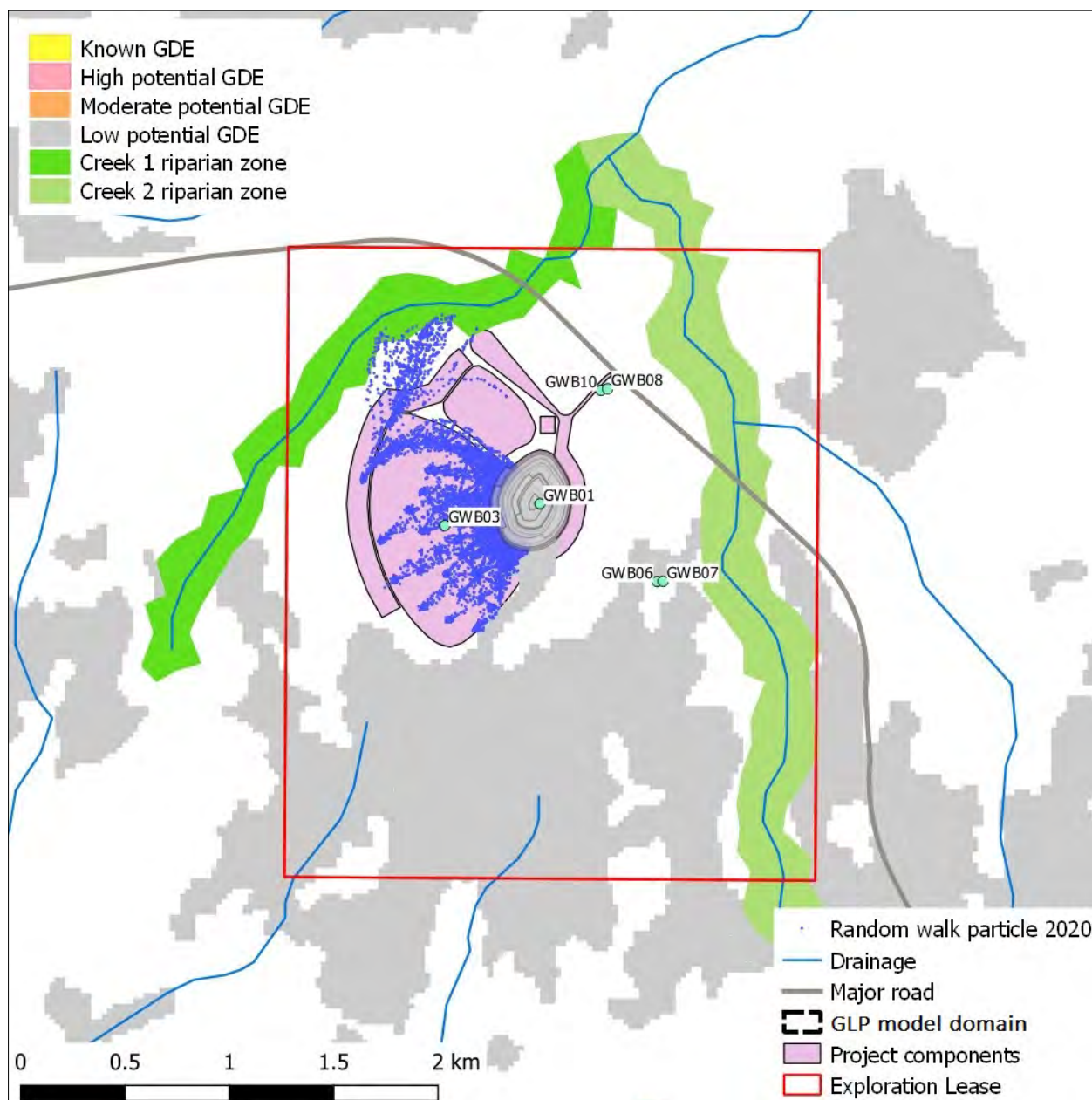


Figure 8-4. Illustration of results of particle tracking modelling for seepage from waste rock dump

8.2.4 Contamination of receiving waters by mine water discharges

Water quality in surface watercourses discharging to West Arm could be impacted by discharge of excess water from the mine site. Discharge could occur either through controlled discharges of excess water during the Wet season or from unplanned releases (overtopping) of onsite water storages. The potential impacts associated with each of these scenarios is discussed below.

Controlled discharges from Mine Water Dam 1 during operations

A monthly water balance was developed for the life of mine in accordance with the *Minerals Council of Australia Water Accounting Framework*. The model was used to determine the requirements for discharge of excess water

during the Wet season. Modelled monthly discharges for an average rainfall year are documented in Chapter 2, Section 2.12. Discharge is likely to be required during the months of January to March in the first year of mining and November to March in the second year.

The onsite water system has been designed to separate clean from potentially dirty or contaminated water. The Raw Water Dam (RWD) is designed to store only clean water from incident rainfall or pumped as required from the off-site water supply dams. Mine Water Dam (MWD) 1 is the largest dam and is designed to receive pit dewatering, which will contain some suspended sediments. MWD 2 will store decant water returned from the TSF, which will also contain suspended sediments. Whilst the materials characterisation work indicates that the tailings (and therefore the decant water) is not expected to contain contaminants (excepting fine sediments), as a precautionary measure the tailings decant water is stored separate in MWD 2, which has been designed to provide for containment and re-use of all decant water. The TSF design incorporates contingency Wet season storage capacity to allow for short-term storage of excess water when MWD 2 is at capacity. As a result, discharge of excess water will only occur from MWD 1, which will store only groundwater/rainfall dewatered from the pit.

The discharge will be released into the nearby drainage lines at times of high flow. The discharge regime and water quality criteria will need to be authorised by a Waste Discharge Licence under the *Waste Management Pollution Control Act*. The discharge water is expected to contain fine sediments, which will be removed by filtering and addition of flocculant to MWD 1 if required. Based on the baseline groundwater monitoring results (section 8.1.2), there are elevated levels of arsenic and phosphorous in the groundwater, often exceeding the ANZECC guideline values; however, concentrations of all other soluble metals were low. The concentrations of arsenic and phosphorous in water dewatered from the pit are expected to be significantly lower than those recorded in the groundwater. This is because rainwater in to the pit will make up approximately 28 to 50 % of the total volume to be discharged.

Discharge requirements and monitoring are addressed in the Water Management Plan (Appendix C). If monitoring of MWD 1 indicates there are elevated concentrations of arsenic, phosphorous or any other contaminants of concern, as a contingency, the Water Management Plan provides for addition of coagulants to precipitate out contaminants so that discharge criteria are achieved prior to release. The available combinations of treatment and dilution are expected to provide for adequate protection of downstream water quality, so that environmental values in the receiving waters of West Arm will not be impacted by Wet season discharges.

Unplanned discharges from onsite water storages during operations

All onsite water storage designs have been derived according to the dam consequence categories assessed by engineers in accordance with the ANCOLD guidelines (ANCOLD 2012). At the feasibility stage, the consequence categories have been rated as 'significant' based on the impact of a dam failure to the business and the environment and emergency spillways for the dams have therefore been designed to pass a 0.1% AEP event. In the event storages do overtop, because they are located inside the flood inundation bund the overflow would be captured in the stormwater drainage network and directed to the sediment dams for treatment prior to release off-site. As a contingency, if discharge criteria cannot be achieved, sediment dams can be pumped to either of the MWD's, TSF or pit, for temporary storage until the failure is addressed. Due to the above design factors, it is unlikely that overtopping of the dams would result in any sustained impact to water quality in receiving waters.

8.2.5 Hydrocarbons and other chemical contamination

Hydrocarbon contamination of surface water or groundwater could be caused by leaks and spills from diesel fuel storages or run-off from workshop/parking areas. The risks of hydrocarbon contamination to land and soils were discussed in detail in Chapter 6, which concluded that the proposal poses an inherently low risk of soil contamination by hydrocarbons or other hazardous materials. However, as is the case with all industrial activities, spills may still occur and therefore potential impacts to water quality have been considered below.

A fuel or chemical spill will either soak into the surrounding soils or run off into the stormwater drainage network, where it will be captured in the sediment dams. Any residual hydrocarbon contamination in the soils post-closure

would also soak into the surrounding soils. The characteristics of the groundwater aquifer, having low transmissivity and direction of flow towards the pit, means that any contaminants entering the groundwater are likely to be contained and would unlikely be detected in the groundwater aquifer down-gradient of the mine site. As the site is surrounded by an inundation bund, there is also no pathway for direct release of spills to the surrounding surface watercourses. Post-closure all fuel storages and any residual soil contamination will be removed. Furthermore, the results of groundwater modelling and baseline surface water monitoring indicate there is limited connection between the groundwater aquifer and surface water courses.

Based on the above information, it is very unlikely that the project will result in any major or sustained exceedances of water quality criteria for hydrocarbons and other chemical contaminants at downstream surface water monitoring sites or monitoring bores. The controls in place are expected to provide for detection and containment of contamination, so that treatment can occur prior to release to the environment. In the event of early closure, releases of hydrocarbon-contaminated water could occur when fuel is present onsite but the water management system is not monitored. The potential impacts to water quality under this scenario are limited by the relatively small volumes stored on site, which would be removed within a short time following the closure.

The Water Management Plan (Appendix C) includes monitoring of surface water sites in the West Arm catchment to ensure the Darwin Harbour water quality objectives are being met. Down-gradient monitoring bores will also be sampled for hydrocarbons. Given the absence of other water users and GDEs, and the relatively small contribution of the mine site catchment to discharges to West Arm (i.e. any contamination would be significantly diluted before discharge to the Harbour), any minor exceedances of water quality criteria are unlikely to have a significant impact on any environmental values.

8.2.6 Bacterial contamination

Bacterial contamination of surface water or groundwater could be caused by leaks from the onsite waste water management system into groundwater. The system type and design is yet to be finalised, but 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*.

During operations, the wastewater management system will be regularly inspected for evidence of leaks. As the site is located close to Darwin, any malfunction of the system will be addressed by calling out a licenced contractor. As a result of these measures, any leaks will be confined to short period and are unlikely to be of a scale that would result in any major or sustained exceedances of water quality criteria for bacteriological contaminants at downstream surface water monitoring sites or monitoring bores.

Baseline monitoring of bacterial contamination in the receiving waters has been undertaken and the Water Management Plan (Appendix C) includes monitoring of surface water sites in the West Arm catchment to ensure the Darwin Harbour water quality objectives are being met. Monitoring bores down-gradient of the wastewater disposal system will also be sampled. Given the absence of other water users and GDEs, and the relatively small contribution of the mine site catchment to discharges to West Arm (i.e. any contamination would be significantly diluted before discharge to the Harbour), any minor exceedances of water quality criteria are unlikely to have a significant impact on any environmental values.

8.2.7 Post-closure pit lake water quality

Post-closure the pit void will fill with water over time to form a pit lake. Post-closure forecasts and interactions with the underlying groundwater aquifer are detailed in Chapter 7.

The EIS ToR (Section 4.2.1.3) require 'predicted long-term water quality levels of the final pit lake'. Knapton & Fulton (2018) used a mass balance model to estimate the water quality in the pit lake that will form in the project area post-closure. EC was used as the indicator under two scenarios: a high salinity (220 $\mu\text{S}/\text{cm}$) inflow model

and a lower salinity (25 $\mu\text{S}/\text{cm}$) model. Details of the model parameters can be found in Appendix H; the modelling results are summarised below.

The first model assumes a groundwater input salinity of 220 $\mu\text{S}/\text{cm}$ – which represents the average EC from the deep monitoring bores across the site; and a rainfall salinity of 10 $\mu\text{S}/\text{cm}$ – which is consistent with Darwin rainfall EC from the peak Wet season months (Crosbie et al. 2012). This model suggests that the pit lake salinity will rise from an initial value of around 40 $\mu\text{S}/\text{cm}$ to a final salinity of 290 $\mu\text{S}/\text{cm}$ in 2090.

However, other shallower pit lakes/dams in the vicinity of the project area have an EC between 17 $\mu\text{S}/\text{cm}$ 26 $\mu\text{S}/\text{cm}$ (refer surface water monitoring site BP Pit). These results are notably fresher than the modelled salinity for the pit lake and may suggest that the mass balance model is overestimating the long term EC in the pit lake. A contributing cause may be basing the groundwater input salinity for the model on the EC measured in the deep observation bores. Once the water level in the pit lake has stabilised, the majority of groundwater inflow will be drawn from the shallow groundwater system which has an EC in the order 25 $\mu\text{S}/\text{cm}$. Re-running the mass balance model with a groundwater inflow EC of 25 $\mu\text{S}/\text{cm}$ results in a final pit lake EC of 50 $\mu\text{S}/\text{cm}$, which is more consistent with EC values observed in neighbouring pit lakes/dams.

The modelled salinity post-closure under both scenarios is shown in Figure 8-5.

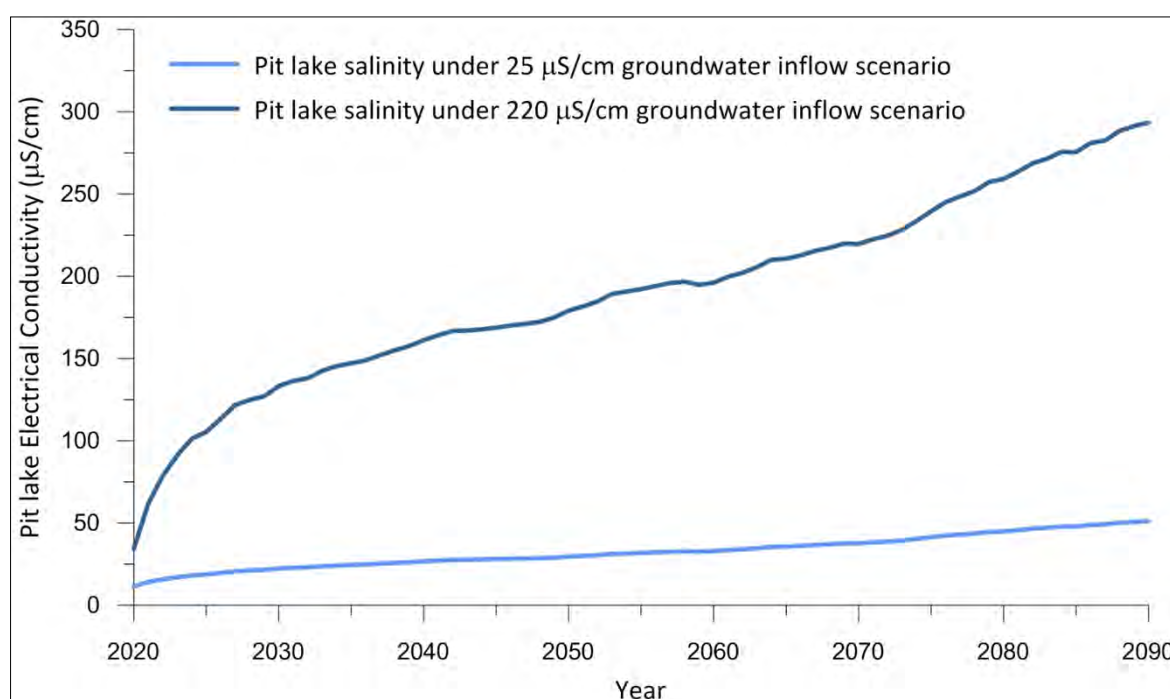


Figure 8-5. Modelled post-closure pit lake salinity under two groundwater inflow scenarios

Water quality in the inundated BP 33 pit (5 km to the south of the project area) may give an indication of water quality of the final pit lake in the years following the end of mining because the geology of the area is similar to the Grants pit (based on Core's recent exploration work at BP 33). Water quality measured in the BP 33 pit waters during 2017 and 2018 was generally good. ECs were low (less than 26.2 $\mu\text{S}/\text{cm}$), pH was not acidic (lowest pH was 6.65), dissolved metal concentrations were all below the water quality objectives (except for one isolated instance of arsenic, which is naturally present in groundwater), and nutrient concentrations were not elevated when compared to the upstream surface water monitoring site.

The pit lake will predominantly operate as a groundwater sink, and therefore the water quality in the lake is not expected to influence the groundwater quality in the surrounding aquifer. The lake level is modelled to recover over a period of 50 years and stabilise at 7 to 8 m below the existing land surface, and therefore there will be no discharge of pit water to the environment.

8.3 Mitigation and management

Measures to minimise and manage potential impacts to water quality were identified through the project risk assessment with the objective of reducing all risks to levels that will ensure that the NT EPA's objective for the inland water environmental quality factor is met. Key mitigation measures are referred to in the above discussion of potential impacts. The sections below summarise the measures that will be implemented during the construction/operations and rehabilitation/closure phases.

8.3.1 Construction and Operations

To address section 4.2.1.4 of the EIS ToR, a Water Management Plan has been prepared (Appendix C). The plan provides details of all measures proposed to minimise the release of contaminants from the mine site so that environmental values of the downstream receiving waters are adequately protected. The plan includes a water quality monitoring program that monitors surface water within the mine site water storages and sediment dams, discharge monitoring points, upstream and downstream surface water monitoring sites, and environmental monitoring bores up- and down-gradient of the mine site. The location of proposed monitoring sites and bores is shown in Figure 8-6.

Baseline monitoring has been used to characterise the existing water quality and, as more data are collected over the 2018-2019 Wet season, updated trigger values will be derived. The plan has been submitted for independent review, the findings of which will be provided with the Supplementary EIS, along with an updated version of the plan that addresses any identified deficiencies.

An ESCP has been provided at Appendix F. The ESCP complements the Water Management Plan by providing more detail in relation to the erosion and sediment controls that will be installed during construction and operations. The ESCP, combined with the engineered designs for mine site components, will be the key measures used to avoid movement of sediments off-site into the surrounding receiving waters. Progressive ESCPs will be developed and implemented as required at each stage of the mining operations.

The project EMP (Chapter 10) documents mitigation measures for the storage and handling of fuels and other hazardous materials as follows:

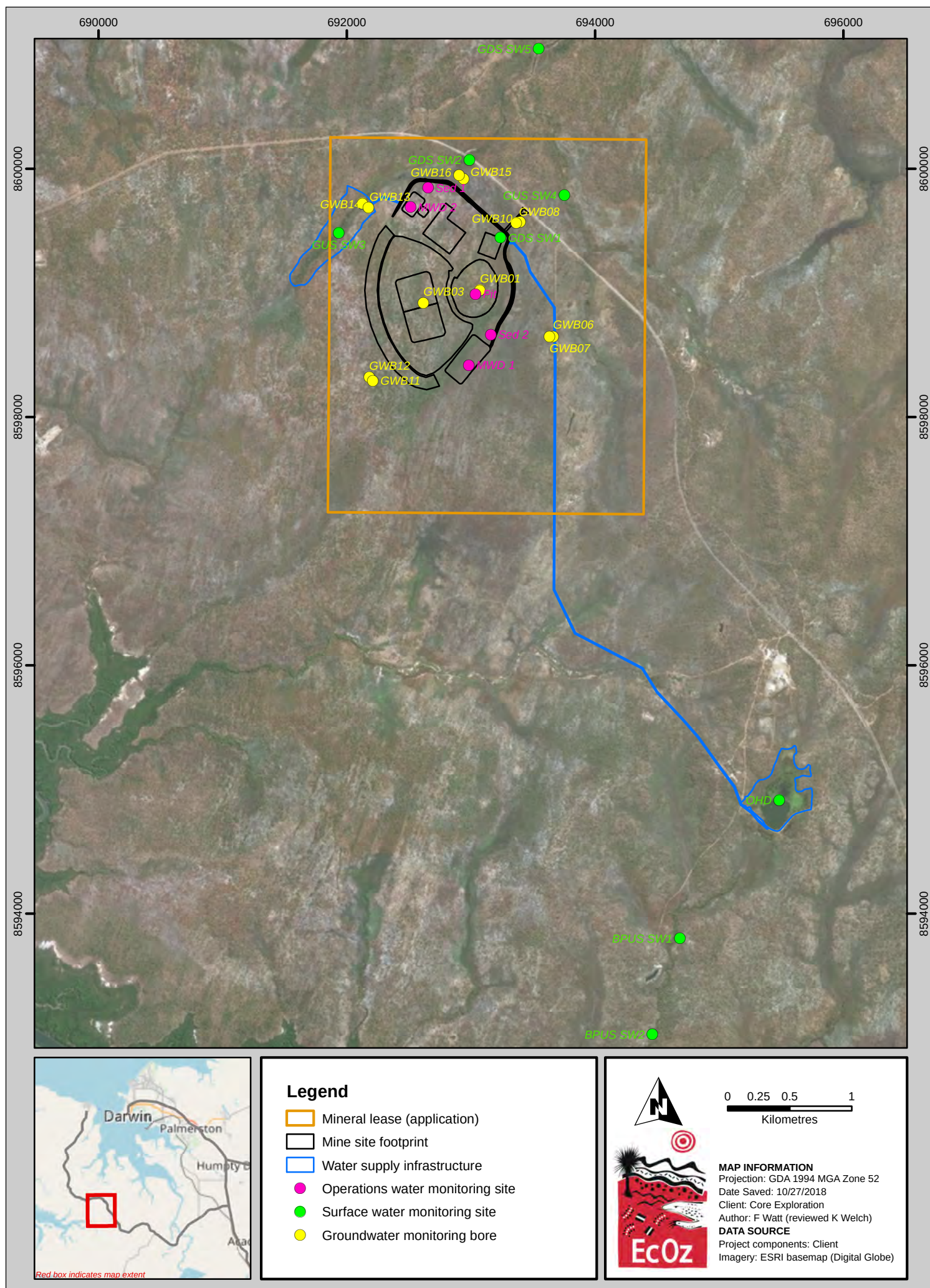
- A spill response plan, procedures and training for all staff and contractors.
- Spill kits on site will include booms and absorbent materials for capturing hydrocarbon contaminants from the water surface prior to offsite release or discharge.

The sediment dams and pit will be routinely inspected for hydrocarbon sheen and sampling for hydrocarbon contamination will as part of the water quality monitoring program described in the Water Management Plan.

8.3.2 Rehabilitation and Closure

A Mine Closure Plan has been included in the EIS (Appendix D). The key risk to water quality associated with the rehabilitation and closure phase of the project is associated with landform instability and erosion. The plan provides details of how this will be managed to achieve 'a stable non-polluting landform'. Post-closure erosion and water quality monitoring will be undertaken in accordance with the plan. If erosion that is rated significant or higher on the severity scale is detected anywhere within the project footprint, a Certified Practitioner of Erosion and Sediment Control (CPESC) will advise on the appropriate control actions. Exceedance of water quality objectives will also trigger investigation of potential causes and corrective actions.

Closure early during the life of mine and/or during the Wet season poses the greatest risk of causing measurable increases in turbidity downstream due to uncontrolled water discharges. Risk assessment and mitigation for unexpected and early closure will be addressed in a Care and Maintenance Plan, which is a legal requirement under the *Mining Management Act*. Closure works would then either be undertaken by Core or by DPIR using the security bond.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ18086 - Grants Project - EIS\01 Project Files\Chapter 8 maps\Figure 8-6 Map of future surface and groundwater monitoring sites.mxd

8.4 Statement of residual impact

The environmental risk assessment process determined that the greatest risks to water quality associated with the proposal relate to the potential for increased sediment loads in the downstream surface water courses. The project does not require the use of chemical additives in processing and the waste rock has been characterised as geochemically benign, therefore sediment is expected to be the only contaminant of concern in drainage originating from the mine site. The absence of potential sources of chemical contamination, coupled with groundwater modelling that indicates the pit will act as a groundwater sink, means the project poses an inherently low risk of impacts to water quality. The measures proposed to minimise leaks and spills of fuels and other hazardous substances, and to prevent release of untreated sewage, are well-established in standard procedures and are expected to result in a low risk of chemical or bacterial contamination in surface and groundwater.

The key measures proposed to reduce the likelihood of off-site release of sediments during the construction and operations phase are implementation of the ESCP (Appendix F), and management and monitoring of discharges in accordance with the Water Management Plan provided at Appendix C. The ESCP has been prepared by a CPESC in accordance with the *Best Practice Erosion and Sediment Control Guidelines* and, on this basis, is expected to provide for good erosion and sediment control outcomes when effectively implemented. The Water Management Plan has been prepared by a consultant with over 15 years of experience in water management in the Top End and is being subject to review by an independent auditor. The outcomes of the review will be made public as part of the supplementary EIS and, if required, the Water Management Plan will be revised to address any deficiencies. Further to this, subject to the project gaining approval, discharges from the mine site require separate authorisation by a Waste Discharge Licence under the *Waste Management Pollution Control Act*, a process which provides an additional layer of regulatory scrutiny and oversight by the NT EPA beyond the EIS process.

During the rehabilitation and closure phase of the project, rehabilitation of disturbed areas and an ongoing erosion and water quality monitoring program are addressed in the Mine Closure Plan (Appendix D). The risks to downstream water quality are expected to be inherently lower post-closure as discharge from the sediment dams and MWD1 will cease. As described in the Mine Closure Plan, the post-closure mine site is proposed to be surrounded by an abandonment bund and the majority of the final landform will drain internally to the pit void, which will not release to the surrounding environment.

Erosion of the external annulus of the WRD is the key ongoing risk to water quality. The closure concepts detailed in the Mine Closure Plan, when effectively implemented, are expected to minimise this risk. It is acknowledged that the plan will need to be updated with details of the final WRD land form and drainage designs as they are developed through the detailed feasibility studies. The requirement for this final plan to be authorised by the DPIR under the *Mining Management Act* provides an additional layer of regulatory scrutiny and oversight beyond the EIS process, and is expected to ensure risks to water quality are reduced to low/moderate.

Unexpected early closure of the mine could increase the risk of increased sediment loads (turbidity) in downstream watercourses; however, due to the short mine life and the economics underpinning the project, the likelihood of early closure is considered low. In any event, risks should be adequately identified and addressed through implementation of a Care and Maintenance Plan, which is a requirement pursuant to the *Mining Management Act*. The bond – required as part of the mining authorisation process – will provide for stabilisation of the site so that downstream water quality impacts can be effectively mitigated.

The above measures combined are expected to ensure that any impacts to downstream water quality associated with the proposal are, at worst, minor exceedances of water quality criteria that are temporary and confined to the ephemeral drainages immediately surrounding the mine site. The proposal is not expected to cause any measurable impact to water quality discharging to West Arm and therefore is not expected to impact on any environmental values that rely on good water quality.

8.5 References

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GRANTS LITHIUM PROJECT

Draft Environmental Impact Statement

Chapter 9

Social, Economic and Cultural Surroundings

9 SOCIAL, ECONOMIC AND CULTURAL SURROUNDINGS

The definition of ‘environment’ in the *Environmental Assessment Act (NT)* encompasses “all aspects of the surroundings of man including the physical, biological, **economic, cultural and social aspects**”. The NT EPA’s objective for this environmental factor is to:

“Protect the rich social, economic, cultural and heritage values of the Northern Territory.”

This objective recognises the importance of ensuring that social, economic and cultural values are considered together and not significantly impacted as a result of a proposal.

This chapter describes the potential social and economic impacts and opportunities associated with the proposal to develop the Grants Lithium Project. The impact assessment considers potential impacts to, and opportunities for, the local communities on the Cox Peninsula where the Grants Lithium Project area is located and other areas where project activities will take place (i.e. along the haul route from the mine site to Darwin Port). The importance of the area to people and communities is discussed and potential impacts to heritage values (Aboriginal Sacred Sites and historic/archaeological heritage sites) are considered.

The mitigation and management measures that Core will implement to avoid and/or reduce impacts to social, economic, cultural and heritage values are summarised, as are the actions that will be undertaken to maximise the benefits of the project to the community. At the end of the chapter, a statement of residual impact is made detailing the extent to which the proposed mitigation and management measures will ensure that the NT EPA’s objective for this environmental factor is met.

The content of this chapter has been developed specifically to address Section 4.3.1 of the EIS ToR, and has been sourced in the main from the independent Social Impact Assessment (Appendix L and M) and Social Impact Management Plan (Appendix N) reports prepared by True North Strategic Communications.

9.1 Existing environment and values

The sections below describe the social and economic characteristics of communities in the Cox Peninsula region and other areas where project activities will take place. The potential for heritage sites and Aboriginal Sacred Sites to occur within the project area is also considered.

9.1.1 Population and government

The area immediately surrounding the project area is sparsely populated, surrounded by undeveloped vacant crown land for 7-8 km in all directions. The nearest community is Belyuen 15 km to the north-west. The small rural settlement of Berry Springs is located 36 km east of the project area. Darwin and Palmerston are the nearest densely populated areas, with estimated populations in excess of 78,000 and 33,000 respectively (ABS, 2016). Mining exploration is the main land-use in the area, and rural living, recreation and tourism occur across the peninsula more broadly.

The project area is not located within the boundaries of any local government area; however, the majority of the haul route is within the Litchfield Local Government Area (Litchfield LGA), with small sections also passing through the City of Palmerston LGA (Palmerston LGA) and the Darwin City LGA. Statistics from the Litchfield LGA have been used to provide a demographic background to the project.

The Litchfield LGA covers approximately 3,100 km² around the outskirts of Darwin, bounded by the Adelaide River to the east, van Diemen Gulf to the north, Coomalie Shire to the south and the cities of Darwin and Palmerston to the north-west. It had an estimated population of approximately 24,000 people in 2016 (ABS, 2016). The Palmerston LGA, covering 56 km², is bounded by the Litchfield LGA to the north, east and south,

and East Arm in the west. Regional demographic statistics are set out in Table 9-1. LGA boundaries are shown in Figure 9-1.

Table 9-1. Population details from 2016 census

Area	Population	Median age	% Aboriginal
Litchfield LGA	23,855	37	9.7
Belyuen	164	30	90.4
Berry Springs	818	35	9.2
Greater Darwin region	136,828	33	8.7
Northern Territory	228,333	32	25.5

9.1.2 Local communities and sensitive receptors

The key communities considered to be part of the project's area of influence are:

- Belyuen – closest community to the project area.
- Berry Springs – located on the Cox Peninsula Rd haul route.
- Tumbling Waters –accessed via the Cox Peninsula Rd (haul route)
- Wagait Beach and Dundee Beach – communities that are accessed via Cox Peninsula Rd
- Outer Darwin rural communities, e.g. Noonamah, Bees Creek, Coolalinga – along the haul route
- Darwin and Palmerston – likely to be a key source of employees and services.

The nearest formal residence is located on a freehold parcel of land 10 km to the south of the proposed mine site. The location of sensitive receptors within the project's area of influence is shown in Figure 9-1. The project's key stakeholders, together with the stakeholder engagement Core has undertaken, are outlined in Chapter 3. Below are profiles of the two communities closest to the project area.

Berry Springs

The Berry Springs community is a small rural settlement with a population of 818 and a median age of 35. At the time of the Census 2016 there were 348 houses and approximately 205 families living in the settlement. Of those employed in Berry Springs, 7% worked in State Government administration, 4.9% in nature reserves and conservation parks operation, 3.3% in other fruit and tree nut growing, 3.3% in primary education and 2.7% worked in vegetable growing. The median weekly income for people aged 15 years and over in Berry Springs is \$1,068.

Infrastructure and services in Berry Springs include the Berry Springs Primary School, medical centres, a tavern, cafes, a fuel station and a small shopping centre. There are similar services and infrastructure in each of the surrounding rural centres located along the haul route.

The Berry Springs area is a popular tourist destination, situated on-route to Litchfield National Park and popular fishing locations on the peninsula. The town experiences peaks in traffic along the Cox Peninsula Road during the tourist season, on weekends and school holidays.

Belyuen

Belyuen is an Aboriginal community with a population of 164, a median age 29 and an average of 4.4 people per household. Most residents (132 people) said they speak another language at home and only 22 people said they speak English at home. There were 40 houses in the community. Of those, 13 households reported having no vehicle. The median weekly household income was \$850.

9.1.3 Education profile

Information relating to education and employment can be useful indicators of a populations ability to support a construction workforce. Of people aged 15 and over in the greater Darwin region, 20.4 % were educated to a Batchelor degree level or above; this figure drops to 9.4 % in the Litchfield LGA and none in Belyuen. Proportions of people holding a Certificate III or IV are higher in the Litchfield LGA (25 %) compared to the greater Darwin region (19 %), and similar for those reporting Year 12 as the highest level of education (14 % in Darwin and 11 % in the Litchfield LGA). The educational attainment figures for Belyuen are significantly lower.

9.1.4 Police and emergency services

Humpty Doo Police Station, approximately 60 km away by road, is the closest police station to the site.

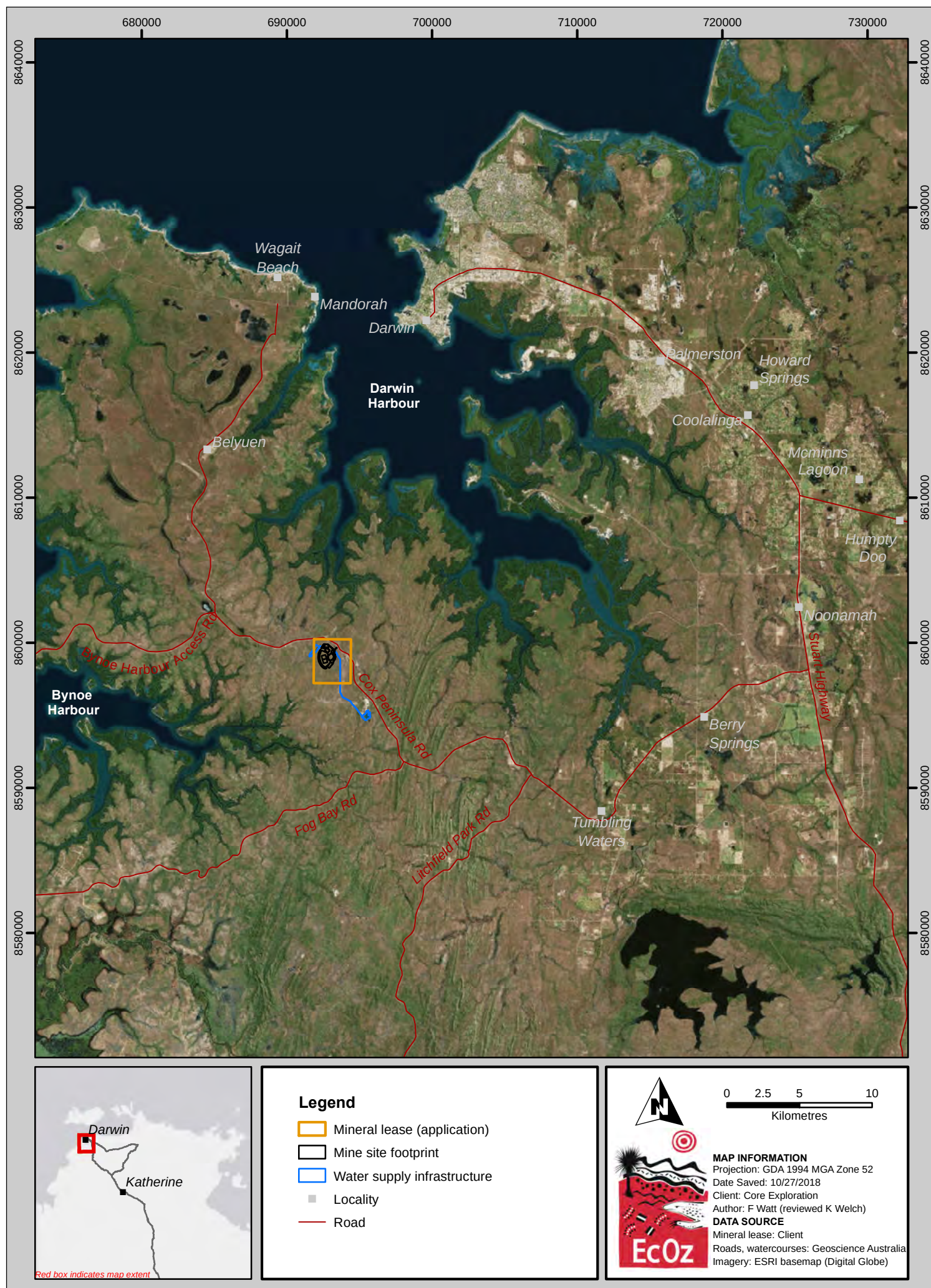
The closest fire station to the project site is also in Humpty Doo, which is open weekdays and there is also a volunteer fire brigade at Humpty Doo. The next closest fire station to the project site is Palmerston. The project is within the Vernon Arafura bushfire management zone, overseen by Bushfires NT.

St John Ambulance services the Darwin, Palmerston and rural areas extending out to 150 kilometres from the Darwin central business district. There are four ambulances servicing this area, with ambulances in Darwin, Casuarina, Palmerston and Humpty Doo. There are 90 staff working on rotation in the northern region. The response time for an ambulance to Dundee Beach is a minimum of one hour.

The Belyuen Health Clinic is open 9 am to 4 pm (five days per week) and provides clinical and emergency services to the surrounding area up to Fog Bay Road, which would include the project area. An ambulance is located at the clinic. There are also various health facilities and private medical practices in the area, including in Berry Springs, Humpty Doo, Coolalinga, Palmerston and Darwin. The closest hospital is the Palmerston Regional Hospital (70 km by road).

9.1.5 Local infrastructure

Cox Peninsula Road is a two-way undivided road maintained by the Department of Infrastructure, Planning and Logistics (DIPL). It is used by a mix of traffic including trucks moving cattle from nearby pastoral properties, tourists travelling to and from Litchfield National Park, Territory Wildlife Park and other locations, local fishermen travelling to and from popular fishing spots, school buses and school traffic going to and from Berry Springs Primary School, and locals commuting to and from work. The project area is not connected to mains water, sewage or telecommunication services.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 9 maps\Figure 9-1. Grants Project location image.mxd

Figure 9-1. Location of communities within the project's area of influence

9.1.6 Economy and employment

In the Litchfield Council LGA, construction is the most productive industry, followed by public administration and safety, and manufacturing. In combination, these three industries accounted for a total of \$3,202 million or 73% of the total value added by industry in the Litchfield Council LGA.

Construction was the largest employer in the Litchfield Council LGA making up 27% of total employment in the area in 2016-17. Public administration and safety is the second largest employer, followed by professional, scientific and technical services and mining.

The main employment industries in the Greater Darwin region more broadly are government administration, defence, hospitals, primary education and other heavy and civil engineering and construction. The region has low unemployment; however, these figures are expected to rise with the completion or closure of some key major projects in the region in the next year or so.

Two organisations function specifically as indigenous employment providers in the area. Ironbark Aboriginal Corporation works out of Belyuen Shire office two days per week, seeking employment opportunities and placements for residents. The Larrakia Development Corporation, based in Darwin, provides employment and business opportunities for the local Larrakia people via contractual or joint venture arrangements with local organisations.

9.1.7 Heritage sites

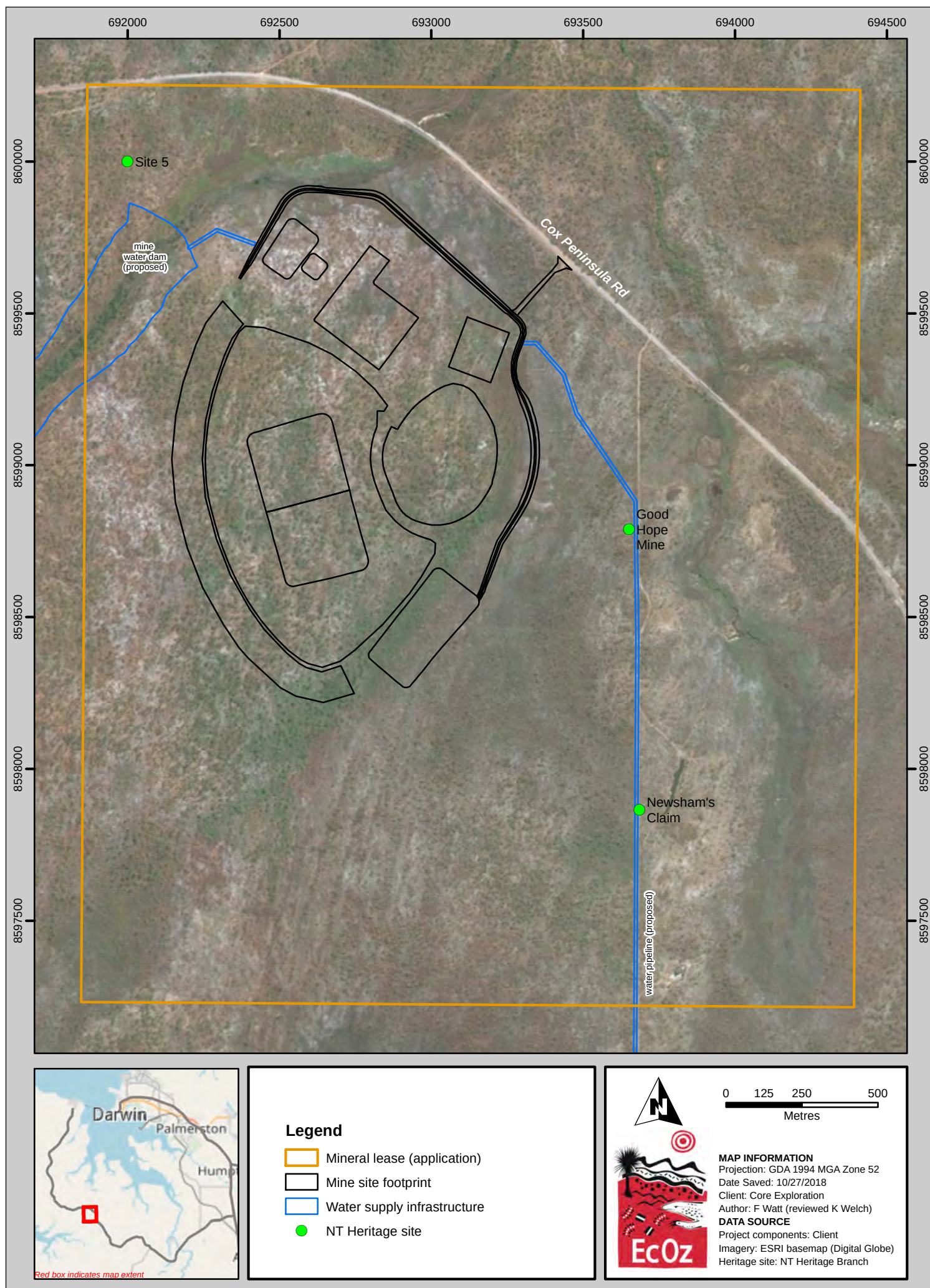
A search of the NT Heritage Register found that one Declared Heritage Area, listed as 'site 5', is within ML(A)31726. This site is located in the north-west corner of the lease area outside of the mine site disturbance footprint. It was identified during the archaeological survey of the proposed Darwin-Katherine optical fibre route and is described as a stone artefact scatter of moderate site significance atop a gentle slope. The NT Heritage Branch indicated no further archaeological surveys are considered necessary for the project area.

Additionally, NT Heritage Branch have provided the locations of two historic tin mine sites; referred to as Good Hope Mine and Newsham's Claim. These sites are located on the ML and are close to the water pipeline route, which follows existing tracks that would have been used to access these mine sites. Neither site is protected under the *NT Heritage Act*; however, the NT Heritage Branch has provided advice that disturbance of these sites should be avoided if possible.

Figure 9-2 displays these sites with respect to the project area.

9.1.8 Aboriginal Sacred Sites

In a letter dated 4 October 2017 the Aboriginal Areas Protection Authority (AAPA) advised that the Authority has no record of sacred sites listed within the project area. Core have submitted an application to AAPA for an Authority Certificate for the project.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ18086 - Grants Project - EIS\01 Project Files\Chapter 9 maps\Figure 9-2. Sites of heritage significance within mineral lease.mxd

Figure 9-2. Sites of heritage significance within Mineral Lease

9.2 Project economic details

Economic feasibility

The project is estimated to generate, in pre-tax terms, a Net Present Value (NPV₁₀) of A\$140 million with an Internal Rate of Return (IRR) of 142% at an average Life of Mine (LOM) concentrate price of US\$649/t over the LOM.

Economic scale

The capital cost to develop the project is estimated to be \$A53.5 million, with the project estimated to generate \$A346 million in revenue and over \$A168 million in free cash flow driving a rapid payback period of less than 12 months.

Overall tax and estimated contributions

The project is estimated to have a post-tax Net Present Value (NPV₁₀) of \$A87 million implying a contribution of \$A53 million in tax and \$A26 million in royalties paid to the NT Government.

9.3 Assessment of opportunities

The social impact assessment undertaken by True North Strategic Communications (2018) (refer Appendix L and Appendix M) identified potential opportunities and impacts associated with the construction/operations phase of the proposal. The key opportunities considered in the assessment are:

- Local business benefit from project-related contracts
- Boost to direct and indirect local employment
- Indigenous employment opportunities
- Sponsorship opportunities.

Each of these is discussed below.

9.3.1 Local business opportunities

Benefits to the local and regional (NT) economies are expected to accrue through the generation of jobs and the sourcing of goods and services required for construction and operation of the project. The capital cost to develop the project is estimated to be \$A53.5 million. There is an expectation that this will provide service and supply opportunities to local businesses in the rural area, Palmerston and Darwin. Given construction is the largest industry in the Litchfield LGA and the Greater Darwin region more broadly, businesses in Darwin, Palmerston and the rural area are likely to have the experience and capacity available to service aspects of the project.

While there is the community expectation of local jobs and contracts, and a concomitant boost to the local economy arising from the project, these expectations need to be managed due to the small scale (maximum 150 jobs during the construction and operations phase) and short duration (~two years) of the project. Given the narrow window of opportunity, it is possible that local businesses may lack the capacity or specialist skills, be ill-prepared or not competitive enough to win contracts associated with the project.

To enhance the opportunity for local business, Core will ensure that recruitment and procurement processes prioritise the local market. Local service and supply requirements will be specified in agreements with contractors. Tenders will be packaged to suit local capacity where possible. Tender opportunities will be promoted early to allow businesses to prepare for competitiveness and to meet the standards required. Core is also committed to proactively identifying local businesses with the capability to work on the project. Ongoing

communication will occur with the community and business sector about project details to ensure that expectations about job numbers and business contracts associated with the project are realistic.

9.3.2 Employment opportunities

Total workforce numbers are expected to peak at 150 during construction, with between 100 and 150 personnel for the two ear operational phase. The majority of positions will be contractors, tradesmen, operators and professionals, with limited senior management and supervisory positions. During the project rehabilitation phase, personnel numbers are expected to be at most 15 part-time positions.

Whilst some specialist skills may be required during construction, the mining workforce is expected to be comprised mainly of residents of Darwin, Palmerston and surrounding areas. There will be no on-site accommodation camp. Given the travel time from Darwin to site is less than one hour; workers will be expected to travel to/from site for each shift.

Core is committed to maximising employment opportunities for local workers and ensuring ongoing communication with the local community and businesses regarding job numbers and opportunities.

9.3.3 Indigenous employment opportunities

The NT Government has an expectation that projects in the NT provide opportunities for indigenous employment. In order to maximise these opportunities over the two to three years' duration of the project, Core will work with indigenous employment and training providers such as Ironbark and the Larrakia Development Corporation to identify opportunities for employment and participation for Aboriginal people.

9.3.4 Sponsorship opportunities

Core has expressed a willingness to work with local stakeholders to minimise negative impacts as much as possible, through various management strategies and by providing sponsorship funds to enhance benefits to the community. Discussions have already commenced between Core and Berry Springs Primary School.

9.4 Assessment of impacts

Assessment of impacts and risks to social, economic and cultural surroundings was undertaken separately for the construction/operations phase and the rehabilitation/closure phase. This section provides details of the assessment processes and discussion of potential impacts associated with each project phase.

Construction/operations phase

The social impact assessment undertaken by True North Strategic Communications identified potential negative impacts associated with the construction/operations phase of the proposal. The assessment involved engagement with key stakeholders as detailed in Chapter 3 of the EIS. Material impacts associated with project activities, and community/stakeholder concerns raised through the consultation process are listed below:

- Reduced amenity due to noise and/or dust emissions
- Increased traffic leads to delays, congestion and increased the road safety risk
- Road pavement impacts due to heavy vehicle traffic
- Pressure on police and emergency services
- Dam wall failure causes downstream flooding
- Stakeholder concern about environmental impacts associated with water use and mine closure
- Damage or destruction of heritage or Aboriginal Sacred Sites
- Reduced access to traditional cultural activities.

Rehabilitation/closure phase

Potential impacts associated with the rehabilitation and closure phase were identified and assessed as part of the closure risk assessment, which is included in the Mine Closure Plan (Appendix D). Potential impacts to social, economic and cultural surroundings considered in the assessment are listed below.

- Public access and safety
- Loss of future land-use opportunities
- Downstream flooding caused by failure of dam walls leads to loss of life or property.

The likelihood of these impacts occurring and the consequences in terms of impacts to social, economic and cultural values is discussed in the sections below.

9.4.1 Reduced amenity due to noise and/or dust

Some stakeholders raised concern about noise and dust disturbance from the project, particularly around the Berry Springs community. Dust and noise from operations at the mine site are not expected to impact amenity given the remoteness of the site from residential areas (i.e. the closest residence is 10 km away) and absence of other land-uses. The haulage of the concentrate from the project site to Darwin Port will see up to ten return truck trips along the haul route each day. The product being transported is a gravel-like substance and all trucks will be covered, therefore dust from transportation is not expected to impact any sensitive receptors along the haul route.

Noise from blasting activities will be audible along Cox Peninsula Road; however, traffic control will restrict access within the danger zone. Dust emissions if not adequately controlled could be visible on Cox Peninsula Road near the mine. Dust suppression requirements have been factored into the site water balance and it is expected that emissions will be confined to within the ML. The Erosion and Sediment Control Plan (Appendix F) provides controls for stabilising cleared areas so that dust emissions are minimised.

Noise and dust emissions are not expected to have a significant impact on the amenity of the region for local residents or visitors. Dust suppression and visual monitoring of dust along Cox Peninsula Road is prescribed in the EMP (Chapter 10) and a process for public feedback/complaints will be established.

9.4.2 Traffic delays, congestion and increased road safety risk

The area's most sensitive to any traffic delays, congestion and road safety risks as a result of the proposal are along Cox Peninsula Road around Berry Springs Primary School and the Berry Springs township. A traffic impact statement has been prepared to assess the impacts of project traffic on the existing road network in terms of increases in traffic, congestion, incidents and damage to the road surface (refer Appendix G). The change in heavy vehicle movements when haulage commences will increase the number of heavy vehicle movements during the school peak periods by 1.3%. This is considered a negligible increase and as such the risk of collisions involving heavy vehicles does not materially increase. Road trains currently use Cox Peninsula Road and therefore the potential of collisions with road trains exists as a managed risk. The small increase in traffic volumes is also not expected to impact other industry sectors that utilise the Cox Peninsula Road.

Some stakeholders raised concern about closure of the Cox Peninsula Road near the mine site for blasting, which is estimated to be required three times per week for approximately 15 minutes. It has been noted that there is an increased volume of local traffic on the road on weekend mornings and afternoons when people are accessing the recreational areas of Bynoe Harbour and Dundee Beach. St Johns raised concerns about restrictions on emergency vehicle access. Core will consider all stakeholder feedback when planning blast times and a Blasting Management Plan will be developed. Measures will be in place to enable emergency vehicle passage through road closures in the event of an emergency, and there will be on-site first aid facilities and an Emergency Management and Response Plan.

Core will implement a Traffic Management Plan to manage traffic delays and impacts to traffic movements. The design of the mine site access intersection with Cox Peninsula Road incorporates a slip lane and signage to minimise traffic impacts at the turnoff. Speed restrictions will be implemented through Berry Springs, and a process for public feedback/complaints will be established. Liaison will continue with the DIPL regarding road usage, and truck movements will be planned to minimise impacts to people and communities. Ongoing communication and engagement with stakeholders will be undertaken by Core to inform motorists of expected delays and traffic movements.

9.4.3 Road pavement impacts due to increased traffic

The impact of the increased heavy vehicles on pavement of Cox Peninsula Road was assessed based on the pavement design procedure described in *Guide to Pavement Technology Part 2: Pavement Structural Design*. The comparative assessment considered the current background pavement loading relative to additional traffic generated from the proposal. Details of the assessment are included in the Traffic Impact Statement provided at Appendix G.

The current traffic volume on Cox Peninsula Road is approximately 2,400 vehicles per day (1,200 per day in each direction). Assuming a 30-year design life and 20% of the traffic is heavy vehicles, this equates to a loading on the Cox Peninsula Road pavement of approximately 87.5 million equivalent standard axels.

Throughout the life of mine, an additional 40,000 truck movements (20,000 loaded and 20,000 unloaded) will occur. This equates to approximately an additional 666,000 equivalent standard axels of load applied to the pavement. The mine will increase the loading on the pavement by approximately 0.75% and reduce the life of the pavement by approximately 0.5%, which is negligible. Any localised impacts to the road pavement can be adequately managed through a standard road maintenance programme.

Stuart Highway, Tiger Brennan Drive and Berrimah Road were not assessed separately as the relative increase in heavy vehicle traffic on these roads is less than that of Cox Peninsula Road. The impact of the addition heavy vehicles on these pavements is also considered negligible.

The current road network is expected to continue to operate safely with the additional haulage movement and upgrades are not considered necessary due to the small volumes of haulage traffic. DIPL have advised that weight restrictions will apply during any flooding events to prevent damage from heavy vehicles.

Communication with DIPL will be ongoing throughout the life of the project and Core will comply with all directions in relation to use and maintenance of the public road network.

9.4.4 Pressure on police and emergency services

Road trauma, bushfires, spills, workplace incidents or other emergencies could increase pressure on emergency services. Given the scale and duration of the project, the risk is not considered high. Issues raised by stakeholders are summarised below.

Both St John Ambulance and NT Police expressed concern about increased road trauma with tourists and local traffic sharing the road with industrial traffic on Cox Peninsula Road where overtaking is difficult. The impact of road closures affecting emergency vehicle access to areas such as Dundee Beach, Belyuen, Wagait and Mandorah was also raised. These matters are discussed in detail in section 9.4.2 above.

Bushfires NT confirmed that the area surrounding the site has a high incidence of bushfires. A project Emergency Management and Response Plan is a standard requirement for all mine sites. This plan will address bushfire response, including engagement with Bushfires NT. Firebreaks will be maintained around the mine site.

9.4.5 Dam wall failure causes downstream flooding

The establishment of surface water dams to supply the projects water requirements could pose a risk of downstream flooding if spillways are not properly engineered. Both water supply dam designs have been derived according to the dam consequence categories assessed by mining engineers in accordance with the ANCOLD guidelines (ANCOLD, 2012). These guidelines are the accepted national standard applicable for water or tailings dams with the potential to cause loss of life or significant environmental or physical damage through operation or failure. At the feasibility stage, the consequence categories for the dams have been rated as 'significant' based on the impact of a dam failure to the business and the environment. Emergency spillways for the dams have been designed to pass a 0.1% AEP event, thus reducing the likelihood of dam wall failure.

In the very unlikely event of a dam wall failure, the areas that would be flooded are uninhabited. The areas are accessible to the public, and the Cox Peninsula Road is within the flood footprint of the mine site dam. Any flood water impact would be over a short period of time.

9.4.6 Stakeholder concern about environmental impacts

Some stakeholder expressed concern about the potential environmental impacts from the proposal. These are addressed in detail in the various sections of the EIS. Key points relating to water use and mine closure are summarised below, as these were key areas of stakeholder concern. Core's EMP for the proposal, documented in Chapter 10, outlines the controls that will be implemented to minimise environmental impacts and how environmental performance will be monitored and reported.

Water use and impacts

Concern has been expressed about the project using groundwater, particularly in light of current concerns about over-extraction from the Berry Springs Dolostone aquifer and a moratorium on the issue of new groundwater extraction licences in the area. Core has commissioned detailed studies of the surface and groundwater around the project area to inform development of a sustainable water supply for the proposal. The project water requirements and sources are detailed in Chapter 2, Section 2.12. Water sources for the mine will be comprised of:

- Surface water pumped from off-site dams; namely, Observation Hill dam and a new mine site dam to be constructed on the ML.

- Groundwater/rainfall in-flows to the pit, which will be dewatered to an on-site storage dam.

Core's proposal does not include extraction from groundwater bores. Further, there is no groundwater connection between the mine site and the Berry Springs aquifer.

Detailed assessment of the potential impacts of the proposal on water flows and groundwater levels (hydrological processes) and water quality is provided in Chapter 7 and Chapter 8 of this EIS. These chapters conclude that the project is not expected to have any significant impact on any environmental values or land-uses that rely on water.

There will be some reduction in early wet season flows downstream of the mine site due to localised alteration of drainage patterns and extraction of water from the Mine Site Dam. Modelling prepared by qualified hydrologists indicates that discharges from the catchment into the upper reaches of West Arm could be reduced by 16-20% in November to January, dropping to between 1% and 7% for the remainder of the wet season (Appendix H). This reduction is not expected to have any measurable impact on environmental values in West Arm.

Some lowering of groundwater levels will occur as groundwater will flow into the open pit. Modelling prepared by qualified hydrogeologists indicates the drawdown will be confined to within one kilometre of the pit and will not affect the ephemeral drainage lines around the site (Appendix I).

The project does not require the use of chemical additives in processing and the waste rock has been characterised as geochemically benign, therefore sediment is expected to be the only contaminant of concern in drainage originating from the mine site. The absence of potential sources of chemical contamination, coupled with groundwater modelling that indicates the pit will act as a groundwater sink, means the project poses an inherently low risk of impacts to water quality.

Core commenced baseline water monitoring in 2017 and will continue to monitor water impacts throughout constructions/operations and post-closure. The Water Management Plan provided with the EIS, documents the proposed approach and measures that will be implemented if impacts are detected. Compliance with this plan will be regulated by DPIR. Core will be required to report any exceedance of water quality criteria to DPIR and submit an annual report.

Mine closure

Some stakeholders have expressed concern that the pit will not be backfilled and an interest in seeing more detail in relation to mine closure. Core's plan for rehabilitation and closure of the mine site is documented in the Mine Closure Plan (Appendix D).

On closure of the mine site, all infrastructure will be removed. The WRD and other disturbed areas will be stabilised and revegetated with local plant species. The key landforms that will remain post-closure are the WRD, abandonment bund (for public safety) and the open pit, which will fill with water over a period of 50 years. The 500 metre vegetation buffer between the site and the road, will limit visual impacts; however, it is possible that the top of the waste rock dump (WRD) may be visible from the Cox Peninsula Road.

The EIS ToR section 4.1.2.4 require "an adequate and transparent evaluation of the benefits, risks and costs of all (closure) options." This requirement is addressed by the 'pit sterilisation assessment' prepared by Innicon (2018). The sterilisation report concludes that backfilling of the pit is an option that would decrease the profit margins of the operation but is unlikely to make the open pit project unviable. However, the key factor that has influenced Core's decision not to backfill the pit is that it would make future underground mining of the already defined ore resource beneath the pit unviable. If the pit is backfilled, the only way the resource can be accessed is from the surface, either by a surface decline or via a shaft. If a decline option is considered, compared to a portal access from deep within the pit void, the additional cost to establish a twin decline would be \$22.2M, which in Core's view would be considered unviable.

9.4.7 Damage or destruction of heritage or Aboriginal Sacred Sites

The heritage sites identified in section 9.1.7 will be designated 'no-go' zones, reducing the likelihood of damage occurring. Core will implement a Code of Conduct for workers and inductions covering protection of heritage values. Any previously unrecorded archaeological sites encountered will be reported to the NT Heritage Branch for advice on how to respond, and procedures for unexpected heritage finds will be included in the Mine Management Plan to be approved by DPIR. Core have applied for an Authority Certificate from AAPA and will comply with any conditions. The above measures and relevant monitoring and reporting requirements are included in project EMP (Chapter 10).

9.4.8 Reduced access to traditional cultural activities

The extent to which the area is used for traditional activities by the Larrakia people is unknown because the relevant stakeholders were not available at the time of stakeholder engagement. However, Core is committed to engaging with relevant indigenous groups such as the Northern Land Council, Larrakia Nation and Belyuen Shire Council, to ensure any traditional cultural activities are not impacted by the mine.

9.4.9 Public access and safety

During operations, the mine site entry will be secured to prevent unauthorised public access. Key hazardous areas, such as explosives storages will be secured in accordance with legislative requirements. Security will be maintained by continuous personnel presence on the site which will be operational 24 hours/day. During blasting, an exclusion zone will be established with traffic control in place to prevent vehicle access into the area on Cox Peninsula Road.

Public access to the abandoned mine site will not be permitted as the open pit will pose a safety hazard. An abandonment bund will be maintained around the site to prevent accidental entry, and signage will be installed to inform the public of danger. The pit shell design has been based on a detailed geotechnical assessment (SRK 2018) so is unlikely to fail or be an area of instability. The pit walls are assumed to be geochemically benign based on the waste rock characterisation undertaken (Appendix E), and modelling of pit water chemistry indicates it to be no risk to human health. The disturbance footprint is not in an area that is frequented by people; however, people could be attracted by the prospect of swimming in the pit lake. Whilst the assessment undertaken to date indicates that contact with water in the pit would not pose a direct health risk, any unauthorised public access to the site has potential to pose a risk to people's safety.

The risk to public safety could be heightened in the event of early or unforeseen closure, due to mine site landforms not being stabilised and rehabilitated. The level of risk will depend on the stage of development and the reason for closure. The short mine life and economics underpinning the project suggest that early closure is unlikely once operations commence. In the event the early or unforeseen closure a care and maintenance plan is required under the *Mining Management Act*. The plan will need to detail how the site will be made safe, stable and non-polluting. The bond required as part of the mining authorisation process – will provide for stabilisation of the site and ensure that access restrictions and signage are put in place.

9.4.10 Loss of future land-use opportunities

Post-closure, the mine site footprint (145 ha) will be sterilised from future land-use due to the presence of the open pit. The assessment of environmental impacts documented in the EIS, indicates the proposal is unlikely to produce Acid Mine Drainage (AMD) or any other impacts that would affect surrounding land, soils or water quality to the extent that future land-use would be constrained. The site is located on vacant crown land and is surrounded by undeveloped land for 7-8 km in all directions. There is no indication of proposed future land-uses that would be constrained by the presence of the abandoned mine site.

Endorsement of the post-mining land use, closure objectives and completion criteria will be sought from the key stakeholders (DPIR, DIPL, DENR and the NT EPA) as part of the environmental assessment process. Core will undertake ongoing rehabilitation, erosion and water monitoring with the objective of rehabilitating the disturbance footprint with a “stable, non-polluting landform with self-sustaining native vegetation groundcover, comparable to that of the surrounding ecosystems.” Effective implementation of the Mine Closure Plan is expected to ensure that loss of future land use is confined to the mine site footprint.

9.5 Mitigation and management

Measures to minimise and manage potential impacts to social, economic and cultural values were identified with the objective of reducing all risks to levels that will ensure that the proposal is consistent with the NT EPA's objective for the social, economic and cultural surroundings factor. Key mitigation measures are referred to in the above discussion of potential impacts. The sections below summarise the measures that will be implemented during the construction/operations and rehabilitation/closure phases.

9.5.1 Construction and operations

A Social Impact Management Plan (SIMP) is provided at Appendix N. The SIMP includes measures for maximising the potential opportunities associated with the project, and mitigation and managing potential negative impacts. These measures have been incorporated into the project EMP (Chapter 10), which establishes performance objective, indicators, monitoring and proposed corrective actions that will be implemented in the event that the predicted benefits and outcomes are not being achieved.

The SIMP refers to the following project plans/documents that will be used to minimise potential negative impacts:

- Traffic Management Plan (to be submitted with MMP)
- Emergency Management and Response Plan (to be submitted with MMP)
- AAPA Certificate
- Employee Code of Conduct.

Core has committed to maximising opportunities for local contracts and employment. Core has initiated engagement with indigenous employment and training providers such as Ironbark and the Larrakia Development Corporation to identify commercial opportunities that may result in employment and participation for Aboriginal people.

9.5.2 Rehabilitation and closure

The Mine Closure Plan (Appendix D) describes proposed closure objectives and completion criteria for the mine site. Endorsement is being sought from the key stakeholders (DPIR, DIPL, DENR and the NT EPA) as part of the environmental assessment process. Conceptual details of the final landform are provided in the plan, including measures for managing unauthorised access by people. The plan also includes a work program for rehabilitation and closure of the site, and a monitoring program that will be implemented to evaluate rehabilitation success and progress towards achieving closure objectives.

9.6 Statement of residual impact

The outcomes of the social impact assessment indicate that the greatest potential impact to social, economic, cultural and heritage values associated with the proposal relates to the increased heavy vehicle traffic and temporary closures on Cox Peninsula Road. This impact was rated as high because it was the key concern raised by stakeholders. The Traffic Impact Statement prepared for the proposal indicates that the increase in peak traffic volumes will be small (1.3%) and is therefore not expected to cause congestion or an increased risk of collisions. Road closures for blasting, albeit for short periods of time, will inconvenience and concern some

people; however, communication with stakeholders and the community in relation to road closure times is expected to reduce this risk to an acceptable level.

All other impacts were rated as low to moderate. The key reasons why the project has inherently limited social and economic impacts are listed below:

- The mine site is remote from residential areas and sensitive receptors
- Small disturbance footprint
- Short-mine life (2-3 years)
- Small workforce (100-150 personnel)
- Local businesses have capacity to service the mine site and most employee skill sets are available in the greater Darwin region.
- Local workforce to be accommodated in the community – no onsite accommodation camp and no fly-in-fly-out workforce.
- No identified AMD or other contamination issues that will restrict future land-uses.
- No archaeological heritage sites or Aboriginal Sacred Sites recorded in the disturbance footprint.

Implementation of the mitigation, management and monitoring measures prescribed in the SIMP, is expected to reduce these impacts to low.

For the rehabilitation and closure phase of the project, the greatest risk relates to public access and safety. The Mine Closure Plan provided at Appendix D provides details of how the mine site will be made safe. The abandonment bund and signage is expected to provide adequate warning of the dangers of entry; however, unauthorised entry cannot be prevented altogether. People accessing the mine site unlawfully will risk injury.

This risk to public safety could be heightened in the event of early or unforeseen closure, due to mine site landforms not being stabilised and rehabilitated; however, given the short mine life and economics underpinning the project, the likelihood of early closure is considered low. In any event, risk should be adequately addressed through implementation of a Care and Maintenance Plan, which is a requirement pursuant to the *Mining Management Act*. The bond – required as part of the mining authorisation process – will provide for making the site safe.

The works program described in the Mine Closure Plan, when effectively implemented, is reasonably expected to make the site stable and non-polluting. However, the extent to which rehabilitation will be effective in establishing self-sustaining native vegetation groundcover, comparable to that of the surrounding ecosystems, is uncertain. Progressive rehabilitation and trials commencing in the first year of operations, will increase the likelihood of good rehabilitation outcomes. Due the small mine footprint and no identified AMD or other contamination issues, even if rehabilitation outcomes are poor, future land-use is not expected to be significantly impacted.

As detailed in Chapter 3 of the EIS, Core has taken a proactive approach to stakeholder engagement. Most key stakeholders have been reached and their input has been incorporated into the SIA and SIMP. Some key stakeholders have not been reached, in particular there is a gap in feedback from the Belyuen community. Core is committed to maintaining efforts to engage with Aboriginal stakeholders and all other stakeholders. Ongoing opportunities for provision of feedback are expected to ensure any issues are identified and addressed as the project planning progresses.

The above measured combined are expected to ensure that impacts to social, economic and cultural values are minimised and not at levels that would be considered unacceptable to stakeholders.

9.7 References

References cited in this chapter are listed below.

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GRANTS LITHIUM PROJECT

Draft Environmental Impact Statement

Chapter 10

Environmental Management

10 ENVIRONMENTAL MANAGEMENT PLAN

This chapter collates all of the mitigation and management measures developed through the impact and risk assessment process undertaken for this EIS, and establishes a framework for monitoring the effectiveness of the measures, responding to any emerging issues that could result in environmental impacts being greater than anticipated and reporting on environmental performance. Commitments to addressing information gaps and/or developing more detailed management plans/procedures are also collated for future reference. This Environmental Management Plan (EMP) is intended to be used as the basis for developing the more detailed plans and procedures, which will be required beyond the EIS process, in order to gain a mining authorisation under the *Mining Management Act* and to comply with all other regulatory requirements applicable to the proposal.

10.1 Scope

As the EIS process is the first step in the regulatory process that applies to the Grants Lithium Project, its focus is on identifying environmental impacts and risks that could be 'significant' if they are not adequately understood, and effectively managed and monitored. The EMP is designed to provide a strategic framework for managing impacts and risks associated with the proposal as it is described in Chapter 2 of the EIS.

The framework documented in this EMP is for the *construction and operations* phase of the project. It is based on the outcomes of the construction and operations phase risk assessment and social impacts and opportunities assessment, both of which were designed to identify and assess risks to the NT EPA's environmental objectives for the environmental factors assessed in the EIS.

For the *rehabilitation and closure* phase of the project, the Mine Closure Plan (Appendix D) provides an environmental management framework. The framework is based on the outcomes of the rehabilitation and closure phase risk assessment, which identified risks related to achieving the closure objectives for the site.

The environmental management provisions described in this EMP, plus any recommendations made by the NT EPA and conditions of subsequent approvals/permits/licences, will be used by Core as the basis for preparing the future Mining Management Plan (MMP) for the project. The MMP will be the plan that is submitted for authorisation under the *Mining Management Act* and will become the key document used by Core and its contractors to manage, monitor and report on environmental performance on a day-to-day basis. The MMP will also be the key regulatory document against which Core's environmental performance is monitored by the Department of Primary Industry and Resources (DPIR) over the life of mine and into the rehabilitation and closure phase.

10.2 Environmental policy

Core has established an Environmental Policy to communicate the company's commitment to understanding and managing environmental and social impacts and risks associated with its proposed activities. This policy will guide the development of environmental management systems, processes, plans and procedures for the Grants Lithium Project. A copy of Core's Environmental Policy is illustrated in Figure 10-1.

Environmental Policy



Core Exploration is committed to ensuring an environmentally respectful workplace for our employees and contractors whilst working towards minimising our potential impact on the environment. Core Exploration will operate in compliance with all relevant environmental legislation and will strive to use environmental best practices in all areas of its operations.

Core Exploration commits itself to minimising its impact on our environment through:

- Having an environmentally sustainable aware culture, where responsibility is assigned and understood;
- Being an environmentally responsible neighbour in our community;
- Conserving natural resources by reusing and recycling;
- Using, in our operations, processes that do not adversely impact the environment;
- Ensuring the responsible use of energy throughout the organisation;
- Participating in efforts to improve environmental protection and understanding;
- Taking steps to improve environmental performance continually;
- Working with contractors who promote sound environmental practices; and
- Enhancing awareness among our employees, contractors and stakeholders – educating and motivating them to act in an environmentally responsible manner.

This policy is supported by an Environmental Management Plan developed for each of Core's projects. The project specific Environmental Management Plans describe Core Exploration's environmental management focus in minimising and eliminating environmental impacts wherever practicable.

Core Exploration will regularly report on its environmental performance in accordance with recognised standards and targets as listed in the respective Environmental Management Plans. This policy and the project specific Environmental Management Plans will be reviewed annually.

Stephen Biggins
MANAGING DIRECTOR

10.3 Impact and risk assessment

The principles of qualitative risk management described in *AS/NZS 31000:2009 Risk Management – Principles and Guidelines* were used to set-up a framework for assessing the level of risk associated with the potential impacts from the proposal. The approach and methods are described in Chapter 4 of the EIS. The resultant environmental risk register for the construction and operations phase is provided at Appendix O.

Social impacts and opportunities were assessed separately to environmental impacts because they require slightly different assessment criteria that incorporate community/stakeholder perceptions and also provide for the assessment of opportunities. The social impacts and opportunities register is provided at Appendix M.

Risks and opportunities were assessed based on the information available at the time the EIS was prepared. The risk registers document assumptions made in assessing the risk and the level of certainty that can be assigned to the resultant risk ratings. As the project progress into more detailed design, and information gaps and uncertainties are addressed, the environmental risk register will be updated. Current versions of the risk register will be included with each future submission of the EMP/MMP.

10.4 Commitments

The technical studies and design detail available to inform the EIS stage risk assessment, were considered sufficient to allow for risks to be assessed with a moderate to high level of certainty. Some information gaps/uncertainties that could impact on the effectiveness of the proposed controls and residual level of risk, are noted in the risk register. Throughout the EIS, Core has made commitments to undertaking further work to ensure all risks are adequately understood and effectively managed. This further work is identified in the Commitments Register (Table 10-1).

Core is also committed to implementing all management provisions, monitoring, corrective actions and reporting requirements outlined in this EMP. Where measures are included in the EMP they are not listed separately in the commitments register.

Table 10-1. Commitments Register

Compliance
In the event that the proposal is amended to the extent that the environmental significance of impacts may increase, Core will refer the proposed changes to NT EPA.
Core will apply for a mining authorisation pursuant to the <i>Mining Management Act</i> and will comply with all conditions of the authorisation.
The Mining Management Plan submitted for authorisation will include an updated environmental risk assessment that re-assesses risks to environmental values associated with the final mine site design and operational plans.
Core will obtain and comply with the conditions of all approvals, permits and licences required by the NT regulatory system.
Core will prepare the following management plans referred to in the EIS to the satisfaction of the relevant regulatory agencies: Mining Management Plan, Traffic Management Plan, Emergency Response Plan, mine Risk Management Plan and an Employee Code of Conduct.
Design
Geotechnical testing and investigation of proposed construction and cover materials will be undertaken, to confirm material characteristics, treatment requirements and final landform designs. Results of this testing will be provided in the MMP submitted to DPIR.
Dams and water storages will be designed and constructed in accordance with ANCOLD guidelines.
Core will apply for permits to construct the dams pursuant to the <i>Water Act</i> .
A wastewater works design approval will be obtained from Department of Health for the onsite wastewater (sewerage) management system.
Materials characterisation
Geochemical classification and leachate testing of tailings will be undertaken from the next stage of the pilot plant, to confirm assumptions of negligible AMD risk.
On-going materials characterisation and monitoring of pit and decant water quality will be undertaken throughout operations to confirm assumptions of negligible AMD risk.
Water management
Water supply dams will be sized based on the minimum requirements to provide a reliable and sustainable supply of water for the project.
The site water management system will be designed to maximise water efficiency and reuse so that extraction of make-up water from off-site dams is minimised.
The Water Management Plan submitted with the EIS will be subject to independent review. The review findings and a summary of subsequent changes made to the plan will be made publically available with the supplementary EIS.
Core will apply for a Waste Discharge Licence pursuant to the <i>Water Act</i> and will comply with all licence conditions.
Baseline monitoring of surface water and groundwater will continue over the 2018-2019 wet season and trigger values will be updated in the Water Management Plan submitted with the MMP.
Core will maintain records to allow for calculation of Greenhouse Gas Emissions and will report year 1 emissions in accordance with the requirements of the <i>National Greenhouse and Energy Report Act</i> if the reporting trigger is exceeded.
Road-use
Core will continue to engage with DIPL in relation to use and maintenance of the road and will apply for all requirements permits and approvals. Core will comply with all conditions imposed to ensure safety and minimise inconvenience to other road users.
Core will engage with stakeholders to determine road closure windows for blasting that will minimise impacts to road users.

Sacred sites protection
Core will obtain an Authority Certificate under the <i>Aboriginal Sacred Sites Act</i> prior to commencing works on site and will comply with all conditions.
Community, local contracts and jobs
Core will continue to engage with stakeholders, in accordance with the procedures outlined in the Social Impact Management Plan, to ensure that negative impacts to the community are minimised and opportunities for employment and local contracts are maximised.
Mine closure
Draft closure objectives identified in the Mine Closure Plan will be finalised using feedback from the EIS process.
The Mine Closure Plan will be updated with final landform and drainage designs. The final designs will be informed by geotechnical test work to demonstrate long-term geotechnical stability of the final landforms. Final designs will be to the satisfaction of DPIR.
Rehabilitation trials will be undertaken during operations to determine soil treatments and supplementary planting requirements to maximise rehabilitation outcomes.
Early unexpected closure
In the event of early unexpected closure, Core will notify the Department of Primary Industry and Resources and will comply with directions to ensure the mine site is safe and stable.

10.5 Legal and other requirements

The Grants Lithium Project proposal triggered assessment under the *Environmental Assessment Act* at the level of an EIS. The NT EPA will assess the EIS and make recommendations in relation to whether or not the proposal can proceed without significant environmental impacts. It will then be up to the Minister for Mines, on the advice of DPIR, to decide whether the project should be authorised under the *Mining Management Act* and what environmental conditions should be attached to that authorisation.

This authorisation is the key regulatory instrument used by the NT Government for approval and compliance monitoring of mining operations in the NT. To apply for an authorisation, Core will prepare a Mining Management Plan (MMP). Pursuant to section 40 of the *MMA*, a MMP is to include the following:

- Identification and description of mining activities
- Particulars of the implementation of the management systems to address environmental issues
- A plan and costing of closure activities
- Particulars of the organisational structure
- Plans of current and proposed mine workings and infrastructure and other information as required.

Most of these details are provided in the EIS and will be transferred across to the MMP, with updates made where required to reflect the most current mine planning.

For projects such as Grants Lithium Project that are assessed under the *EA Act*, the Minister may impose conditions relating to recommendations received from the NT EPA. Authorisations are granted following completion of the EIS assessment process.

The other key approvals, permits and licences required by the project are listed below.

- Waste Discharge Licence under the *Water Act*
- Permit to construct a dam under the *Water Act*
- Licence to take or use surface water under the *Water Act*

- Permit to Work in NTG Road Reserve and other road approvals required by DIPL under the *Control of Roads Act*
- Authority Certificate issued under the *Aboriginal Sacred Sites Act*
- Wastewater works design approval under the *Public and Environmental Health Act*
- Explosives Business Licence under the *Dangerous Goods Act & Regulations*.

These requirements provide for an additional level of regulatory scrutiny and oversight beyond the EIS process. As each of the approvals, permits and licences required is obtained, the project EMP will be updated to include details of those approvals and the management provisions that will be implemented to achieve compliance.

10.6 Management framework

This EMP provides an environmental management framework for each of the following environmental factors assessed in this EIS:

- Terrestrial flora and fauna
- Terrestrial environmental quality (land and soils)
- Hydrological processes
- Inland water environmental quality
- Social, economic and cultural surroundings.

Environmental values and potential impacts identified through the impact and risk assessment process are tabled, and for each potential impact the framework provides:

- Environmental objective/outcomes
- Management provisions
- Performance targets/indicators
- Monitoring procedures
- Contingency measures
- Reporting requirements.

Specialised management plans have been developed to provide a higher level of operational detail for key areas of environmental risk. The following additional management plans and procedures have been submitted with the EIS:

- Vegetation Clearing Procedure
- Water Management Plan
- Erosion and Sediment Control Plan
- Social Impact Management Plan
- Mine Closure Plan.

10.6.1 Terrestrial flora and fauna

The NT EPA's objective for terrestrial flora and fauna is to:

"Protect the NT's flora and fauna so that biological diversity and ecological integrity area maintained."

The framework that will be adopted to mitigate and manage impacts and risks to terrestrial flora and fauna, is tabled below.

Value	Potential impact	Objective / outcome	Management provisions	Targets / performance indicators	Monitoring	Response	Reporting & Record-keeping
Native vegetation & habitats (Eucalyptus woodland and broad drainages)	Reduced regional habitat due to land clearing	Restrict land clearing to the minimum required for the project	• Delineate area to be cleared as per Vegetation Clearing Procedure • Develop and adhere to a land clearing schedule • Clear and stockpile vegetation as per Vegetation Clearing Procedure • Remove (by burning) stockpiled vegetation as soon as practicable	No vegetation clearance or ground disturbance outside of the approved footprint	Weekly inspection (using a GPS) during vegetation clearing to ensure no clearing outside of flagged area	• Investigate why excessive clearing occurred and update procedures as necessary, and/or implement rehabilitation plan for over-cleared area	Site Inspection Register
		Reinstate cleared land to similar condition that the site was previously	• Remove and store topsoil as per the Vegetation Clearing Procedure and ESCP • Implement erosion control of top-soil stockpile as per ESCP • Undertake rehabilitation as per Mine Closure Plan	Regeneration of self-sustaining native vegetation similar to that which was on the site previously	Monitoring of vegetation as detailed in the Mine Closure Plan: • Transitional vegetation monitoring conducted annually following reinstatement of top-soil • Final vegetation assessment once there are no rehabilitation risk areas identified in the transitional vegetation surveys	• Maintain rehabilitation monitoring database • Implement corrective actions as detailed in Mine Closure Plan • Review monitoring measures and effectiveness of rehabilitation actions every five years as per the Mine Closure Plan	Annual Rehabilitation Report
Native vegetation & habitats (Eucalyptus woodland and broad drainages)	Reduced habitat quality due to smothering of plants with dust	Minimise the generation of project-related dust	• Undertake dust suppression using water carts and the application of polymer products • Supply sufficient water for dust management • Stabilise cleared areas as per ESCP • Cover all vehicles transporting materials that may produce dust	No signs of project-related dust beyond Mining Lease (ML)	• Visual monitoring of dust beyond ML boundary • Monitoring of water supply for dust management • Monitoring of stockpiles as per ESCP	• Undertake additional dust management if dust is visible	Site Inspection Register
Native vegetation & habitats (Eucalyptus woodland and broad drainages)	Reduced habitat quality and mortality of individuals due to bushfire	Minimise the impact of bushfires caused by project activities	• Burn stockpiled vegetation as soon as practicable and with a permit, as per Vegetation Clearing Procedure • Maintain spot fire response capability (i.e. water truck, and fire extinguishers fitted in all vehicles and machinery) to prevent fires from spreading • Establish firebreaks around all laydown, stockpile and central work areas • Develop bushfire response procedures within site Emergency Management Plans	No bushfires attributable to project activities escape the ML	Weekly check that fire-fighting equipment is in order during dry season	• Investigate cause of fire and update procedures as necessary	Report fires that cross ML boundary to Bushfires NT Site Inspection Register
Native vegetation & habitats (Eucalyptus woodland and broad drainages)	Reduced habitat quality due to the introduction of weeds	Minimise the potential for introduction and spread of weeds	• Source off-site materials from sites that have been declared weed-free • Survey disturbance area for weeds prior to commencement of construction and control/eradicate existing infestations • Clean, check and certify all earth-moving equipment and vehicles as	No new weed species introduced into the project area No increase in weed infestations from baseline conditions	Monthly surveying for the presence of weeds, focussing on: • Areas to be disturbed that are in the vicinity of any weed occurrence • Stockpiles • Areas that have soil, sand or gravel introduced	• Review weed hygiene measures • Implement weed controls appropriate to the species detected	Weed and Pest Monitoring & Control Log Weeds of National Significance to be reported to DENR

Value	Potential impact	Objective / outcome	Management provisions	Targets / performance indicators	Monitoring	Response	Reporting & Record-keeping
			- weed-free before entering site (during pre-strip and construction phase) - Install wash bay facilities and maintain wash-down logs - Make available information on potential weeds to assist staff with identification and response		- Access tracks - Watercourses, particularly after floods		
Native vegetation & habitats (Eucalyptus woodland and broad drainages)	Reduced regional habitat due to land inundation of dam footprints	Restrict land inundation to the minimum required for the project	Design dam sizes based on the minimum requirement to achieve a sustainable water supply for the project	No inundation outside of the approved footprint	Mapping of inundation footprint	Update site details in MMP to reflect as constructed footprints	Any increases in project footprint recorded in future updates of MMP
Riparian vegetation	Reduced regional riparian habitat due to reduction in flow volumes downstream of dams	Restrict water extraction to the minimum required for the project.	- Size dam based on the minimum requirement to achieve a reliable and sustainable water supply for the project - Maximise water re-use on site	No significant deviation from water extraction volumes used in modelling of flow reductions	- Modelling of reduction in flow based on as-built dams - Monitoring of water extraction from dams - Monitoring of operational efficiencies.	Re-assess risk to riparian communities if reduction in flow greater than forecast.	Report in accordance with conditions of extraction permits
Native fauna (no threatened species present)	Mortality of individuals due to introduction of pest animals	Minimise potential for introduction of new pest species (i.e. feral ants and mosquitoes)	- Source off-site materials from sites that have been declared pest-free - Clean and check all earth-moving equipment and material loads for pest species before entering site (details to be entered into a register)	No new pest species identified within the project area	Incidental observations of new pest species in the project area	- Review hygiene measures - Response and control in consultation with DPIR	Weed and Pest Monitoring & Control Log Report incursions to DPIR
Native fauna (no threatened species present)	Mortality of individuals due to proliferation of pest animals	Minimise potential for proliferation of existing pest species	- Store waste in designated covered bins - Remove waste regularly from site by a licensed contractor	No noticeable increase in the presence of pest or vermin	Incidental observations of pest and vermin attracted to the project area	- Implement control if required - Review waste management measures	Weed and Pest Monitoring & Control Log
In addition to the impacts presented above, terrestrial flora and fauna could be impacted by reduced soil quality, and/or water quality and availability. Management measures to minimise those potential impacts are discussed below in the <i>Terrestrial environmental quality</i> and <i>Inland water environmental quality</i> .							

10.6.2 Terrestrial environmental quality

The NT EPA's objective for terrestrial environmental quality is to:

"Maintain the quality of land and soils so that environmental values are maintained."

The framework that will be adopted to mitigate and manage impacts and risks to land and soils, is tabled below.

Value	Potential impact	Objective / outcome	Management provisions	Targets / performance indicators	Monitoring	Response	Reporting & Record-keeping
Soil quality	Contamination caused by mishandling and/or inappropriate storage of fuels	No contamination of soil by fuels	- Surround storage areas for fuels and oils with an impervious bund that contains 120 % of the largest container stored in the bund, as per AS1940 - Refuel vehicles within bunded areas - Make available spill containment equipment kits at the works area that are adequately-sized to manage the volume of fuels that could be spilled	- No signs of significant spill outside of bunded area - No leaks from equipment	- Regular inspection of site for signs of spills - Weekly check that spill containment equipment kits are in order	- Investigate cause of spill and update procedures as necessary - Remediate contaminated site	Site Inspection Register
Soil quality	Contamination caused by Acid Mine Drainage (AMD) from WRD/TSF	No contamination of soil by AMD	- Implement ongoing waste and tailings characterisation monitoring - Any identified PAF material to be placed in centre of WRD - Design TSF with lining of low permeability material that will minimise infiltration and release of contaminants	- No significant impacts on downstream water quality based on assessment using criteria in Water Quality Monitoring Plan - No visible signs of AMD	- On-going operational waste and tailings characterisation to confirm material characteristics - Water quality monitoring in accordance with Water Management Plan - Visual monitoring of and drainage from the WRD	- Capture and treat contaminated drainage - Approach and methods to be approved by DPIR through update to MMP	- Any major exceedance of water quality criteria to be reported to DPIR - Monitoring results reported in annual reports to DPIR
Soil structure and seedbank	Loss of soil structure and seedbank due to inappropriate topsoil removal and storage	Minimise loss of soil structure and seedbank due to inappropriate topsoil removal and storage	- Remove and store topsoil as per Vegetation Clearing Procedure - Implement controls to maintain structural integrity of stockpile as per ESCP - Commence rehabilitation of the WRD annulus as soon as possible	Top-soil stockpiles managed in accordance with ESCP	- Inspection of stockpile height and batter slopes - Monitor stockpile for erosion as per ESCP - Monitor vegetation growth by natural regeneration in rehabilitation trials	Implement corrective actions as detailed in Mine Closure Plan	- Site Inspection Register - Annual rehabilitation monitoring report
Soil structure	Loss of soil and altered landform due to erosion of disturbed areas	Minimise erosion of cleared areas	- Undertake construction in the Dry season - Implement the ESCP re stabilisation measures of cleared areas - Design culverts and sediment dams in accordance with specifications in the ESCP	- Controls in place in accordance with ESCP - Effectiveness of controls is maintained - No signs of significant erosion of stockpiles or work area	- End-of-Dry season inspection of all drainage and erosion and sediment controls to identify any issues or maintenance requirements - Inspection of erosion and sediment controls on a weekly basis during operation, within 24 hours of expected rainfall, and as soon as practicable following significant rainfall events (i.e. > 10 mm).	- Maintain controls and remove captured sediment as needed to ensure capacity - Review ESC measures and develop site-specific Progressive ESCPs - Engage CPESC advice for significant erosion	Site Inspection Register
Soil structure	Loss of soil due to run-off from WRD annulus	Minimise erosion of WRD	- Construct the WRD annulus from competent waste material - Place dispersive waste in the centre of the WRD - Rehabilitate the WRD annulus in year 1	No signs of significant erosion of WRD	- Geotechnical testing to define materials characteristics, sources and treatments for WRD construction and rehabilitation - Monitor initial rehabilitation success as per Mine Closure Plan	Implement corrective actions as detailed in Mine Closure Plan	- Site Inspection Register - Annual rehabilitation monitoring report
Soil structure	Loss of soil due to alteration of surface water flow paths due to construction of water pipeline	Minimise erosion on pipeline footprint	- Clear, stockpile and remove vegetation as per Vegetation Clearing Procedure - Remove and store topsoil as per the Vegetation Clearing Procedure and ESCP - Implement erosion controls as per ESCP	No signs of significant erosion along pipeline footprint	Weekly inspection of vegetation and soil stockpiles during construction, with focus on erosion controls detailed in ESCP	Investigate cause of erosion and update procedures as necessary as per ESCP	Site Inspection Register
Soil structure	Erosion of downstream stream banks when dams overflow	Minimise erosion of stream banks downstream of dam walls and spillways	- Implement the erosion and sediment controls that accompany the construction engineering drawings for the dam walls and spillways - Design dam walls and spillways to ANCOLD guidelines	No signs of significant erosion of stream banks downstream of dam walls and spillways	Regular inspection of downstream stream bank integrity	Investigate cause of instability and address by engineering controls as required	Site Inspection Register

10.6.3 Hydrological processes

The NT EPA's objective for hydrological processes is to:

"Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected."

The framework that will be adopted to mitigate and manage impacts and risks to surface water and groundwater flow regimes, is tabled below.

Value	Potential impact	Objective / outcome	Management provisions	Targets / performance indicators	Monitoring	Response	Reporting & Record-keeping
West Arm & Charlotte River	Downstream flooding due to dam wall failure of Mine Site Dam and/or of Observation Hill Dam	Dam wall failure risk minimised by best-practice engineering design	Design dam in accordance with ANCOLD Guidelines	Dam walls maintain their structural integrity	Regular inspection and testing of dam wall integrity	- Repair wall immediately - Implement Emergency Response Plan in event of dam wall failure	Major incidents reported to DPIR
West Arm – hinterland mangroves Charlotte River – riparian rainforest	Altered environmental flows due to harvesting of surface water to fill Mine Site Dam and Observation Hill Dam	Minimise reduction of surface water flow volumes downstream of the dams	- Design dams based on the minimum requirement to achieve a sustainable water supply for the project - Design mine site to incorporate additional storages (MWD 1 & 2) so that TSF decant and pit dewatering can be used as the primary project water supply - Include water efficiency and recycling in the design of processing facility - Adopt a conservative approach when modelling potential impacts and estimating returns through recycling of water	No significant deviation from water extraction volumes used in modelling of flow reductions	- Modelling of reduction in flow based on as-built dams - Monitoring of water extraction from dams - Monitoring of operational efficiencies	Re-assess risk if volumes substantially greater than initial forecasts	Water usage volumes and water balance updates as required for annual MMP reporting
West Arm – hinterland mangroves and marine receiving waters	Altered environmental flows due to a release from Mine Site Dam of water excess to requirements	Minimise increase of surface water flow volumes downstream of the dams	- Design mine site to incorporate additional storage (MWD2) for dewatering of pit inflows so that discharge required in Wet season only - If early-Wet season discharges are required, release the water in pulses rather than slow continuous release to simulate early Wet season storms and avoid stream eutrophication that can occur under low-flow conditions - Adhere to the discharge timing and volumes that are authorised by the project Waste Discharge Licence	- No non-conformances of Waste Discharge Licence conditions - No significant impacts on downstream water quality based on assessment using criteria in Water Quality Monitoring Plan	- Recording of discharge volumes from MWD1 - Monitoring downstream impacts in accordance with Water Quality Monitoring Plan and Waste Discharge Licence conditions	- Temporarily transfer water to on-site storages to reduce discharge requirements. - Assess potential for land irrigation if required.	- Water usage volumes and water balance updates required for annual MMP reporting - Annual Waste Discharge Licence reporting requirements and non-conformance reporting requirements
Local aquifers	Localised mounding of groundwater seepage from TSF cells	Minimise seepage from the TSF cells to local aquifer	- Construct TSF foundation from low permeability material that has been rolled and compacted - Incorporate an underdrainage system in the TSF design - Cap TSF at closure and encase within WRD	- No unseasonal (Dry-season) increases in standing water levels in monitoring bores - No significant increases in contaminant concentrations in groundwater due to TSF seepage	Groundwater level and water quality monitoring as per Water Quality Monitoring Plan	Re-assess and treat risks if mounding detected.	Water quality results assessment as required for annual MMP reporting

10.6.4 Inland water environmental quality

The NT EPA's objective for inland water environmental quality is to:

“Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected.”

The framework that will be adopted to mitigate and manage impacts and risks to surface water and groundwater quality, is tabled below.

Value	Potential impact	Objective / outcome	Management provisions	Targets / performance indicators	Monitoring	Response	Reporting & Record-keeping
West Arm environmental and cultural beneficial uses Charlotte River catchment environmental values	Turbidity due to rainfall run-off from the mine site Turbidity due to erosion of downstream stream banks when dams overflow	No significant impact to downstream water quality	- Implement all management provisions identified for land and soils. - Design mine site such that all run-off is intercepted by stormwater drains and directed to sediment dams - Design and operate sediment dams in accordance with the ESCP - Treat the water in sediment dams with a flocculent and tested whether water quality criteria have been achieved prior to release	Water released from sediment basins meets the 75 NTU criteria Downstream turbidity does not consistently exceed 20 NTU criteria	Water Quality Monitoring Plan – surface water monitoring	- Review all on-site erosion and sediment controls and make improvements - Increase stream bank protections - Slow down release of water from dams	- Site Inspection Register - Water quality results assessment as required for annual MMP reporting
West Arm environmental and cultural beneficial uses	Turbidity due to an overflow of the Raw Water and/or Process Water Dam	No overflow of the Raw Water and/or Process Water Dam	- Dam sizing and design criteria to provide contingency storage for wet weather events. - As a contingency, excess water can be directed to the pit and/or TSF.	Water levels in the Raw Water and Process Water Dams do not encroach within 0.8 m of the dam wall tops.	Monitor dam water levels daily	Direct excess water to the pit and/or TSF	Water quality results assessment and water balance updates as required for annual MMP reporting
West Arm environmental and cultural beneficial uses	Turbidity and/or contamination due to a release from MWD1 of water excess to requirements	Adhere to the discharge timing and volumes authorised by the Waste Discharge Licence	Discharge excess water as per the timing and volumes authorised by the Waste Discharge Licence	- Downstream turbidity does not exceed 20 NTU objective - No significant exceedance of water quality objectives in relation to potential contaminants	- Downstream turbidity monitoring as per Water Quality Monitoring Plan - Surface water monitoring for contaminants as per Water Quality Monitoring Plan	- Improvements to treatment of water pumped from the pit - Treat water in MWD1 with flocculants to reduce suspended sediments and contaminants	- All Waste Discharge Licence non-conformances must be reported to NT EPA. - Water quality results reported for annual MMP report. - Water quality results reported for annual Waste Discharge Licence report
Local aquifers	Contamination caused by seepage of water from the WRD/TSF	No seepage of contaminated water from the WRD/TSF into groundwater	- Construct TSF foundation from low permeability material that has been rolled and compacted - Incorporate an underdrainage system in the TSF design - Cap TSF at closure and encase within WRD	No exceedance of water quality objectives in relation to potential contaminants	Groundwater monitoring for contaminants as per Water Quality Monitoring Plan	- Implement measures to reduce an/or treat stop seepage - Assess risks to environmental values and implement risk-based controls to be approved by DPIR	- Water quality results assessment as required for annual MMP reporting - Reporting of pollution incident to NT EPA followed by investigation into potential environmental impacts
West Arm environmental and cultural beneficial uses Local aquifers	Contamination caused by mishandling and/or inappropriate storage of fuels	No contamination of groundwater or surface water by fuels	- Surround storage areas for fuels and oils with an impervious bund that contains 120% of the largest container stored in the bund – as per AS1940 - Refuel vehicles within bunded areas - Make available spill containment equipment kits at the works area that are adequately-sized to manage the volume of fuels that could be spilled - Remove contaminated soil.	No detection of hydrocarbons	Surface water and groundwater monitoring for hydrocarbons as per Water MP	Investigate cause of spill and update procedures as necessary	- Reporting of pollution incident to NT EPA followed by investigation into potential environmental impacts - Include incident report in annual MMP report

Value	Potential impact	Objective / outcome	Management provisions	Targets / performance indicators	Monitoring	Response	Reporting & Record-keeping
West Arm environmental and cultural beneficial uses Local aquifers	Contamination caused by mishandling and/or inappropriate storage of hazardous waste	No contamination of groundwater or surface water by hazardous waste	• Use, handle, store and dispose of all hazardous materials in accordance with the <i>Dangerous Goods Act</i> and the <i>Waste Management and Pollution Control Act</i> • Locate chemical and hazardous goods storage areas no less than 50 m from any areas of concentrated water flow, flood and poorly-drained areas • Make available spill containment equipment kits at the works area that are adequately-sized to manage the volume of hazardous materials stored within the works areas	No exceedance of water quality objectives in relation to potential contaminants (see Water MP for detail)	Surface water and groundwater monitoring for contaminants as per Water Quality Monitoring Plan	Investigate cause of spill and update procedures as necessary	• Reporting of pollution incident to NT EPA followed by investigation into potential environmental impacts Include incident report in annual MMP report
West Arm environmental and cultural beneficial uses Local aquifers	Contamination caused by a leak from the septic system	No contamination of groundwater or surface water due to septic system	• Locate and construct the septic system based on the <i>NT Code of Practice for Onsite Wastewater Management</i>	No exceedance of water quality objectives in relation to nutrients	Surface and water groundwater monitoring for nutrients as per Water Quality Monitoring Plan	Investigate cause of leak and update procedures as necessary	• Reporting of pollution incident to NT EPA followed by investigation into potential environmental impacts Include incident report in annual MMP report

10.6.5 Social, economic and cultural surroundings

The NT EPA's objective for social, economic and cultural surroundings is to:

“Protect the rich social, economic, cultural and heritage values of the Northern Territory.”

The framework that will be adopted to mitigate and manage impacts and risks to social, economic and cultural values, is tabled below.

Value	Potential impact	Objective / outcome	Management provisions	Targets / performance indicators	Monitoring	Response	Reporting & Record-keeping
Sacred sites (no registered or recorded sites – AAPA certificate pending)	Desecration or disturbance to a sacred site by project activities	Sacred site restrictions are respected	- Obtain AAPA certificate - Comply with conditions	Compliance with all conditions of AAPA certificate	To be determined following issue of AAPA certificate	In accordance with conditions of AAPA certificate	In accordance with conditions of AAPA certificate
Aboriginal archaeological site (listed) Historic heritage sites (not listed)	Desecration or disturbance of heritage values by project activities	Minimise potential for disturbance of heritage values by project activities	- Retain and buffer archaeological and heritage sites - If additional artefacts are uncovered: - Stop works in the area - Consult with Heritage Branch re appropriate response - Include any additional mitigation measures in the MMP	No impact on known heritage sites and previously unrecorded sites reported to NT Heritage Branch	Weekly inspection (using a GPS) during vegetation clearing to ensure no clearing outside of flagged area	To be determined in consultation with NT Heritage Branch	- Site Inspection Register - Previously unrecorded site finds reported to NT Heritage Branch
People and communities (amenity)	Reduced amenity due to project-related traffic noise	Minimise the impact of project-related traffic noise to residences and businesses along the haul route	- Develop a Traffic Management Plan, including speed restrictions through Berry Springs and truck speed alert system - Complaints process. Publicise contact details for lodging complaints.	No unresolved complaints regarding noise management	Feedback from stakeholders	Investigate cause of impacts and amend procedures if necessary	- Complaints/Incident Register - Report against key indicators including the number and nature of complaints on amenity issues and the response.
People and communities (amenity)	Reduced amenity due to dust generated from the site activities or dust emissions from haul trucks	Minimise the generation of dust	- Undertake dust suppression using water carts and the application of polymer products - Implement dust management in accordance with <i>IECA Guidelines</i>, as detailed in the ESCP - Cover loads - Complaints process. Publicise contact details for lodging complaints.	- No signs of project-related dust on Cox Peninsula Rd - No unresolved complaints regarding dust management	- Visual inspections along Cox Peninsula Road - Feedback from stakeholders	- Investigate cause of impacts and amend procedures if necessary - Ensure all loads are adequately covered - Increase dust suppression	- Complaints/Incident Register - Report against key indicators including the number and nature of complaints on amenity issues and the response.
People and communities (amenity)	Disruption and inconvenience to road users due to temporary road closures for blasting operations	Minimise disruption and inconvenience to road users	- Determine less disruptive closure windows using traffic monitoring and stakeholder consultation - Develop a Traffic Management Plan that addresses, <i>inter alia</i>, disruption minimisation during blasting - Install roadside signage that advises road users of potential closure times and durations. - Advise of closure times and durations via community notices and direct contact with key stakeholders. - Develop measures to enable emergency vehicles passage through road closure to respond to an emergency. - Complaints process. Publicise contact details for lodging complaints.	- No unresolved complaints regarding traffic management - Level of disruption broadly acceptable to community	- Feedback from stakeholders - Maintain a record of any traffic incidents involving project traffic or identified road safety risks - Monitoring in accordance with DPIL permit requirements	- Follow-up complaints or issues and determine collaborative remedies to any issues - Investigate cause of incidents and amend procedures in consultation with affected stakeholders - Major issues to be reported and response agreed with DIPL	- Complaints/Incident Register - Traffic reporting in accordance with DIPL permit requirements (TBA)
Health, wellbeing and safety	Traffic incidents and/or congestion due to increased project-related vehicle movements along the haul route	Safe use of roads	- Construct a slip-lane at mine site entry off Cox Peninsula Road - Develop a Traffic Management Plan, including speed restrictions through Berry Springs and truck speed alert system	- No project-related traffic accidents - No unresolved complaints regarding traffic management	- Feedback from stakeholders - Maintain a record of any traffic incidents involving project traffic or identified road safety risks	In conjunction with NT Police, DIPL and other stakeholders, ensure proactive identification and any road safety risks and	- Complaints/Incident Register - Traffic reporting against indicators in Traffic Management Plan in accordance with DIPL permit requirements (TBA)

Value	Potential impact	Objective / outcome	Management provisions	Targets / performance indicators	Monitoring	Response	Reporting & Record-keeping
			• Collaboration with NT Police, Berry Springs Primary School and community on truck movements • Install roadside signage that informs motorists of the presence of road trains • Transport workers by bus to and from the mine site (or else encourage workers to car pool) • Ensure the timing of shift changes avoids traffic increases through Berry Springs at school start/end times • Complaints process. Publicise contact details for lodging complaints.		• Monitoring in accordance with DPIL permit requirements	appropriate responses. • Conduct reviews in response to any incident.	
Health, wellbeing and safety	Anxiety as a result of fears about project impacts (e.g. impacts on water).	Community acceptance that the project poses no threat to environmental values, such as the quality of surface and groundwater.	• Public EIS process • Environmental Management Plan. • Ongoing communication with the community and stakeholders to minimise rumours and misinformation that leads to fear and anxiety. • Mine Closure and Rehabilitation Plan. • Complaints process. Publicise contact details for lodging complaints.	• Community confidence in the project's environmental performance.	• Feedback from community	• On-going communication with community	• Records of community engagement • Complaints/Incident Register
Road infrastructure	Damage to local roads because of project activities	Minimise any project-attributable damage to local roads	• Inspection and remediation of road damage in accordance with DIPL permit requirements	No un-remediated damage to local road integrity as a result of project traffic	Inspection in accordance with DIPL requirements	Response in accordance with DIPL requirements	• Inspection records • DIPL advice/approvals for maintenance works
Access to emergency services	Increased pressure on police and emergency services	Minimal additional demand on emergency services	• Establish and maintain workplace health and safety culture • Project Emergency Response Plan. • Fire breaks to reduce the risk of bushfires. • Traffic Management Plan. • Emergency response capability and first aid facilities on site. • Road rescue capabilities on site. • Fencing and security measures onsite for security of explosives. • Compliance with workplace standards for storage and handling of hazardous materials. • Measures in place to enable emergency vehicles passage through road closure to access an emergency	Zero incidents requiring an external emergency response.	Record any incidents requiring police or emergency services.	• Post-incident debrief and review with stakeholders • Amend procedures if required	• Complaints/Incident Register • Reporting in accordance with WHS Regulations
Aboriginal land-use and access	Reduced access to land and enjoyment of traditional cultural activities due the development of the site	Indigenous people maintain access to the area around the mine site for cultural activities.	• Liaise with Belyuen Council and other relevant Indigenous organisations to ensure a good understanding of access needs and to communicate the potential for disruption by project activities • Communicate to Traditional Owners who to contact should there be any access issues • Complaints process. Publicise contact details for lodging complaints.	No impacts to access and enjoyment of traditional cultural activities.	• Feedback from Belyuen Council and other relevant Indigenous organisations	• Proactively check with organisations that there have been no issues. • Discuss recurring issues with Belyuen Council and other relevant Indigenous organisations	• Complaints/Incident Register • Minutes from meetings with Belyuen Council and other relevant Indigenous organisation

10.6.6 Maximising socio-economic opportunities

The framework that will be adopted to maximise social and economic opportunities associated with the proposal, is tabled below.

Value	Opportunity	Objective / outcome	Management provisions	Targets / performance indicators	Monitoring	Response	Reporting & Record-keeping
People and communities	Local communities benefit through distribution of sponsorship funds.	Maximise benefits to the local community	- Establish a sponsorship budget. - Prepare a sponsorship plan, prioritising projects that benefit community groups and young people in the project's local area. - Identify sponsorship objectives in conjunction with the community.	Core recognised as actively contributing to the local community.	Produce annual reports outlining sponsorship expenditure, with a short summary of what was achieved.	NA	Annual reporting against objectives for communities /groups as a result of sponsorship.
Employment and education	Local businesses benefit from winning contracts.	Maximise local content. Build the capacity of local small businesses.	- Recruitment and procurement processes prioritising the local market. - Package and promote tenders to suit local capacity and prepare businesses for competitiveness and standards required by Core. - Proactive identification of local business with the capability to work on the project. - Agreements with contractors to specify local service and supply requirements.	- Business and industry satisfied with the number and value of contracts awarded locally. - Positive feedback about the level of local content.	Monitoring of feedback from business and industry on level of local content.	Meetings with job service providers to investigate and address issues.	Progress reports to stakeholders. Report against indicators including the number and value of local contracts awarded.
Employment and education	Boost to direct and indirect local employment, through jobs on the project or throughout the local supply chain.	Maximise the recruitment and retention of local workers, both directly and with contractors	- Recruitment and procurement processes prioritising the local market. - Package and promote tenders to suit local capacity. - Ongoing communication with the community and stakeholders to manage local content expectations - Work with local job providers. - Good communication about jobs available on the project.	Number and total value of local contracts and jobs awarded in line with industry/community expectations.	Monitoring of feedback from business and industry on level of local employment and local contracts awarded.	NA	Progress reports to stakeholders. Report against indicators including the number and value of local contracts awarded and local job figures for the project.
Employment and education	Local economies stimulated through payments to workers, contractors and local companies.	Local economic growth through contracts and increased discretionary expenditure.	- Recruitment and procurement processes prioritising the local market. - Package and promote tenders to suit local capacity where feasible.	Local industry satisfied with action taken to increase local participation.	Monitoring of feedback from business and industry on level of local content.	Communicate progress against objectives.	Progress reports to stakeholders. Report against indicators including the number and value of local contracts awarded and the amount and proportion of expenditure in the local economy.
Employment and education	Employment opportunities for local Indigenous people (Larrakia and other Indigenous people living on the Cox Peninsula or the Darwin region).	Maximise Indigenous employment on the project, direct and with contractors.	- Work with Indigenous employment and training providers. - Provide support to contractors to employ and train local Indigenous people. - Liaise with other large projects about the opportunities to transition staff, e.g. as Inpex winds down.	Number of Indigenous jobs awarded in line with Government and community expectations.	Feedback from Government, Indigenous stakeholders and the community on the level of Indigenous employment on the project.	Meet with Indigenous employment and training providers.	Progress reports to stakeholders. Report against indicators including Indigenous employment figures.

10.7 Responsibility

Core will maintain over-arching responsibility for complying with the EMP/MMP and the conditions of all approvals, permits and licences issued for the project. The Grants Project operational organisation structure includes a Health, Safety, Environment and Community (HSEC) Manager who will have over-arching responsibility for environmental compliance. The HSEC Manager reports directly to Core's General Manager of operations. Within the HSEC team there are identified positions for a HSEC Coordinator and Environmental Advisor.

Core may delegate environmental responsibilities to key contractors i.e. processing or haulage contractors. In this case, those contractors will be required to provide their own management plans and procedures that align with the EMP/MMP. Core will monitor contractor environmental performance and will maintain responsibility for reporting to external regulatory agencies.

Where Core does not maintain the required technical skill sets to address a requirement in the EMP/MMP, suitably qualified consultants will be engaged.

10.8 Induction, communication and training

All new site personnel, contractors, and unaccompanied visitors will be presented with a site induction package featuring essential environmental management information. Inductees will also be required to complete a questionnaire to demonstrate understanding of the induction presentation. Induction and training activities will be reviewed regularly to ensure they contain the most up-to-date information and procedures.

Scheduled regular toolbox meetings will keep employees informed of environmental issues, as well as safety awareness and hazards in the workplace. This will ensure that personnel are continually aware of environmental management activities on the site, and enable any issues to be identified and resolved.

Relevant staff will have training provided so that they are able to undertake the environmental management and monitoring activities specified in this plan. In-house training will be provided by relevant contractors (consultants) in specific environmental monitoring tasks.

10.9 Incident response and reporting

Incident response and reporting will be in accordance with the project Emergency Response Plan. This plan will be developed for submission with the MMP. The plan will address all environmental incident response and reporting requirements in accordance with the provisions of the mining authorisation issued by DPIR. The following legislative requirements will apply:

- The operator must notify the Department on becoming aware of a serious environmental accident or critical incident on the site.
- When a serious environmental accident occurs, the operator must carry out an investigation to determine its cause and forward a written report to the Department.
- The operator of a mining site is to notify the Minister in writing of the proposed cessation of mining activities if it does not form part of the MMP proposal.

The plan will also address reporting requirements that apply as conditions of other approvals permits and licences issued to the project i.e. Waste Discharge Licence, Water Extraction Licence.

An Incident and Complaints Register will be maintained. The register will record dates and details of complaints and incidents, response and close-out details.

10.10 Auditing, reporting and review

Compliance with this EMP will be monitored by the HSEC Manager. A schedule for auditing will be developed prior to commencement of construction and will reflect any commitments or requirements identified through the EIS and subsequent approvals permits and licences issued to the project.

Both internal and external reporting requirements are identified within this EMP.

Internal reporting requirements will include:

- Communication, consultation and training outcomes
- Daily and weekly inspection checklists
- Monthly and annual report on monitoring, environmental compliance, incidents and corrective actions
- Records and logs of construction and operational activities
- Internal complaint and incident reports
- Environmental monitoring data.

External reporting is required to meet conditions of approval and statutory requirements. These will be confirmed following receipt of the conditions of approval, but are expected to include:

- Annual reporting to DPIR
- Annual reporting on compliance with Waste Discharge Licence
- Annual reporting on water extraction pursuant to the conditions of a water extraction licence.

Monitoring and auditing data will be used as a basis for continual review and improvement of the EMP, and may also be prompted by any of the following:

- Non-compliance with approval conditions
- Complaints received
- Monitoring results
- Changes in regulatory requirements
- Changes in operational activities.

