ARAFURA
RESOURCES LIMITED

Environmental Impact Statement – Supplementary Report

NOLANS PROJECT
ARAFURA RESOURCES LTD

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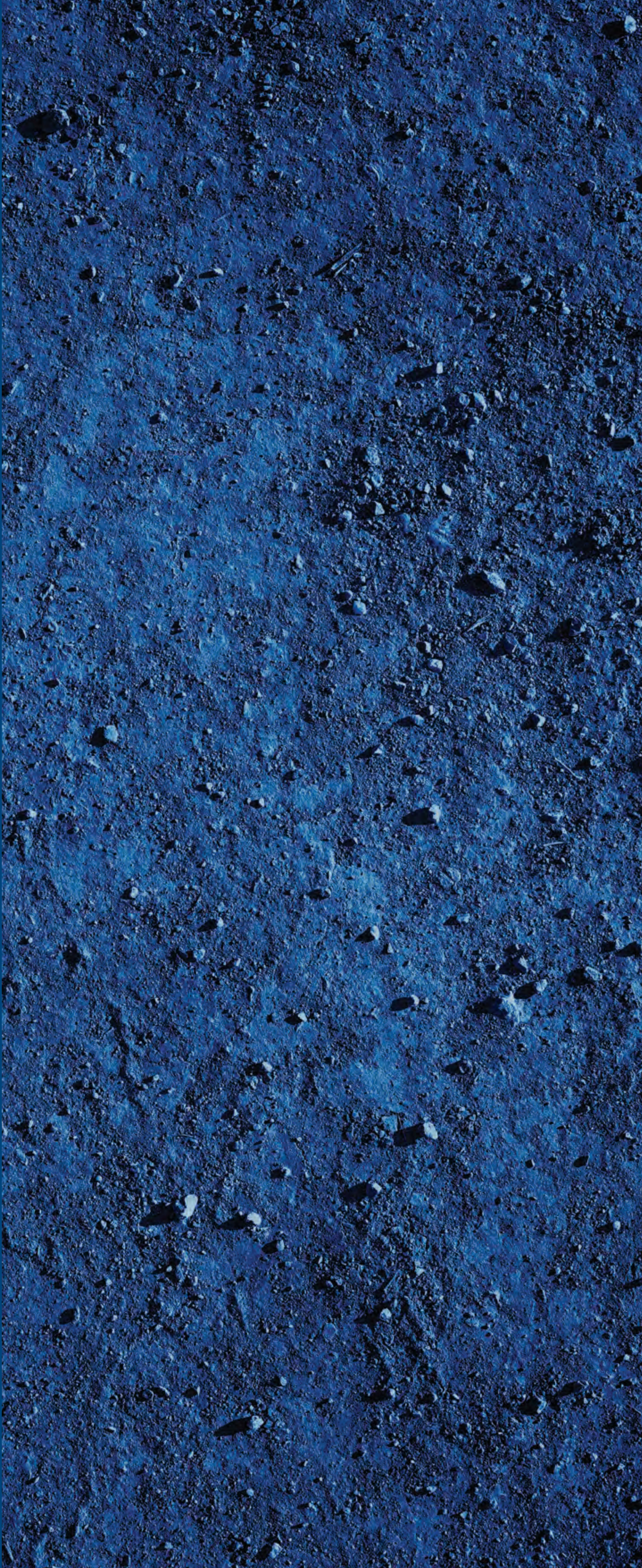
GHD



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Abbreviations

Term	Description
αdps/m^3	Alpha decays per second per cubic metre
µg/m^3	Micrograms per cubic metre
µGy/h	Micrograys per hour
µJ/m^3	Microjoules per cubic metre
µm	Micrometre, or micron
µSv/h	Microsieverts per hour
µSv/y	Microsieverts per year
AADT	Average annual daily traffic
AAPA	Aboriginal Areas Protection Authority
ABS	Australian Bureau of Statistics
AE Act	Atomic Energy Act
AIPA	Australian Industry Participation Authority
ALARA	As Low As Reasonably Achievable
AMD	Acid Metalliferous or Saline Drainage
ANCOLD	Australian National Committee on Large Dams Incorporated
ANFO	Ammonium nitrate fuel oil
ANSTO	Australian Nuclear Science and Technology Organisation (Australian Government)
ANZECC	The Australian and New Zealand Environment Conservation Council
ARI	Average recurrence interval
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency (Australian Government)
ASL	Above sea level
ATSIHP	Aboriginal and Torres Strait Islander Heritage Protection Act
AUD or $	Australian dollars
BAL	Basic auxiliary left (turn treatment)
BAR	Basic auxiliary right (turn treatment)
BCM	Bank cubic metre (in blasting)
BIBO	Bus-in/bus-out
billion	Billion measured by 1x10^9 (or 1,000 million) as per the US convention
BMP	Biodiversity Management Plan
BOM	Bureau of Meteorology
Bq	Becquerel (one disintegration per second)
Bq/g	Becquerels per gram
Bq/kg	Becquerels per kilogram
Bq/L	Becquerels per litre
Bq/m^2/s	Becquerels per square metre per second
Bq/m^3	Becquerels per cubic metre
BRT	Burt Plain Bioregion
Ce	Cerium
CEO	Chief Executive Officer
CHMP	Cultural Heritage Management Plan
CHMP	Cultural Heritage Management Plan
CLC	Central Land Council
CO	Carbon monoxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cth	Commonwealth

Term	Description
dB	Decibel is the unit used for expressing the sound pressure level or power level in acoustics
dB(A)	Frequency weighting filter used to measure ‘A-weighted’ sound pressure levels,
DFS	Definitive feasibility study
DG Act	Dangerous Goods (National Uniform Legislation) Act
DG Reg	Dangerous Goods (National Uniform Legislation) Regulation
DLRM	Department of Land Resource Management (Northern Territory Government)
DME	Department of Mines and Energy (Northern Territory Government)
DMP	Dust Management Plan
DotE	Department of the Environment (Australian Government)
DSP	Double Sulfate Precipitation
EA Act	Environmental Assessment Act 1982 (Northern Territory Government)
EA Act	Environmental Assessment Act
EAD	Equivalent Aerodynamic Diameter
EIS	Environmental impact statement
EL	Exploration licence
EMEL	Extractive mineral exploration licence
EMP	Environmental Management Plan
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Australian Government)
EPCM	Engineering, procurement and construction management
ERICA	Environmental Risk from Ionising Contaminants: Assessment and Management
ESCP	Environment and Sediment Control Plan
ESD	Ecologically Sustainable Development
FIFO	Fly-in/fly-out
FMP	Fire Management Plan
FOPS	Falling object protection systems
g/m^2	Grams per square metre
g/m^2/month	Grams per square metre per month
GL	Gigalitre (billion litres)
GPS	Global positioning system
GSP	Gross State Product
GWA	Genesee Wyoming Australia (rail operator between Tarcoola (SA) and Berrimah (NT)
ha	Hectare
HDPE	High density polyethylene
HPRG	High pressure roller grinding
HV	High voltage
IAEA	International Atomic Energy Agency
ICN	Industry Capability Network
ICRP	International Commission on Radiological Protection
ILUA	Indigenous land use agreement.
ILUA	Indigenous Land Use Agreements
ISO	International Organisation for Standardisation
JORC	Joint Ore Reserves Committee
kg/y	Kilograms per year
km^2	Square kilometre
ktpa	Thousand tonnes per annum
kV	Kilovolt (thousand volts)

Term	Description
L/s	Litres per second
$L_{A10(period)}$	The sound pressure level that is exceeded for 10% of the measurement period.
$L_{A90(period)}$	The sound pressure level that is exceeded for 90% of the measurement period.
$L_{Aeq(period)}$	Equivalent sound pressure level
Land Rights Act	Aboriginal Land Rights (Northern Territory) Act
LOM	Life of mine
LOM 43	43-year life of mine (EIS)
LOM 55	55-year life of mine (Supplement to the EIS)
LTS	Long term stockpile
M&I	Measured and Indicated (Mineral Resources)
m/s	Metres per second
m^3/day	Cubic metres per day
m^3/s	Cubic metres per second
mAHD	Australian Height Datum in metres
mASL	Metres Above Sea Level
MAT	Material type
MBq/s	Megabecquerel per second (million becquerels per second)
MCA	Minerals Council of Australia
mg/m^3	Milligrams per cubic metre
MIN	Mineralisation
ML	Mineral lease
ML/y	Mega Litre per year (million litres per year)
Mlcm	Million loose cubic metres
MM Act	Mining Management Act
mm/s	Millimetres per second
MMP	Mining Management Plan
MNES	Matters of National Environmental Significance
MRCP	Mine rehabilitation and closure plan
mSv	One thousandth of a sievert
mSv/y	Millisieverts per year
Mt	Million tonnes
MT Act	Mineral Titles Act
Mtpa	Million tonnes per annum
MW	Megawatt (million watts)
NAG	Net Acid Generation
NAPP	Net Acid Producing Potential
NdPr Oxide or Didymium Oxide	Neodymium and praseodymium mixed oxide
NE	North East
NGERA	National Greenhouse Energy Reporting Act
NNTT	National Native Title Tribunal
NO_2	Nitrogen dioxide
NORM	Naturally occurring radioactive material
NP1	Nolans material (ore) type that is suitable for processing using the PAPL metallurgical process
NP2	Nolans material (ore) type that is least suitable for processing using the PAPL metallurgical process
NPI 2012	National Pollution Inventory emission estimation guidelines
NRETAS	Natural Resources Environment and the Arts and Sport
NT	Northern Territory (of Australia)
NT EPA	NT Environment Protection Authority

Term	Description
NTA	Native Title Act
NW	North West
OEM	Original equipment manufacturer
P_2O_5	Phosphate
PAEC	Potential alpha energy concentration
PAF	Potential acid forming
PAPL	Phosphoric acid pre-leach metallurgical process
PAPLP	Nolans material (ore) type that is most suitable for processing using the PAPL metallurgical process
PAR	Population at risk
PAS	Personal air samplers
Pb	Lead
PEHA	Public and Environmental Health Act
PEHR	Public and Environmental Health Regulations
PFS	Preliminary feasibility study
PLL	Potential lives lost
PM_{10}	Particulate Matter 10 micrometres or less in diameter
PMF	Possible maximum flood
PMP	Probable maximum precipitation
PMST	Protected matters search tool
Po	Polonium
ppm	Parts per million
PPV	Peak Particle Velocity
Ra	Radium
RBL	Rating Background Level.
RC	Reverse circulation drilling
RE	Rare earth
REO	Rare earth oxide
RL	Reduced level
RMP	Radiation Management Plan
Rn	Radon
Rn220	Radon isotope known as Thoron
Rn222	Radon isotope
RnDP	Radon decay product
ROM	Run of Mine
RPA	Radiation Protection Act
RQ	Risk Quotient
RSF	Residues storage facility
Sacred Sites Act	Northern Territory Aboriginal Sacred Sites Act
SAPL	Sulfuric acid pre-leach metallurgical process
SE	South East
SIA	Social Impact Assessment
SIMP	Social impact management plan
SO_2	Sulphur dioxide
Sv	Sievert
Sv/y	Sieverts per year
SW	South West
t	Tonne
TDG Act	Transport of Dangerous Goods Act
TDG Act	Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Act
TDG Regs	Transport of Dangerous Goods Regulations

Term	Description
TDG Regulations	Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Regulations
TEU	Twenty-foot equivalent containers (intermodal shipping container)
Th	Thorium
TLD	Thermoluminescent Dosimeter
TnDP	Thoron Decay Product
TO	Traditional Owner
TOR	Terms of Reference
tpa	Tonnes per annum
TPWC	Territory Parks and Wildlife Conservation Act 2000
TREO	Total RE oxide
TSF	Tailings storage facility
TSP	Total suspended particulates
U	Uranium
U_3O_8 or UO_4	Uranium oxide
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
US	United States
UV	Ultra violet
V	Volts
VoIP	Voice over Internet Protocol
vpd	Vehicles per day
vph	Vehicles per hour
WA	Western Australia
WHIMS	Wet high intensity magnetic separation
WHS Act	Work Health and Safety (National Uniform Legislation) Act
WHS Regulations	Work Health and Safety (National Uniform Legislation) Regulations
WM Act	Weeds Management Act
WMP	Water Management Plan
WMPCA	Waste Management and Pollution Control Act
WRD	Waste rock dump

Glossary

Term	Description
Acidity	Latent acidity is a hidden stock of potential or future acid generation, based on a range of factors including local environmental geochemical conditions
AMD	A result of the exposure of some sulfide minerals to oxygen and water, resulting in drainage waters that can be acidic and/or have high concentrations of dissolved metals. The drainage produced from the oxidation process may be acidic or neutral, with or without dissolved heavy metals, but always contains sulfate.
Burra Charter	The Australia ICOMOS Charter for Places of Cultural Significance, 2013
Curtilage	The area of land occupied by a dwelling and its yard and outbuildings, actually enclosed or considered as enclosed
dB(A)	Frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies
Decibel	The unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics
Endorheic basin	Closed drainage basin retains water and allows no outflow
Equivalent sound pressure level	The steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring
Gangue	Valueless rock or mineral aggregates in ore
Indigenous land use agreement.	A formal agreement under the Native Title Act that contemplates access to land for the purposes of mining, mineral processing, and the placement of associated infrastructure
JORC 2012	Current (2012) edition of the guidelines for public reporting of Exploration Results, Mineral Resources and Ore Reserves
Long term stockpile	Stockpiled ore scheduled for processing during life of mine
Mine site	Area comprising Mineral Lease Application ML 26659 lodged with the Northern Territory Government by Arafura in February 2008. Includes the mine, concentrator and associated infrastructure.
Mineral Resources	Defined under the JORC Code as concentration of solid material of economic interest in such form, quality and quantity that there are reasonable prospects of economic extraction
Mineral Titles Act	Legislation that regulates mineral exploration and mining titles in the Northern Territory
Monazite	A phosphate mineral that may contain up to 70 wt% REO
Nolans Bore	The Nolans Bore deposit, resource or mineral resources
Nolans Project or the project	Comprises the development of the proposed Nolans site
Nolans site	The collective term refers to the project site including all components - mine site, processing site, borefield area, accommodation village, access roads, utilities corridors (potable water pipeline, water supply pipeline, power lines)
Ore	Ore used in the context of this document is a generic term for mineralisation, or metal-bearing mineral or rock
Ore Reserves	Defined under the JORC Code as the economically mineable part of Measured and/or Indicated Mineral Resources
Processing plant	The plant within which the RE extraction processes are undertaken to produce the RE intermediate products

Term	Description
Processing site	Area comprising the processing plant, ancillary plants and supporting infrastructure
Pyrite oxidation	Pyrite oxidation by atmospheric and/or aqueous oxygen occurs through a complicated sequence of biologically mediated reactions
Rating Background Level.	The overall single-figure background level representing each assessment period (day / evening / night) over the whole monitoring period
RE extraction	Process converting RE concentrate to the RE intermediate product for RE separation
RE intermediate	The product from the RE extraction process in the form of a mixed RE compound which is the feed for the RE separation process
Separation plant	Comprises the plant and associated ancillaries for processing RE intermediate to separated REO products. Note this will be an offshore plant and is not part of the EIS scope of work.
Gangue	Valueless rock or mineral aggregates in an ore
Section	A section reference within the report
Southern Basins	Northern Burt and Eastern Whitcherry basins
The project	Nolans Rare Earth Project

1. Introduction

1.1 Overview

An Environmental Impact Statement (EIS) for the Nolans Rare Earth project was submitted to the Northern Territory Environment Protection Authority (NT EPA) in May 2016. As per the NT EPA environmental assessment process, the document is a Draft EIS, however for ease of reference, is herein referred to as an EIS.

The EIS was circulated to agencies and available for public comment. Following submission of the EIS to the NT EPA, Arafura formally notified the NT EPA of a key change to the project i.e. changing the processing method from Sulfuric acid pre-leach (SAPL) to Phosphoric acid pre-leach (PAPL); and also provided a Supplementary Tailings and Residue Report (July 2016).

A total of 504 written submissions on the EIS were received from NT and Commonwealth government advisory bodies and agencies, and four non-government organisations.

Since development of the EIS, Arafura has continued to develop the Project and refine details of processing, mining sequencing and design of facilities. As a result, more recent information about the measured and indicated (M&I) resource is also available. Consequently, Arafura is proposing a Life of Mine (LOM) of 55 years (rather than 43 years that was assessed in the EIS).

An updated “Project Description” / proposed action is provided in Chapter 3 that describes the proposed action in terms of PAPL and the change in LOM, as well as additional information that was requested as part of written submissions to the NT EPA.

1.2 Structure of the supplementary report

The 504 submissions on the EIS, and the corresponding Agency/Organisation that made the submission, are listed in Chapter 3. A unique identification (UID) number was assigned to each submission for ease of reference.

The structure of this Supplementary Report is:

- **Chapter 1 Introduction -** providing an overview of the status of the project environmental assessment process and the structure of the report.
- **Chapter 2 Project Description** - updated project description that includes relevant information, updates to the proposed action associated with the change of LOM and processing method, and a comparison of the proposed action presented in the EIS compared to the now proposed LOM 55 year proposed action.
- **Chapter 3 Response to Submissions responses per agency / community member -** alphabetical, with unique identification number (UID), each individual submission and Arafura’s response to those submissions.
- **Chapter 4 Additional Information** – provides additional information about environmental impact areas and cross referenced to individual submissions from Chapter 3.
- **Chapter 5 Commitments** – a list of commitments and approximate timeframes.
- **Chapter 6 References**
- **Appendices** – Appendices are provided to support responses or provide additional information. Reference to Appendices to this report have been named numerically (1,2,3, etc.) rather than the usual alphabetical naming (A, B, C etc.) to avoid confusion with references to the Appendices that are contained within the EIS.

Arafura has, where possible, responded to similar submissions only once; however, issues have been addressed separately where they occur in the context of different chapters of the EIS. This has resulted in some repetition of information from one chapter to the next.

Pursuant with clause 12 of the Environmental Assessment Administrative Procedures, Arafura Resources Ltd (Arafura) prepared this Supplementary Report to address individual submissions to the EIS.

1.3 Scope and limitations

This report: has been prepared by GHD for Arafura Resources Ltd and may only be used and relied on by Arafura Resources Ltd for the purpose agreed between GHD and the Arafura Resources Ltd as set out in Section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Arafura Resources Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has prepared this report on the basis of information provided by Arafura Resources Ltd and others who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report that were caused by errors or omissions in that information.

2. Project description

2.1 Introduction

A detailed description of the proposed project / proposed action is provided in this chapter. It replaces Chapter 3 of the EIS. Key information that has been updated in this chapter includes:

- Discussion of, and comparison with, the previous sulfuric acid pre-leach (SAPL) and current phosphoric acid pre-leach (PAPL) processing technology, including an updated processing flowsheet. The key features and impacts of the process improvements are listed below, and metrics comparing the previous and current configurations are summarised in Table 2-9.
- Product diversification, and lower operating expenditure (OPEX).
- Reduction in reagent use and generation of waste streams resulting in a smaller project footprint and environmental impact.
- A reduction in the mining rate and run-on-mine (ROM) feed to the crushing plant.
- Simplification of the comminution circuit to deliver a coarser feed into beneficiation.
- Simplification of the beneficiation circuit to employ less intensive unit operations that deliver a coarser phosphate-rich feed into pre-leach.
- A material increase in total rare earths recovery in beneficiation.
- suppression of deleterious elements in the phosphoric acid process
- Smaller unit operations in sulfation and water leach as a consequence of treating a phosphate-rich feed in pre-leach.
- Context of life of mine (LOM) change from 43 (LOM 43) to 55 (LOM 55) years including updated mining schedules.

The project detail is preliminary or concept and subject to change. Further studies such as definitive feasibility studies and piloting of processing technology will provide opportunity to develop efficiencies, reduce impacts or provide improved economic outcomes. Arafura will continue to inform the regulator of any material change to the Proposed Action as required by legislation and regulations.

Detailed design of project components and site surveys will be completed where relevant, at a later stage, post environmental approval and post Arafura's investment decision to proceed with the project.

This chapter addresses most of Section 3 of the EIS TOR, in addition to providing information on SAPL compared to PAPL, LOM 43 compared to LOM 55 and further information required as part of the EIS Supplementary reporting process.

2.2 Key project components

Arafura plans to mine, concentrate and chemically process RE-bearing ore at the Nolans site (Figure 2-1), then transport an intermediate product to an offshore refinery (separation plant) for final processing into high-value RE products.

The key activities include:

- Mine, concentrate and chemically process rare earth-bearing ore. (No change from EIS).
- Produce a cerium (RE) product (of around 53% purity). (New process change).
- Produce a mixed RE chloride intermediate product (of around 42% purity) for further downstream processing. (No change from EIS).
- Produce a merchant grade phosphoric acid product (of around 54% purity). (New Process Change).

There general arrangement of the proposed operation includes the mine site, the processing site and the borefield. In addition to these three sites, the workers' accommodation village, utilities corridors and access roads comprise Nolans project site. A more detailed inventory of key project infrastructure is provided in the following sections.

The cerium product will now be extracted at the site and sold and shipped direct to international customers. A smaller volume of RE chloride intermediate product will be transported to an offshore refinery (separation plant) for final processing into three commercial RE products: a lanthanum oxide, a neodymium and praseodymium mixed oxide, and a mixed RE carbonate containing the remaining REs. The phosphate which was previously reporting to a waste stream is now being recovered as a merchant grade phosphoric acid product will be sold into the Australian domestic or the international market.

2.2.1 Life of Mine

A Life of Mine (LOM) mining schedule has been developed for 55 years and for production of 14,000 tpa of RE products.

In the EIS the LOM was 43 years and production of 20,000 tpa of RE products.

The process change from SAPL to PAPL resulted in additional analysis being undertaken on the Nolans Resource. The ore types were reclassified geologically, geochemically and metallurgically to target material that provides higher RE and phosphate recoveries. This work, together with refined production schedules to 14,000 tpa (6,000 tpa less than proposed in the EIS) has resulted in the LOM increasing by 12 years.

The project is being designed to recover:

- 14,000 tonnes of total rare earth oxide (TREO) from 29,700 tonnes of less refined (cerium and RE chloride intermediate) products.
- 110,000 tonnes of merchant grade phosphoric acid (a new product).

Additional mine planning work undertaken in August 2017, determined a series of pit optimisations for both the M&I and the LOM cases. Pit shell selection was undertaken to make allowance for minimum mining width considerations and to determine optimum pit staging and mine scheduling. Eleven pit stages (rather than seven presented in the EIS) were selected for mine scheduling for the LOM optimisation scenario (Figure 2-8).

Mine production schedules were generated from the pit optimisation shells based on a philosophy of preference for higher grade/ higher recovery material types (i.e. PAPL-preferred (PAPLP)) whilst less favourable material will be stockpiled for future potential processing (i.e. non-preferred (NP1 and NP2)).

The strategic mining schedule for the LOM optimisation scenario is based on a maximum overall mining rate of 10 Mtpa after Year 10. Pre-stripping commences in Year 1 will provide waste rock for project infrastructure including TSF, RSF and ROM pad construction etc. It will also provide ore in sufficient quantities for plant feed for plant start-up and commissioning which commences in Year 2. The open pit will develop over the LOM and comprise eleven stages within the overall pit shell footprint of about 135 ha.

This production schedule does not include potential production from the non-PAPL preferred ore (NP2). During the M&I production phase around 8.8 Mt of NP2 will go into stockpile and this stockpile will grow to around 15.7 Mt over the LOM case.

The following Table 2-1 provides an overview of the Nolans Project LOM and Table 2-2 outlines the planned production rates for the project, including a comparison of these items for the LOM 43 versus LOM 55.

Table 2-1 Nolans Project

Description	Unit	EIS		Now Proposed	
		M&I Case1	LOM Case2	M&I Case1	LOM Case2
Pit Stages	Number	6	7	11	11
Total Mine Life	Years	25	43	34	55
Pre-commissioning Period (construction and start-up)	Years	2	2	2	2
Effective Mine Production Period	Years	23	41	34	55

Note 1: M&I refers to the higher-confidence Measured and Indicated classifications of the project's total inventory of Mineral Resources that, under certain assumptions, could be converted to economic Ore Reserves in accordance with the 2012 JORC code.

Note 2: LOM refers to the project's total inventory of Mineral Resources, represented by Measured, Indicated and Inferred classifications in accordance with the 2012 JORC code.

Table 2-2 Outline of production rates for the LOM 43 (EIS) and LOM 55 (now proposed)

Activity	Formal notification to the NT EPA following submission of EIS (for LOM 43)	Now proposed LOM 55
Mined ore – PAPLP + NP1 (total)	25.6 Mt	37.0 Mt
Mined ore – NP2 stockpiled (total)	28.8 Mt	15.7 Mt
Mined NORM waste >1Bq/g (total)	304.1 Mt	173.5 Mt
Mined benign waste <1Bq/g (total)		128.7 Mt
Maximum bene plant feed rate	750 ktpa (Y2-Y9)	525 ktpa (Y2-Y11)
	1,100 ktpa (Y10-Y49)	750 ktpa (Y12-Y37)
		900 ktpa (Y38-Y55)
Maximum Mining Rate	5 Mtpa (Y1-Y10)	4.5 Mtpa (Y1-Y7)

Activity	Formal notification to the NT EPA following submission of EIS (for LOM 43)	Now proposed LOM 55
	10 Mtpa (Y10-Y43)	7.5 Mtpa (Y8-Y36)
		10 Mtpa (Y37-Y55)
Mine life (mining)	43 years	55 years
Mine life (mining & processing)	49 years	55 years
Tailings	450,000 tpa	262,500 tpa (dry) (Y2-Y11)
		487,000 tpa (dry) (Y12-Y37)
		637,500 tpa (dry) (Y38-Y55)
Processing		
Mineral concentrate	308,000 tpa	262,500 tpa
Process residues	1,090,000 tpa	304,000 tpa (dry)
Products		
Cerium hydroxide	17,010 tpa @ 53% TREO	13,250 tpa @ 53% TREO
RE Intermediate	26,600 tpa @ 42% TREO	16,450 tpa @ 42% TREO
Phosphoric acid	Not produced	110,000 tpa @ 54% P_2O_5

2.2.2 Mine site

An open pit will be excavated to a depth of 285 m below surface with a surface area of around 135 ha. (In the EIS the estimated pit depth was 225 m however, due to more mine planning work undertaken during August 2017, a series of pit optimisations was completed and the deepest part of the pit is now a further 60 m below this RL).

As stated above, the refined mine planning work undertaken in August 2017 has provided additional data to allow further refinement and optimisation of pit dimensions. An open pit will be excavated to a depth of 285 m below surface with a total surface area at end of mining of around 135 ha.

The EIS noted the associated infrastructure which has been reproduced below or, if changed, identified below:

- Five waste rock dumps (WRDs) (previously six in the EIS) will receive a LOM waste quantity of 302.2 Mt (159.9 million loose cubic metres (Mlcm)) constructed to a height of 50 m in 10 m lifts, potentially interspersed with 5 m wide berms. Final landform design will be determined following completion of detailed landform design studies that are planned to be undertaken when representative mined material is available for test work from the mining process. This WRD height was determined to blend in with natural landforms in and around the mine site area. The WRDs will not be visible from the nearest public access point to the mine site (i.e. the Stuart Highway about 10 km to the east) due to the presence of hills east of the mine site that are 30-100 m above the surface RL of the planned WRDs.

- Topsoil storage with a total footprint of about 114 ha and height of about 3 m if all available soil was stripped from Nolans site and not progressively used. Topsoil and soil media will be stripped ahead of infrastructure development and either stockpiled or shifted and respread onto available rehabilitation surfaces e.g. lower batters of WRDs. This approach will contribute to soil remaining viable as a rehabilitation media. The potential topsoil resources available are estimated to be in excess of 3 Mlcm for the M&I case and 5 Mlcm for the LOM case. Rehabilitation requirements for topsoil, for each case, is 1.2 Mlcm and 2 Mlcm respectively.
- Stockpile areas.
- A ROM pad to provide a facility for selective mining and ore blending (up to three months' ore supply). Low grade ore and NP2 (ore which when processed returns lower RE recoveries using the PAPL process), will be stockpiled either adjacent to the ROM pad on a hardstand area, or incorporated into the designated area in the south-eastern end of WRD No. 2. If this non-PAPL preferred ore remains unprocessed in the longer term, it can be encapsulated into the WRD and rehabilitated without having to be relocated (see Figure 2-1).
- Concentrator comprising a comminution circuit to crush and grind the ore, and beneficiation circuit (flotation) to reject gangue (valueless rock or mineral aggregates in an ore) and produce a mineral concentrate.
- Flotation TSF comprising LOM footprint of around 195 ha (approximately 50 ha less than proposed in the EIS) and an embankment height of around 22 m on the highest embankment in the north and around 5 m on the most southern embankment (refer to Appendix 2. This estimate was based on a 43 year mine life and now with the 55 year mine life the proposed TSF will require either the embankment height to be raised to around 25 m or alternately a small increase in footprint to accommodate the additional 12 years of mine production.
- Equipment and heavy and light vehicle workshop and administration offices and staff facilities comprising wash down area, tyre change facility, lube storage facility etc.
- Haul roads (refer Figure 2-1).
- Kerosene Camp Creek diversion. The current path of this creek transects the planned open pit in the northern part of the orebody. An assessment of potential alignment options determined that a western deviation of the creek into the larger western arm of the Kerosene Creek drainage network was the preferred option. Whilst this is a longer distance to redirect the creek this option provides the least risk in terms of potential release of contaminants into the planned drainage system as the creek alignment is furthest away from all planned mining activities.

The open pit is designed and reaches a depth of 285 m below ground level in stage 5 of the pit schedule. The natural standing groundwater level at the mine varies and is around 15-16 m below surface. Therefore dewatering to turkeys nest dams near the pit will be required early in the mining process. The turkeys nest dams will be established at the commencement of mining considering contours and catchment of the dams. All water from the dewatering process will, where possible, be utilised in onsite ore beneficiation processing or dust suppression, rather than drawing water from the Southern Basins borefield for those activities (refer to section 2.11 for further information).

Mining operations will deliver broken ore to various stockpiles on the ROM pad from which a front-end loader will blend and feed the crushing circuit. A single stage primary crusher, with dust suppression, will crush the rock to around 50 mm. The oversized crushed material will then be fed to an AG mill (autogenous grind mill (no grinding balls)) or SAG mill (semi-autogenous (steel balls)) for grinding before it is pumped to a cyclone cluster that will sort the fine from oversize particles. The coarse particles will recycle through the mill whilst the finer particles of <150 µm will move on to the beneficiation circuit comprising flotation cells to reject gangue (tailings) and produce a mineral concentrate. The concentrate is then pumped via a bunded HDPE slurry pipeline to the processing site located 8 km south of the mine site.

Overburden and waste rock will be deposited in constructed WRDs. Design of these dumps will be formalised once mining commences and representative mined waste rock is available for test work to fully inform the design. A stand-off distance for WRD from the pit perimeter of 50 m has been determined as a safe distance following geotechnical investigations.

The geotechnical work included drilling diamond core holes through the proposed pit hanging wall and footwall lithology, to provide representative drill core for geotechnical testing and analysis. Once operations commence it is intended that additional geotechnical investigation will be completed prior to pit development to validate the standoff distance required.

Figure 2-1 illustrates the general arrangement of the central mining and haul road network.

2.2.3 Processing site

As discussed above, the processing method discussed in the EIS is no longer proposed.

The most significant change to the project configuration is the removal of the process' demand for approximately 34% (30,110 tpa) of sulfur for sulfuric acid production in the post beneficiation pre-leach phase; and replacement with a phosphoric acid pre-leach. The majority of the phosphoric acid is generated from the naturally occurring phosphate in the Nolans ore body. Compared to the EIS, there is thus a reduced amount of reagent being imported to site and reduced volumes of waste residues.

The processing plant will also now produce

- a cerium product for shipment to international markets,
- an RE chloride intermediate product to an offshore separation plant for refining into three mixed and individual rare earth products, and
- a merchant grade phosphoric acid product for sale either domestically or overseas.

Construction of the following infrastructure at the processing plant is proposed:

- A number of integrated processing units in the processing plant:
  - Sulfuric acid plant (no change to EIS, smaller output)
  - Phosphoric acid plant (new)
  - Sulfation kilns (no change)
  - Recovery and purification units (no change)
  - Storage tanks. (no change)
- Process RSFs to store impurity and water leach residues in cells, with a combined potential footprint area of about 345 ha (rather than 160 ha proposed in the EIS) and embankment heights of around 14 m (rather than 24 m in the EIS). The larger footprint is to enable settlement of residues and accelerate evaporation.
- Evaporation pond or ponds consisting of a number of small cells (up to six about 10 ha each) to enable concentration of brine concentrate for recycle through the processing circuit.
- A 12.5 MW gas fired power station (rather than 18.5 MW proposed in the EIS).
- A slurry pipeline between the concentrator and processing plant.

The processing plant will still produce a number of waste streams. Waste streams will be confined to onsite engineered storage facilities.

Figure 2-2 depicts the processing site general arrangement.

2.2.4 Borefield

No change to borefield arrangement to that described in the EIS is proposed. Reduced impact on water balance is described in Section 2.11. Groundwater will be supplied from multiple bores located northeast of the Reaphook Hills and pumped to a centrally located transfer water pond for onward pumping to a desalination plant and demineralisation plant for use in the processing plant and other areas of the project.

Production bores will be distributed within designated 100 km^2 areas. There may be up to four or five of these designated production bores within the Reaphook palaeochannel over the life of the project. The final number of production bores will be determined once sufficient monitoring data is available to further inform the groundwater model therefore providing guidance to managing the borefield aimed at minimising potential impacts. Data following prolonged pumping is needed to enable the groundwater model to be recalibrated to provide a higher confidence and improved understanding of aquifer behaviour. The borefield configuration will be monitored to ensure that the groundwater resources within the basin behave as predicted and can sustain the project.

Infrastructure in support of the borefield will comprise:

- Well heads, pumping stations and above ground water transfer pipelines.
- Monitoring bores.
- Minor service roads and power supply or supplies.
- A centralised distribution pumping station.

Figure 2-3 depicts the borefield general arrangement.

2.2.5 Access and haul roads

No change to access and haul road configuration is expected from those described in the EIS.

Access roads/tracks and service corridors will be established:

- From the Stuart Highway (at a point approximately 5 km south of the Aileron Roadhouse access road) to the processing site, a distance of about 16 km. This will be the main access road into the project site.
- Between the processing site and the mine site, a distance of about 8 km by road.
- From the main access road to the accommodation village.
- From the processing site to the borefield area via an access track and services corridor, a distance of about 23 km to the centre point of the proposed borefield.

The main access road from the Stuart Highway to the processing site will be built to a public road standard with a pavement width suitable for the safe passing and overtaking of heavy vehicles i.e. road trains. It will be a sealed road with signage, road markings, etc. also suitable for anticipated occasional public use.

The internal road between the processing site and the mine site will be gravel because traffic volumes will be relatively low. The road will be to an appropriate engineered standard and maintained by internal road maintenance crews. This road will receive regular watering for dust suppression.

Other project roads, including those to the borefield, will likely be of a lesser quality but all will be constructed to ensure user safety as a guiding principle.

Roads will be designed and constructed to minimise changes to surface water flows, through construction of floodways and/or culverts and/or installation of side drains where necessary. Baseline biodiversity data will be used during the road design to avoid impact to sensitive areas e.g. limit creek crossings where possible.

Wherever practicable, services including power, water, sewerage and communication will run within the access road corridors. This will enable regular inspection of infrastructure by site personnel. It is intended that wherever practical, natural drainage will be allowed to flow under or across roads with minimal impediment to natural flow of surface water.

Flora, fauna and heritage surveys of the proposed corridors for all internal roads (and utility corridors) have been undertaken. An allowance of a 100 m- wide corridor for the sealed main access road between the Stuart Highway and the processing site, and 30 m- wide for all other access roads, was made. The wide corridor assessment allows flexibility in alignment of the road and temporary construction laydown areas. The final road alignment will be significantly less than the surveyed corridor.

The road corridors have been selected to avoid sensitive vegetation and heritage sites (with the exception of RWA8 through which the existing main access road (developed by others) runs. Refer to the Cultural Heritage Management Plan (Appendix 7).

2.2.6 Other infrastructure

Other infrastructure proposed to be constructed for the project includes:

- An accommodation village (Figure 2-4) with messing and recreational facilities.
- Project administration buildings, stores building with associated goods/reagents handling and storage facilities and compound (located near processing facilities).
- Laundry to deal with contaminated clothing.
- Vehicle and equipment wash bay area.
- Two packaged water treatment plant units located within the processing plant precinct.
- Small sewage treatment plant units at each of the processing site, mine site and accommodation village.
- Site wide drainage collection and unlined sediment traps
- Above ground pipelines including:
  - A gas supply offtake pipeline to connect to the existing Amadeus Basin to Darwin, high pressure natural gas pipeline) located near the power station.
  - Potable water supply pipelines from the borefield area to the mine site, processing site and accommodation village.
  - Process water supply pipelines from the borefield area to the processing site and mine site).
  - A slurry transfer pipeline HDPE pipeline earth bunded along the pipeline corridor and use of deflection shields on welded joints to minimise impact of pipe welding failures from the concentrator at the mine site to the processing site.
- Overhead powerlines from the power station at the processing site to the mine site and accommodation village.

- Fuel and materials storage facilities at the mine site, processing site and accommodation village. It is likely there will be three or four fuel storages, the largest of which will be at the mine to provide fuel for the mining fleet. Smaller storages will be built at the processing site and at the accommodation village for backup power. A small storage facility may also be required to service the borefield.

Additionally, the project will include offsite components as detailed below.

2.2.7 Logistics

Arafura intends to work with the owners and operators of existing freight facilities in Alice Springs and Darwin to ensure those facilities meet the logistics requirements of in and outbound reagents, materials and product volumes.

The main material storage facility at the processing site will be sized to store and manage all in and outbound shipping and tank containers (that meet the International Organisation for Standardisation (ISO) requirements). The facility that is to store and handle these materials and regents will be constructed to comply with the relevant Australian Standards.

2.2.8 Separation plant

A separation plant will be constructed within an established chemical precinct at an offshore location (at this stage assumed to be South Korea, although other locations are under consideration). Rare earths will be separated at this facility into three final products using solvent extraction followed by precipitation and calcination.

This separation plant will be subject to a separate approvals process and is **excluded** from the scope of the EIS.

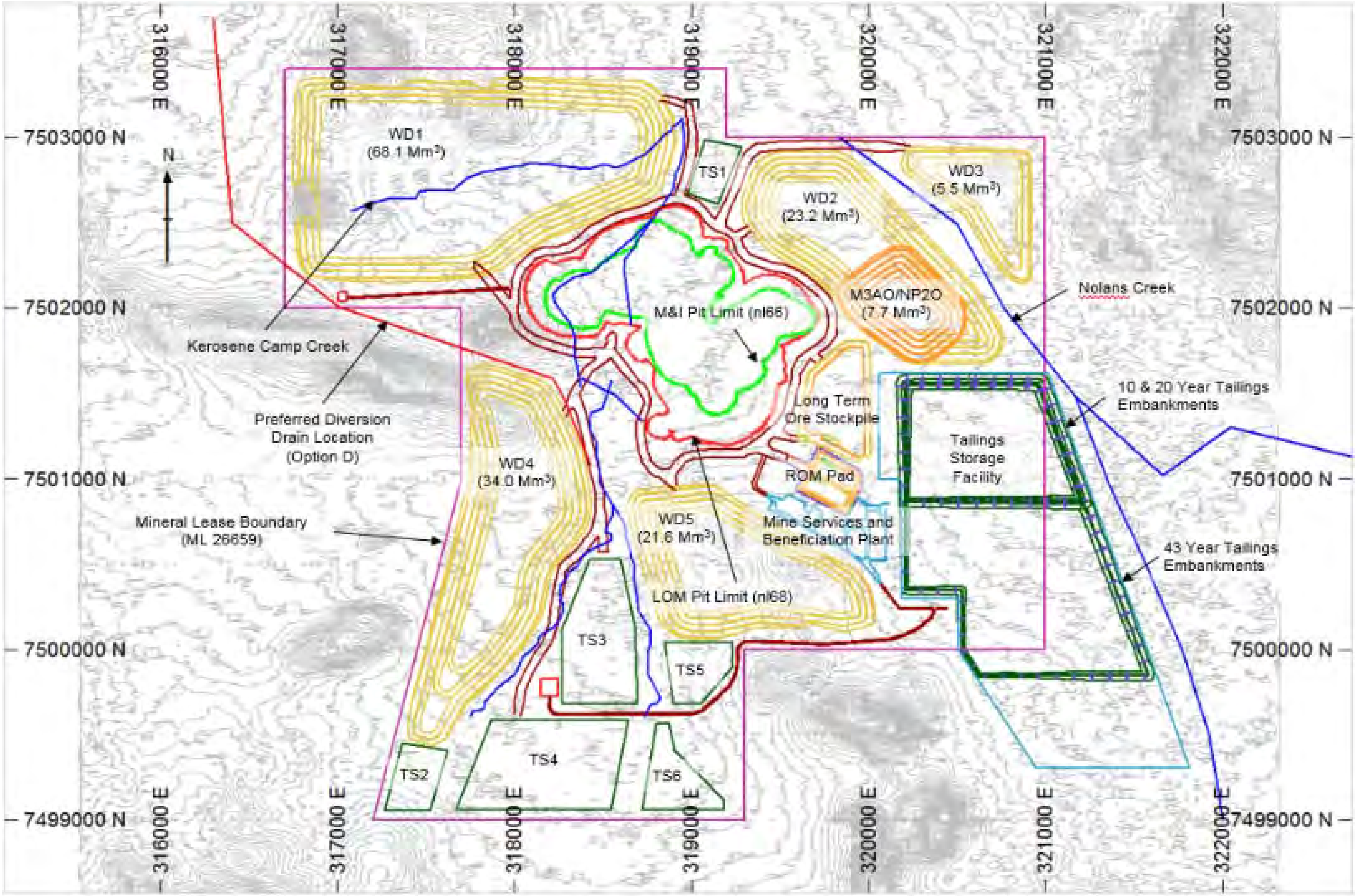


Figure 2-1 Mine site general arrangement (LOM 55) (Appendix 2)

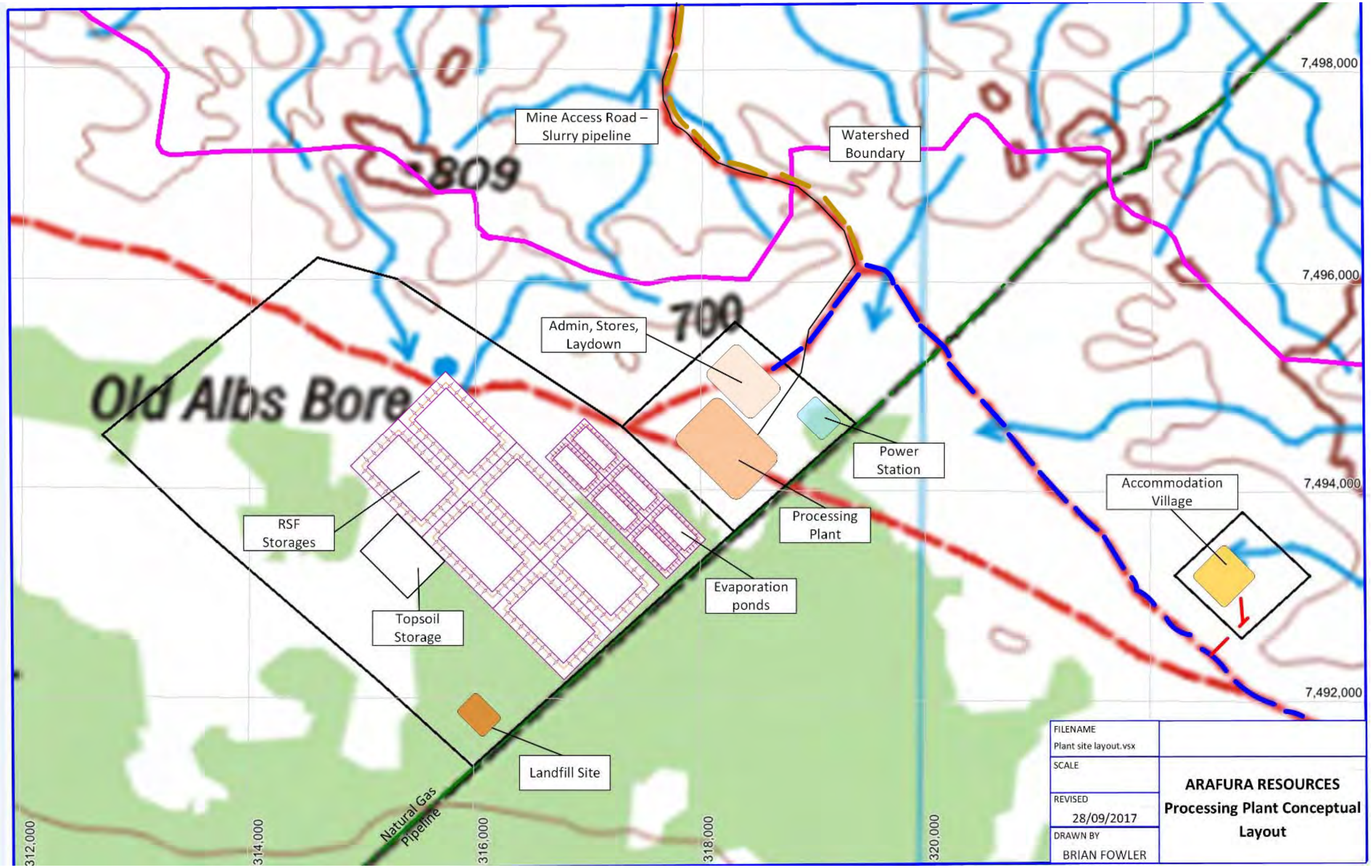
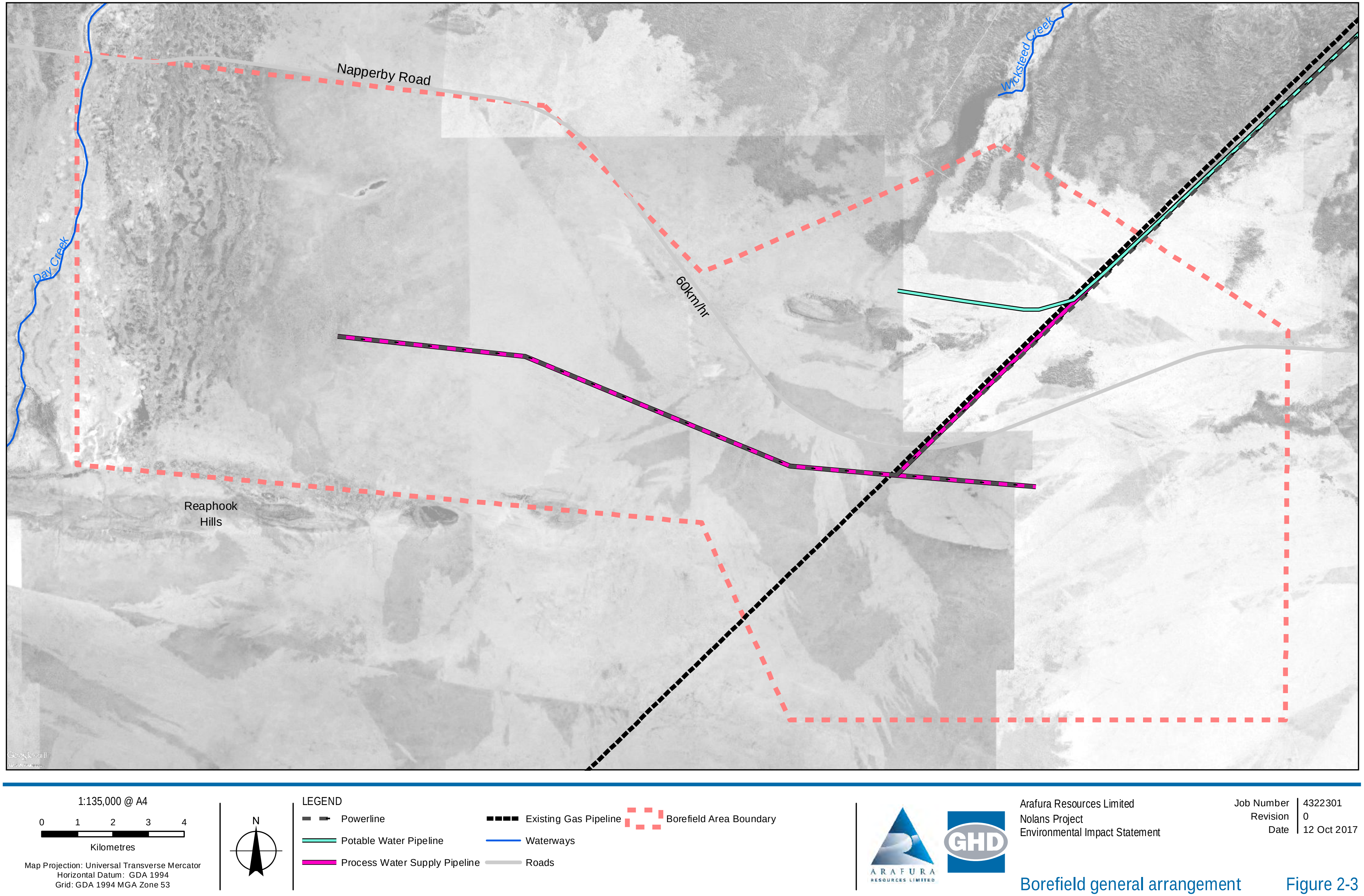


Figure 2-2 Processing site general arrangement (Arafura 2017)



Arafura Resources Limited
Nolans Project
Environmental Impact Statement

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Date	12 Oct 2017

Borefield general arrangement

Figure 2-3

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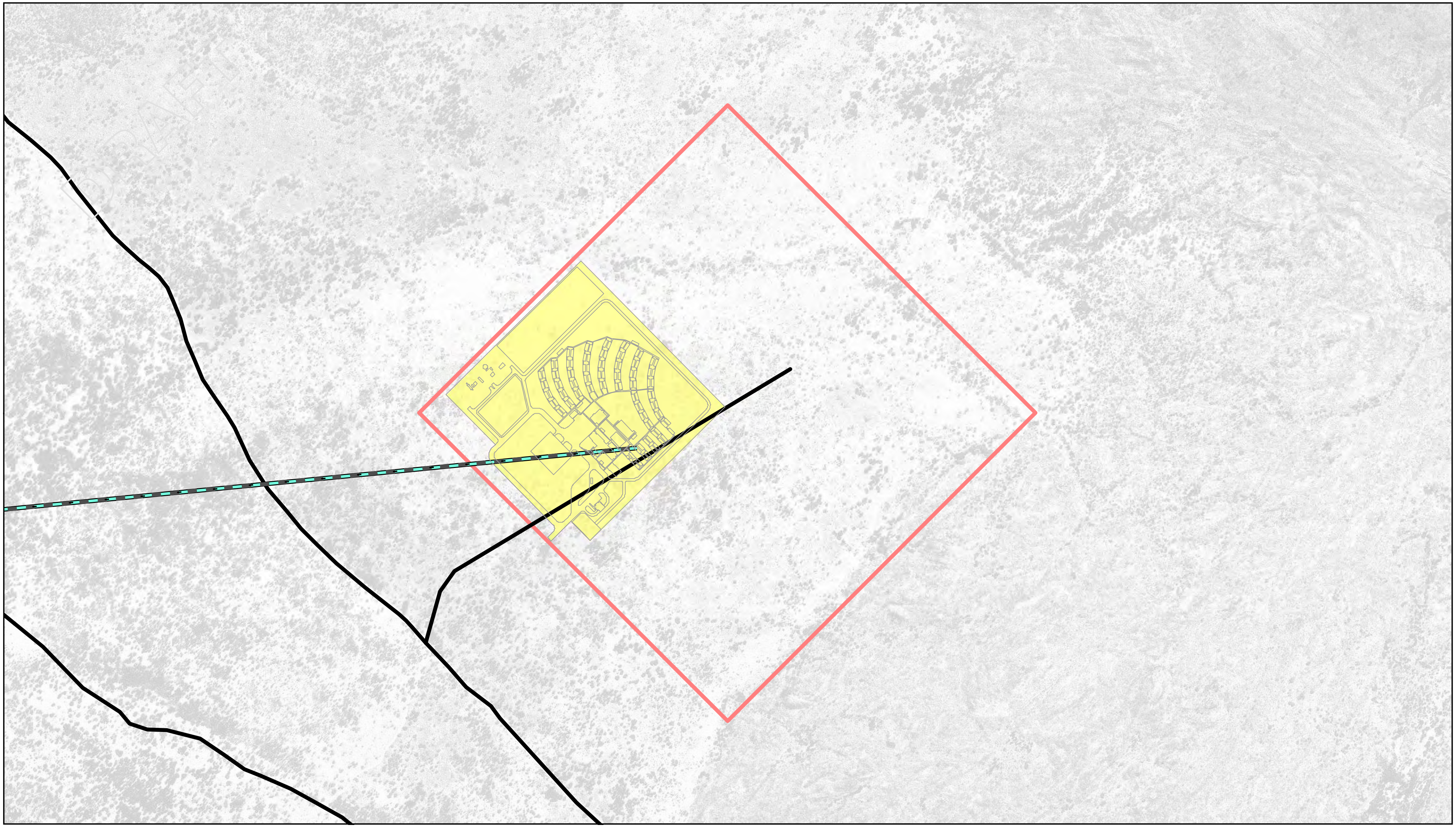
Level 7 24 Mitchell Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 29/04/2015). ARL - Proposed Pipelines, Proposed Powerlines, Borefield Area (2015). Created by: CM



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0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

▬ ▬	Powerline	🟥	Accommodation Village Boundary
═	Potable Water Pipeline	🟨	Accommodation Village
▬	Access Road		

Arafura Resources Limited
Nolans Project
Environmental Impact Statement

Job Number	4322301
Revision	0
Date	12 Oct 2017

Accommodation village general arrangement

Figure 2-4

G:\43\22301\GIS\Maps\4322301_013_ProjectInfrastructureAccommodationVillage.mxd

Data source: Google Earth Pro - Imagery (Date extracted: 29/04/2015). ARL - Proposed Pipelines, Proposed Mine Site, Proposed Diversion Channel Options, Tailings Storage Facility (2015). Created by: CM

2.3 Buildings and facilities

All site buildings and facilities will be constructed in accordance with the relevant NT building regulations, codes and Australian Standards applicable to the Nolans site.

The concentrator and processing plant areas will comprise a mix of site erected steel framed and clad buildings and transportable modular buildings. Where practicable, the buildings will be of a modular type construction that can be manufactured off site and transported to the site. Some of the larger buildings may be formed by multiples of these transportable modules or constructed on site as required.

2.3.1 Concentrator

The concentrator is a small facility (relative to other site infrastructure) located within the mine site (Figure 2-1) featuring conventional comminution and beneficiation processing technology buildings which include:

- A plant control room - including an operations area, control stations and space for office and a small staff amenities area.
- A crusher control room - a small prefabricated transportable building located adjacent to the crusher with working space for crusher operator.
- A plant workshop - bays open at the front with wide aprons. An overhead crane will service the bays. There will be an air-conditioned room for electrical and instrument maintenance and services.
- A warehouse – to house small to medium components and provide secure storage for spare parts and consumables in high racking designed to be accessed from a personnel access platform.
- A plant crib room, change room and first aid facility - including a serving bench and wash up facilities. The clinic and first aid facility will be a single transportable building and include treatment room, office, store room and ablution.
- Plant ablution blocks at the plant.
- A reagents storage warehouse - a steel framed building with roof cover only for flotation reagents. The concrete floor will be bunded and graded towards sumps to prevent contamination of the surrounding environment should reagents spill accidentally.

2.3.2 Processing plant

The processing plant area (Figure 2-2) buildings will include:

- A prefabricated administration building providing individual offices for senior staff and open plan partitioned work stations.
- A prefabricated amenity / crib room attached to the administration building with ablution block.
- A prefabricated emergency services facility comprising a small office and storage area for rescue equipment. There will be an undercover area for an ambulance, fire truck /rescue vehicle and emergency response trailer.
- A prefabricated operations centre complex will be a series of buildings including a control room, training room, crib room, change room, plant ablutions and laundry.

- The shower and change facility will have capacity for the entire plant workforce to change and shower each shift. The change room will contain dirty and clean change areas, showers, toilets and lockers as well as cleaner and plant rooms. Adjacent to the change room facilities will be a small commercial laundry. To control the unintended dispersion of radioactive material, all operations personnel from the plant and mine will be required to change potentially contaminated work clothing before leaving site. Grey water from the laundry will be pumped to the tailings facility.
- A laboratory will be used for sample preparation and storage and will comprise a well-equipped prefabricated laboratory building. The drainage system will include provision for handling analytical liquids and small volumes of strong acids and bases.
- A maintenance workshop will have open access and will include service bays for mobile equipment, fixed plant, electrical equipment and welding.
- A warehouse will form an extension of the workshop building. It will provide secure storage for spare parts and consumables in high racking designed to be accessed from a personnel access platform. The warehouse will house small to medium components and larger items susceptible to weather damage and stores. A secure compound will adjoin the warehouse for containerised reagent storage. This area may also contain an undercover area for ultraviolet sensitive product. The concrete floor will be bunded and graded towards sumps to prevent contamination of the surrounding environment should reagents spill accidentally.
- A product warehouse will be sized to store bulk bags of product and will include a concrete loading area external to the building. Storage tanks for phosphoric acid will also be incorporated into this storage area. All will be built to be compliant with the relevant Australian Standard for the storage and handling of the products held within.
- Wash down area and a wheel wash facility for equipment and vehicles that have come into contact with radioactive materials.

2.4 Construction

2.4.1 Project implementation strategy

Arafura will be the operations manager and contract suitably qualified engineering companies to carry out various construction and operational roles during the project's development. Arafura will obtain all necessary approvals and permits and ensure that any contracting companies are aware of and comply with all regulatory requirements and any additional requirements imposed by Arafura to ensure standards are adhered to. All construction that will be completed as part of the project construction will be compliant with relevant Australian and accepted engineering standards e.g. Australian National Committee on Large Dams (ANCOLD).

As part of the project's development Arafura will award two primary contracts:

- An engineering, procurement and construction management (EPCM) contract to carry out all necessary design, engineering, procurement, construction and commissioning works for the processing plant and infrastructure.
- A separate contract with a mining contractor to carry out mine development and pre-stripping works (mine design will be finalised in the project's definitive feasibility study (DFS) during 2018 and mining contract tendering will be undertaken in the latter part of the DFS and early in project implementation).

2.4.2 Construction method

Construction will generally follow four steps, as outlined below:

- **Site preparation** including vegetation clearing and topsoil stripping of the mine area, initial waste dump footprints, haul roads and access roads, TSFs and other dams, plant site and ancillary buildings and facilities. Topsoil will be stockpiled for later re-use in rehabilitation or landscaping. Graders, front-end loaders and bulldozers will level the ground to the required gradients. Cleared vegetation will be stored for later application as mulch to the rehabilitated landforms.
- **Building platforms and hardstand areas** will be established and site drainage constructed. Foundations of major plant items and buildings will be established using concrete mixed in a temporary on-site batching plant.
- **Equipment installation and construction of the plant** will involve assembling and installing equipment items fabricated or manufactured off-site using a range of cranes.
- **Plant commissioning** will involve testing and commissioning equipment in preparation for operations. Pre-commissioning is generally carried out using air and/or water. Once pre-commissioning is complete, commissioning takes place with ore, reagents and other process materials. When the pre-determined levels of output and quality are achieved, the plant will be handed over to operations personnel for optimisation and routine operation.

2.4.3 Sources of construction materials

A preliminary geotechnical site investigation has been undertaken to evaluate foundation conditions at the mine site and identify potential borrow material sources for the Nolans site infrastructure. This survey investigated several locations within 30 km of the Nolans site to assess construction material. Some of the sites investigated are sites used previously for highway construction or road construction on Aileron Station. Prior to project construction a more comprehensive geotechnical investigation will be undertaken at the mine, processing site and adjoining areas, including further investigations into materials for construction. Any required regulatory approvals to source these materials for subsequent construction purposes will be sought prior to construction. Wherever possible Arafura intends to use material from the pit pre-strip or other infrastructure foot print pre-strip as construction material.

Interpretation of site conditions is based on the sub surface lithology revealed during the investigation program which included visual assessment of the in-situ materials, the results of in-situ field tests, and the results of laboratory geotechnical testing carried out on selected representative samples collected during the fieldwork. Arafura has a comprehensive understanding of the geology and regolith of the Nolans project area and surrounding district, and is confident that all required construction materials can be sourced locally. This is based on Arafura’s Chief Geologist, Kelvin Hussey’s extensive mapping experience in Central Australia. Kelvin prior to joining Arafura, worked for the NT Geological Survey undertaking extensive regional mapping programs from 1989 until 2005.

The previous geotechnical site investigation identified borrow material for earthworks construction within 30 km of the mine site, and these are summarised in Table 2-3.

Table 2-3 Summary of borrow materials

Material Type	Description	Location
Zone A	Low permeability material, generally greater than 30% fines and a PI of 8 or more.	Two possible source areas, within the pit area and to the south east of the TSF.
Zone C	Granular material (sandy gravel) with a fines content typically of 15 % to 20 %.	This material will be won from the overburden in the pit or by selective excavation from the waste dump.
Zone F	Sand with less than 5% fines.	Two possible source areas, within creeks and imported from a local quarry.
Base Course	Granular material (sandy gravel) with a fines content typically of 15% to 20% and a CBR value of greater than 50.	Two possible source areas, Native Gap road quarry and imported from a local quarry.
Road Aggregate	14 mm high strength stone.	One possible source area, imported from a quarry in Alice Springs.
Concrete	Variable properties but generally 40 N/mm^2	Proposed onsite batching plant during construction.

2.4.4 Construction traffic

A traffic and transport impact assessment was conducted for the EIS. As discussed in the EIS, they key roads and surrounding road network has traffic capacity to service additional traffic. The remaining capacity for the routes identified for operations (which would also be similar for the construction stage) range between 21 % and 99 % (Table 17-4 of Chapter 17 of the Draft EIS).

In the EIS, the conclusion was that overall the project is unlikely to have a significant impact on the capacity of the key roads in the surrounding road network. It is anticipated that there would be only a very small increase in overall traffic volumes as a direct result of the Nolans Project.

2.5 Mining

2.5.1 Mineral resources

Systematic exploration of the Nolans Bore site has been undertaken by Arafura since 2001, with most of the exploration and resource definition activity confined to an area measuring 1.5 x 1.2 km within the mine site boundary.

There is limited outcrop at Nolans Bore, with most of the deposit covered by a thin veneer of soil and alluvium up to around one and a half metres thick. Systematic drilling indicates the widespread presence of RE mineralisation, with steeply dipping veins up to tens of metres in thickness and hundreds of metres in length, extending below 250 m drilled depth, across large parts of the deposit. The full extent of the deposit is yet to be outlined but limited deeper drilling has demonstrated that mineralisation extends down to at least 430 m below surface in the deposit's North Zone.

A total of 99,340 metres of drilling and costeaning has been completed in and around the Nolans Bore deposit (Figure 2-5) comprising:

- 628 reverse circulation and diamond core holes, 48 wide diameter holes and 9 costeans in the main part of the deposit.
- 421 shallow percussion holes, 9 shallow diamond core holes and 54 reverse circulation exploration holes outside of the main area of the deposit.

The amount and overall proportion of diamond core drilling is considered sufficiently high (31%) to provide good geological control and support the estimation of higher confidence mineral resources. This data set has also informed the project's environmental studies regarding characterisation and predicted behaviour of ore, waste rock and tailings.

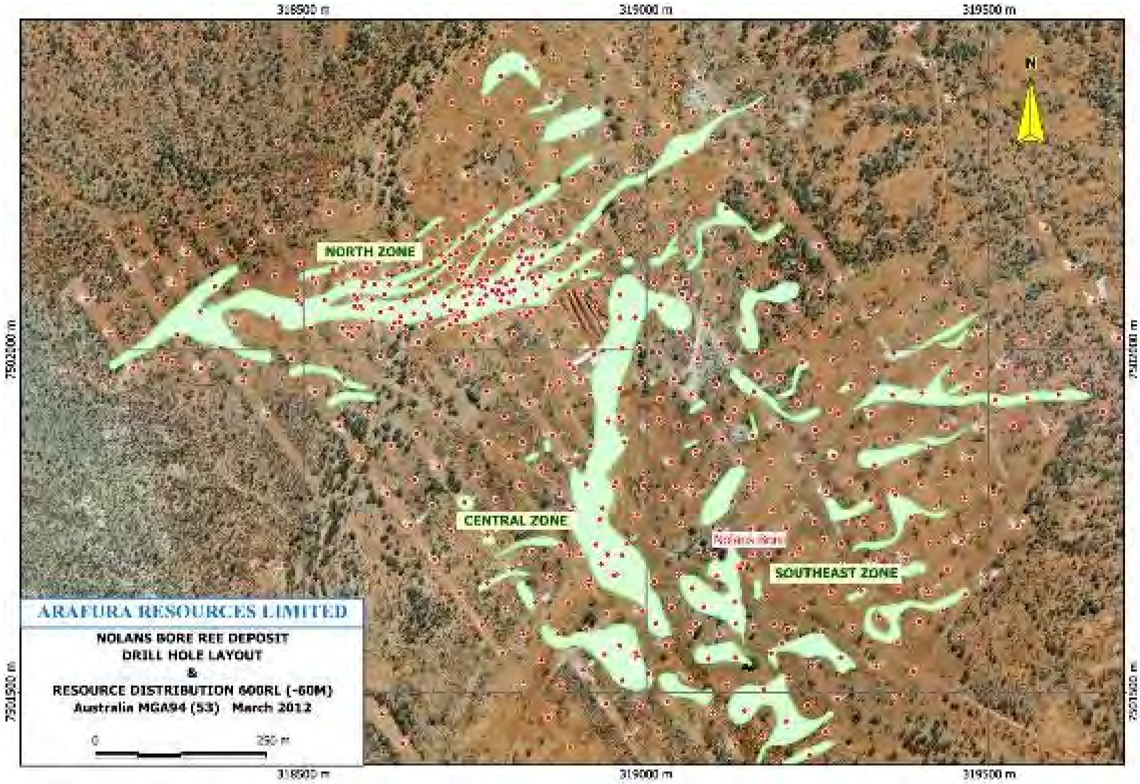


Figure 2-5 Distribution of drilling and mineral resources – plan view

The estimate of mineral resources presented in the EIS was current as at December 2014, and supported a 22-year production life mining Measured and Indicated resources only (M&I Case). Adding Inferred Resources supported a potential 43-year LOM case at a production rate initially around 750,000 rising to 1,100,000 Mtpa in the later part of mine production.

The recent June 2017 estimate of mineral resources will now support a 34-year production life mining M&I resources only. Adding Inferred Resources supports a potential 55-year LOM case at an initial production rate of 525,000 tpa that then rises in year 12 to about 750,000 tpa and again increases in year 38 to around 900,000 tpa until the end of mine life. These resources are shown in Table 2-4, and the distribution of these resources both laterally and with depth is shown in Figure 2-6.

The 15.7 Mt of material classified as non-preferred (NP2) will be stockpiled for future processing when recovery outcomes are less critical. A further mining study that may alter these schedules will be completed as part of the DFS when we have more accurate costings and project detail to inform the study.

Table 2-4 Mineral resources

Resources	Tonnes million	Rare earths (TREO %)	Phosphate (P_2O_5 %)
Measured	4.9	3.2	13
Indicated	30	2.7	12
Inferred	21	2.3	10
TOTAL	56	2.6	11

Compliant with JORC 2012. Reported above a 1% TREO cut-off grade. Numbers may not compute due to rounding.

The deposit contains elevated concentrations of REs, phosphate, uranium and thorium, averaging 2.6% TREO, 11% P_2O_5, 190 ppm U_3O_8 and 2,900 ppm ThO_2 respectively. In addition to the REs, Arafura plans to recover the phosphate to produce a merchant grade phosphoric acid but does not initially intend to commercially recover either the uranium or thorium. The uranium and thorium and any radioactive decay chain daughter products of these elements will report to either tailings or process residue storages

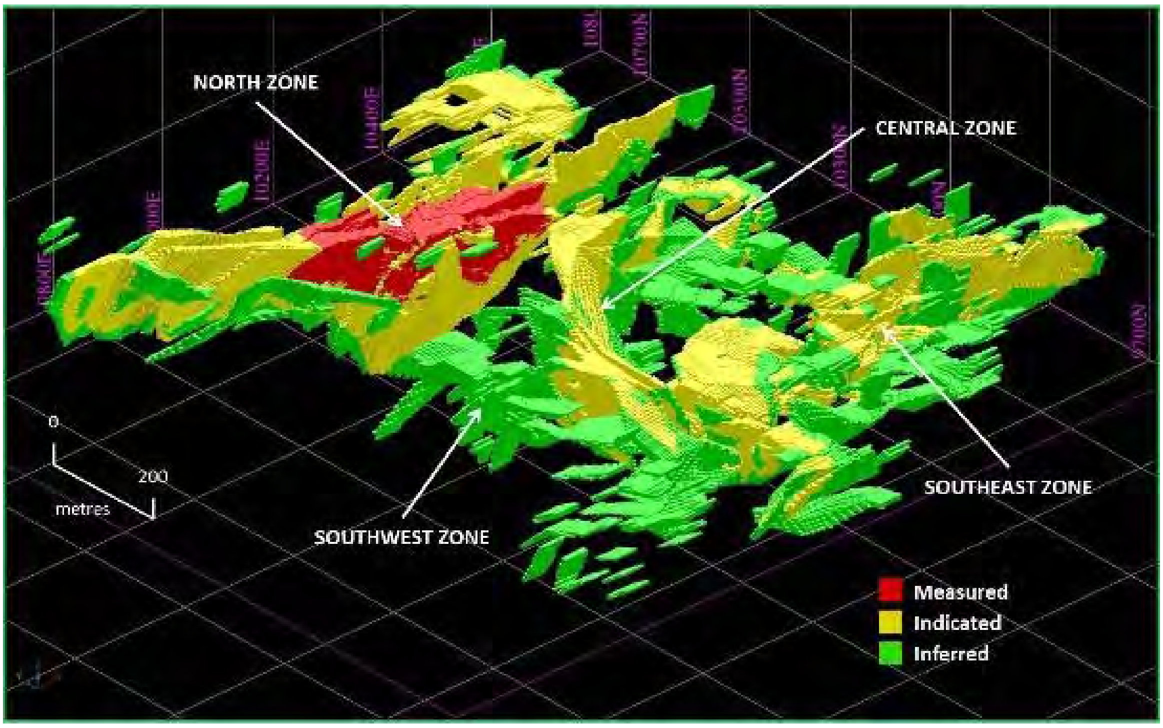


Figure 2-6 Distribution of Mineral Resource categories – oblique view

2.5.2 Mineralisation

The project’s Mineral Resources are comprised of two broad styles of RE-bearing mineralisation:

- **Apatite mineralisation** comprises up to about 95% apatite and typically contains abundant mineral inclusions of RE-bearing minerals such as monazite group minerals, allanite, thorite and numerous other RE phosphates, silicates and carbonates. The apatite itself contains variable amounts of REs but a higher proportion of REs are hosted in the mineral inclusions.
- **Calcsilicate mineralisation** tends to be lower grade than the apatite mineralisation, and is typically dominated by apatite, allanite, epidote, amphibole and pyroxene.

In addition to REs, the mineralisation has elevated concentrations of calcium, phosphorous, thorium, uranium, strontium and fluorine.

Following the adoption of the PAPL process improvements, a revision of the geological model was undertaken and an improved understanding (new model) of the distribution of the various mineralised material types at Nolans Bore has been developed. A comprehensive program of material type re-classification was completed to support Arafura’s metallurgical test work on recoveries of REE and phosphorus for different material types. Furthermore, the company considered the original classifications previously used for mine planning studies was obsolete. The new material type classification is shown in Table 2-5 (which replaces Table 3-4 of the EIS).

Table 2-5 Material type classification for Nolans Bore (Appendix 17)

MAT type	MAT Group	Description	Comments
0A	WASTE	Country rock with no evidence of mineralisation (MIN).	Waste rock with TREO <0.5%. No evidence of MIN (veins) in core. Some country rock pegmatites exceed 0.5% TREO however these have a distinct chemistry with low P_2O_5.
OB1	WASTE	Country rock with evidence of minor MIN but <0.5% TREO.	Essentially waste. Narrow/minor MIN veins can be present but low grade.
0B2	WASTE	Country rock with evidence for minor MIN but >0.5% TREO.	Probable waste in many cases. Isolated or narrow/minor MIN but generally low grade.
0B3	WASTE	Country rock but geochemical evidence for MIN in interval. No obvious MIN in reverse circulation (RC chips).	Only used for RC samples. Mineralogy of stored sample is not consistent with chemistry of >1% TREO and elevated P_2O_5. This is not unusual in RC drilling if the stored sample was poorly sampled.
0C	WASTE	Altered country rock with <0.5% TREO.	Essentially waste but the style of alteration is geologically associated with MIN. Examples include extensive epidote-rich alteration, calcsilicate alteration selvages, bleached zones (*i.e.* plagioclase alteration with minor tremolite veins) and extensive zeolite alteration.
1	PAPLP	Cream/green apatite with <2% allanite (<30% clay and <25% calcsilicate).	Unoxidised massive apatite MIN with trace or no obvious allanite. Typically containing minor carbonate especially if trace allanite. Lacks obvious hematite/goethite staining and therefore should have lower Fe than MAT2. High P_2O_5 and elevated TREO and P_2O_5/TREO typically >4. Fresh country rock nearby.
2	PAPLP	Brown apatite with <2% allanite (<30% clay and <25% calcsilicate).	Oxidised massive apatite MIN with trace or no obvious allanite. Typically contains voids with chalcedony and hematite/goethite. Should have higher Fe than MAT1. High P_2O_5 and elevated TREO and P_2O_5/TREO typically >4.
3A	NP1	Fine grained monazite and crandallite-rich MIN >30% clay	>30% clay is essential. High grade “cheralite” MIN with P_2O_5/TREO <2.5. Typically described as ‘puggy baby-poo’ coloured but many clay-rich examples with suitable chemistry have a much lighter hue.
3B	PAPLP	TREO >0.5% and >30% clay with oxidised apatite, cheralite, kaolin and clay	>30% clay is essential. MIN similar to type2 but with higher clay content and variable TREO grades. P_2O_5/TREO >2.5. Note not classified where TREO and P_2O_5 are low because material should be assigned to type 3C.
3C	WASTE	TREO <0.5% and >30% clay with mixture of oxidised country rock, apatite, cheralite, kaolin and clay	>30% clay is essential. Low grade clayey intervals often associated with MIN but essentially altered waste rock. Examples include extensive low-grade kaolin alteration.

MAT type	MAT Group	Description	Comments
			This classification is differentiated from type 0C largely due to the abundance of clay and kaolin. It is often closely associated with types 3A and 3B.
4A	PAPLP	Apatite with 2-10% allanite	Massive apatite with minor allanite (mostly type 1 observed), < 25% calcsilicates and <30% clay.
4B	NP2	Apatite with >10% allanite	Massive apatite with significant allanite (mostly type 1 observed); <25% calcsilicates; <30% clay. Note Central Zone often has apatite+allanite+amphibole rocks which are best classified as type 5B2.
5A1	PAPLP	>25% OH-free calcsilicates + apatite + <10% allanite	OH-free calcsilicate minerals (pyroxene and garnet) are key minerals in this type. Variable amounts of apatite and <10% allanite; often a mixture of veins and variably altered selvages. Trace or minor allanite is often associated with calcsilicate-rich parts. <30% clay.
5A2	NP2	>25% OH-bearing calcsilicates + apatite + <10% allanite	OH-bearing calcsilicate minerals (*e.g.* epidote, amphibole, zeolite etc) are key minerals in this type. Variable amounts of apatite and <10% allanite Trace or minor allanite is often associated with calcsilicate-rich parts. <30% clay.
5B1	NP2	>25% OH-free calcsilicates + apatite + >10% allanite	This type was devised for allanite-rich type 5A1. However as expected, no samples were identified in this category.
5B2	NP2	>25% OH-bearing calc-silicates + apatite + >10% allanite	This type was devised for allanite-rich type 5A2. Epidote and/or amphibole often dominate this type, and sometimes zeolite; the apatite + allanite + amphibole breccias in the Central Zone fall into this category; <30% clay
6B	WASTE	>30% clay, >25% calcsilicates + apatite + allanite; TREO > 0.5%	Rare. Dominated by clay and calcsilicates. Probable waste.
6C	WASTE	>30% clay, >25% calcsilicates + apatite + allanite; TREO < 0.5%	Rare. Dominated by clay and calcsilicates. Essentially waste

NB: The different MAT types have been grouped for detailed geological assessment and mining studies.

The distribution of the new mineralised material types at Nolans Bore is geologically complex. To simplify and to portray them visually (below) the material types have been interpreted and viewed in terms of their MAT group (Table 2-5). Although many resource blocks in the current resource model contain mixed material types, there are large parts of the deposit where PAPLP material types dominate, as shown in Figure 2-7 and Figure 2-8.

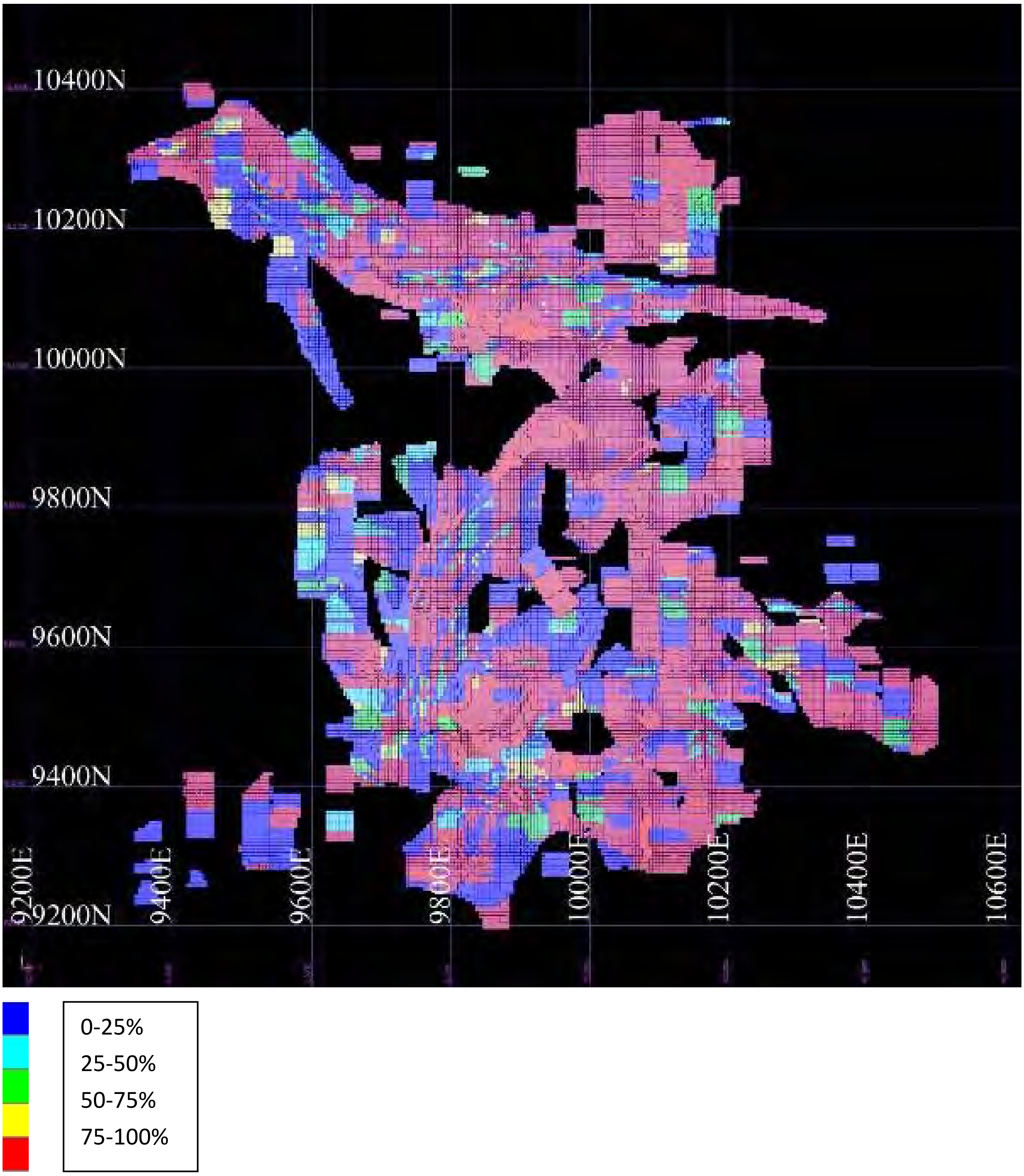


Figure 2-7 Plan view of Nolans Bore showing the distribution of PAPLP*

*colour-coded by the fraction of this material type in each resource block. This colour code also applies to Figure 2-8.

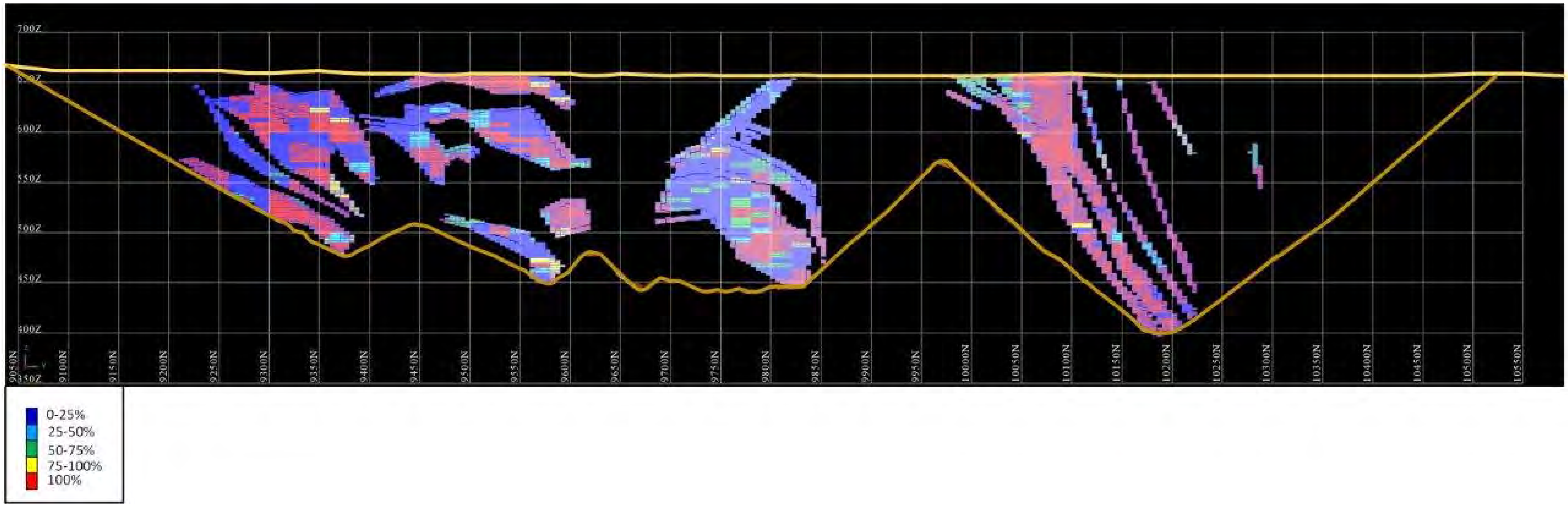


Figure 2-8 Section 9840E showing the distribution of PAPLP*

*colour-coded by the fraction of this material type in each resource block

2.5.3 Future exploration

Arafura has been exploring the region around the project site for REs and other mineral commodities since 1999. In that time, it has held exploration rights over approximately 6,300 km^2 of land, including the current EL that hosts the Nolans Bore deposit (EL 28473), either in its own right on in joint venture with other companies.

Arafura's exploration methodology involves flying airborne geophysical surveys to provide a focus for detailed on-ground geological, geochemical or biogeochemical investigation (as appropriate) in advance of drilling. Often, a target area fails to deliver encouraging results at an early stage of its assessment, leading to relatively rapid turnover of ELs.

There are currently no areas, apart from the Nolans Bore deposit itself where potentially mineable resources have been identified. Nonetheless, Arafura maintains a modest exploration presence in the region, and is currently acquiring exploration tenure targeting alternative models for RE deposits that have the potential to delivery complementary feed to the Nolans processing plant.

2.5.4 Mine scheduling and pit development sequence

Mine production rates have been reviewed and modified to ensure sufficient ore is mined at a grade to produce the revised annual target of 14,000 tonnes of TREO equivalent. The proposed mining methodology has not changed since the EIS. Selective mining methods continue to be utilised from the pit, and the use of stockpiles, to optimise the required ore feed to the concentrator. The revised mining production rates are 4.5 Mtpa (year 2-11), then 7.5 Mtpa (year 12 – 37) and finally 10 Mtpa (year 38-55).

The open pit mining operation will use conventional drill, blast, truck and excavator mining methods. The truck and excavator mining method was selected because:

- A high degree of ore selectivity and blending can be achieved.
- Studies have shown this method to be cost effective and often the lowest cost option.
- A high degree of operational flexibility is possible, particularly for multiple pit stages and the bench geometry associated with nested pit stages at the mine site.

2.5.5 Mining methodology

Drill and blast will be required for both ore and waste with design powder factors ranging from around 0.40 kg/BCM for oxide mineralisation and waste to around 0.60 kg/BCM for fresh mineralisation and waste. Blasthole drilling will be carried out by 89 mm blasthole drills. All blasting will be undertaken using emulsion explosives selected mainly for its water resistance and resultant reduced drilling cost given that the orebody is mostly below the water table and saturated below about 16 m depth. The bulk emulsion explosives will be delivered by a sub-contractor as a down-the-hole service which is the supply of bulk explosives on the bench.

All final design batters and interim walls will be pre-split drilled and blasted with specialised packaged explosives.

The sub-contractor's explosives plant will be located south-east of the now proposed WRD 4 as shown in Figure 2-1, (the same position as in the EIS however was then south of WRD 3, and north of WRD 5). An explosives magazine will be located near the south west corner of WRD 1, and east of the proposed Kerosene Camp Creek diversion.

In and adjacent to zones of mineralisation, blasthole cuttings will be sampled, radiometrically and geologically logged, and analysed to determine the type of mineralisation and TREO, P_2O_5, U and Th grade as well as other indicator elements as required. Zones of mineralisation will then be identified by the geologists as plant feed, material to be stockpiled and waste. After blasting and prior to excavation, the various material types will be marked out by the geological and grade controllers. The excavator operators then proceed to selective mine the various material types sending each truck to the designated destination (ROM pad, stockpile or WRD).

As an additional grade control aid, two radiation discriminators will be installed. The discriminators use gamma detection units to determine the average radioactivity of the material within a truck's tray, and therefore provide the truck operator and grade controllers' guidance regarding the destination of the truck (to the ROM pad, stockpile or WRD). This equipment will help to prevent mineralisation being sent in error to the WRD and conversely waste being sent to the ROM pad. It will also guide the deposition of waste rock material that exceeds 1 Bq/g. This type of equipment is currently in use at another mine site in the NT.

The extraction sequence for the LOM 55 case provides for a total of eleven pit stages, and this is shown in Figure 2-9. Table 2-6 shows the timing of the planned pit stages and indicates the final depth of the pit floor form the surface at the end of each pit stage. Extraction quantities are summarised in Table 2-7.

The following LOM information has been derived from the August 2017 scoping level mine planning study (Appendix 1) and is included to provide a more representative view of the potential maximum project impact that may arise should the LOM resource be successfully converted to ore reserves and mined.

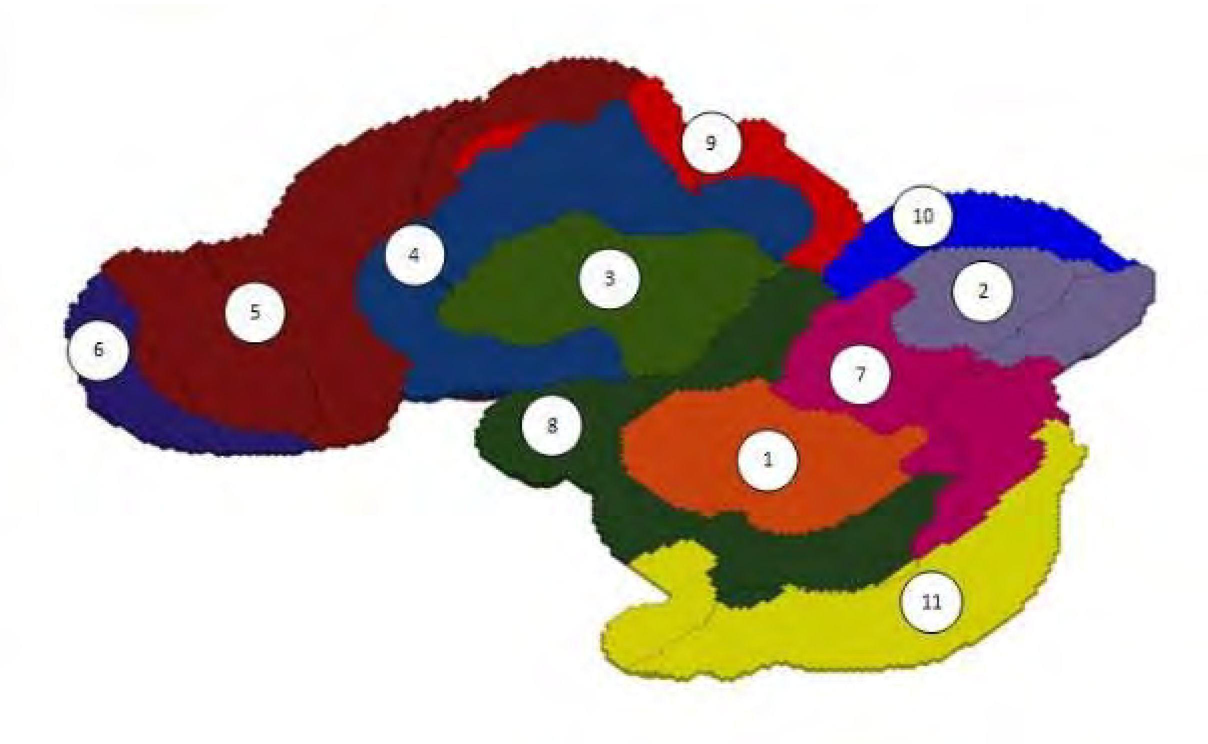


Figure 2-9 LOM (55 years) pit stages

Table 2-6 Pit stages, start, finish and final pit stage depth (in metres) below surface

Pit Stage	Year Starts	Years Ends	Depth from Surface
1	1	10	70
2	1	8	70
3	1	10	80
4	3	22	140
5	2	49	285
6	2	50	195
7	2	14	135
8	13	34	220
9	26	38	220
10	26	38	205
11	43	55	235

Table 2-7 LOM extraction quantities

Item	Total over LOM (tonnes) (EIS)	Total over LOM 55 (tonnes)
Mined		
Ore (ROM)		27,361,730
Ore (Low Grade)		9,629,864
Ore (Long Term Stockpile)		15,944,520
Ore – Total	54,326,902	52,707,628
Waste	304,092,777	302,191,924
Total Mined	358,419,679	355,128,071

The mining schedule and associated information presented here is for the LOM 55 scenario and is based on a maximum overall mining rate of 10 Mtpa of ore and waste (Figure 2-10) to produce the required beneficiation plant feed to sustain the proposed production outputs from the processing plant. This generates a total of 355.1 Mt of ore and waste over the 55-year LOM scenario.

Mine production schedules have been generated from the pit optimisation shells based on selectively mining and processing higher grade material in the early years of the project, and stockpiling the processing of lower grade material by blending. A stockpile of NP2 ore is not included in the plant feed schedule. This material will be placed into WRD 2 for possible future recovery and processing.

Plant feed is mined from the open pit and stockpiled on the ROM pad adjacent to the primary crusher. It is then rehandled by a front-end loader into the primary crusher. To optimise grade control some lower grade mined material is stockpiled off the ROM pad and is rehandled twice; once from the long-term stockpile (LTS) to the ROM, and again from the ROM to the primary crusher.

Multiple pit stages will be mined simultaneously (refer Figure 2-10). That is, when a pit stage has been developed sufficiently to expose the ore in that stage, waste development of the next stage or stages commences. Generally, one excavator fleet will remain mining ore and associated waste while the other excavator fleet(s) commences mining waste in the subsequent stage(s).

The annual material movement in tonnes for each pit stage is shown in Figure 2-11.

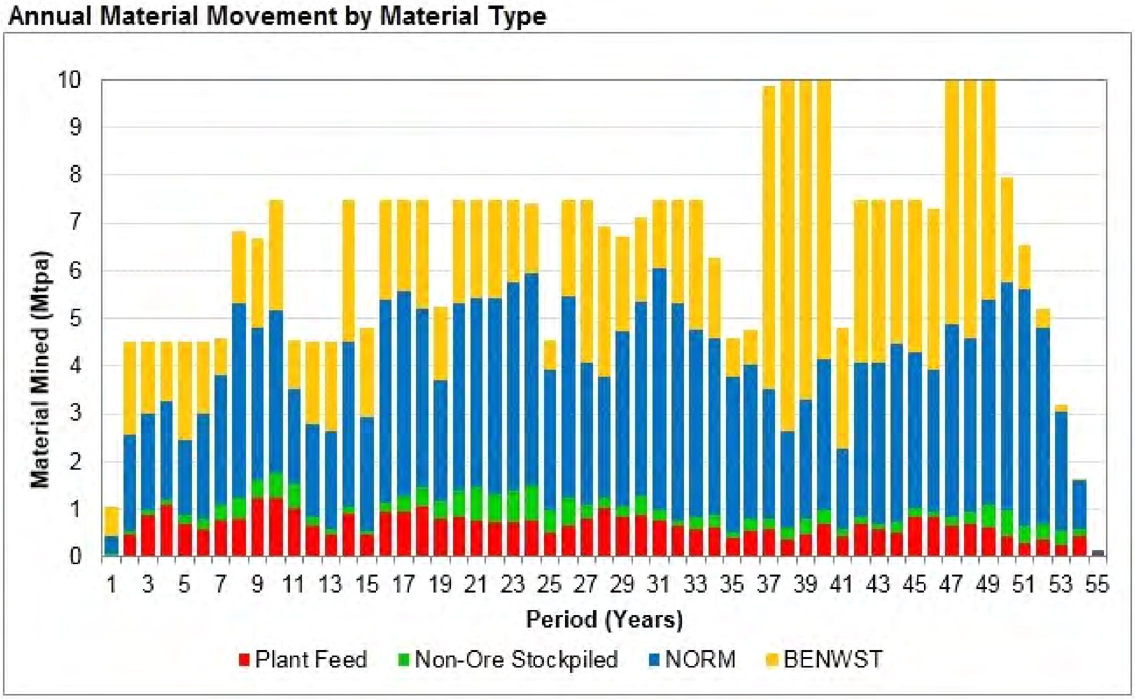


Figure 2-10 LOM production profile – material mined (Source: AMC 2017)

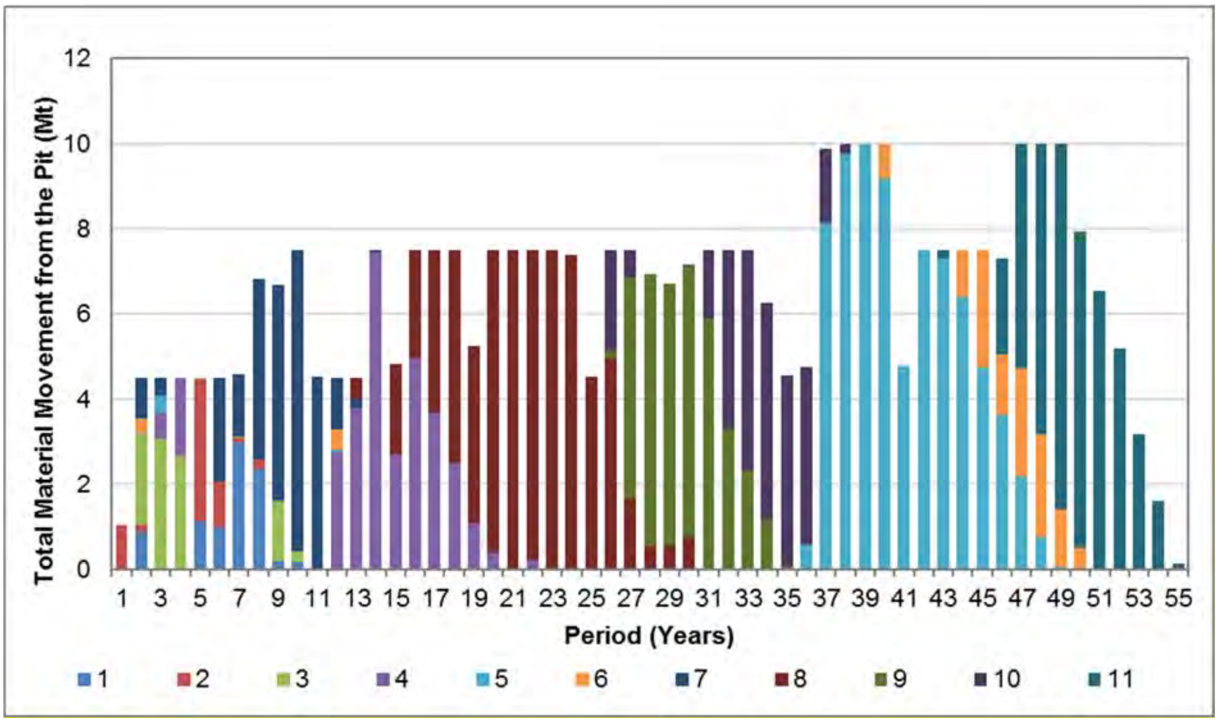


Figure 2-11 LOM production profile – pit stages

2.5.6 Mining fleet

The mining fleet required for the new planned production scenario will be similar to that described in the EIS. The final configuration will be available when the DFS is completed and firm material movement are known and have been provided to mining contractors for assessment. Mining will still consist limited blasting of waste rock and ore and use of dozers (49 t CAT D9T), graders (CAT 16M) and excavators (108 t Hitachi EXI 200). The ore and waste rock are loaded in the pit by excavators, into haul trucks (90 t CAT 777F). The haul trucks are used to transport material out of pit to either:

- The concentrator ROM or LTS.
- One of up to five WRDs (variable locations).

The primary and auxiliary mining fleets for 14,000 tpa TREO are shown in Table 2-8 below. Truck allocation to each of the excavators is dynamic, will depend on the ore and grade requirements, and ore exposures at any point in time i.e. as the ore haulage is from deeper parts of the pit and on a longer haul lead to the ROM pad, the ore excavator will require more trucks than the waste excavator(s).

On average, when the excavator fleet is at its peak, truck allocation would be four trucks allocated to the ore excavator and three trucks each to the waste excavators with a single truck under maintenance or being serviced.

Table 2-8 Mining equipment

Type	Make and Model	Class	Activity	Peak Number
Excavators	Hitachi EXI 200	108 tonne	Load-and-Haul	3
Trucks	Caterpillar 777F	90 tonne	Load-and-Haul	11
Dozers	Caterpillar D9T	49 tonne	Auxiliary	3
Graders	Caterpillar 16M	16' blade	Auxiliary	2
Service Truck	Man 6 x 6	-	Auxiliary	1
Water Trucks	Man 6 x 6	-	Auxiliary	2
Rock breaker	Caterpillar 336DL	-	Auxiliary	1
Lighting Plant	Allight	-	Auxiliary	12
Front End Loaders	Caterpillar 990H	-	Auxiliary	2
Light vehicles	Various	-	Auxiliary	22
Surface Crawler Drill	Sandvik DP1100	89 mm dia. hole	Blast Drilling	6
RC Drill	Atlas Copco RC 127	127 mm dia. hole	Grade Control	1
Dewatering Pump	Chesterton	-	Dewatering	3

2.6 Processing

2.6.1 Overview

The Nolans process configuration changes do not alter the overall envelope size of the three geographical and processing categories as described below in Figure 2-12.

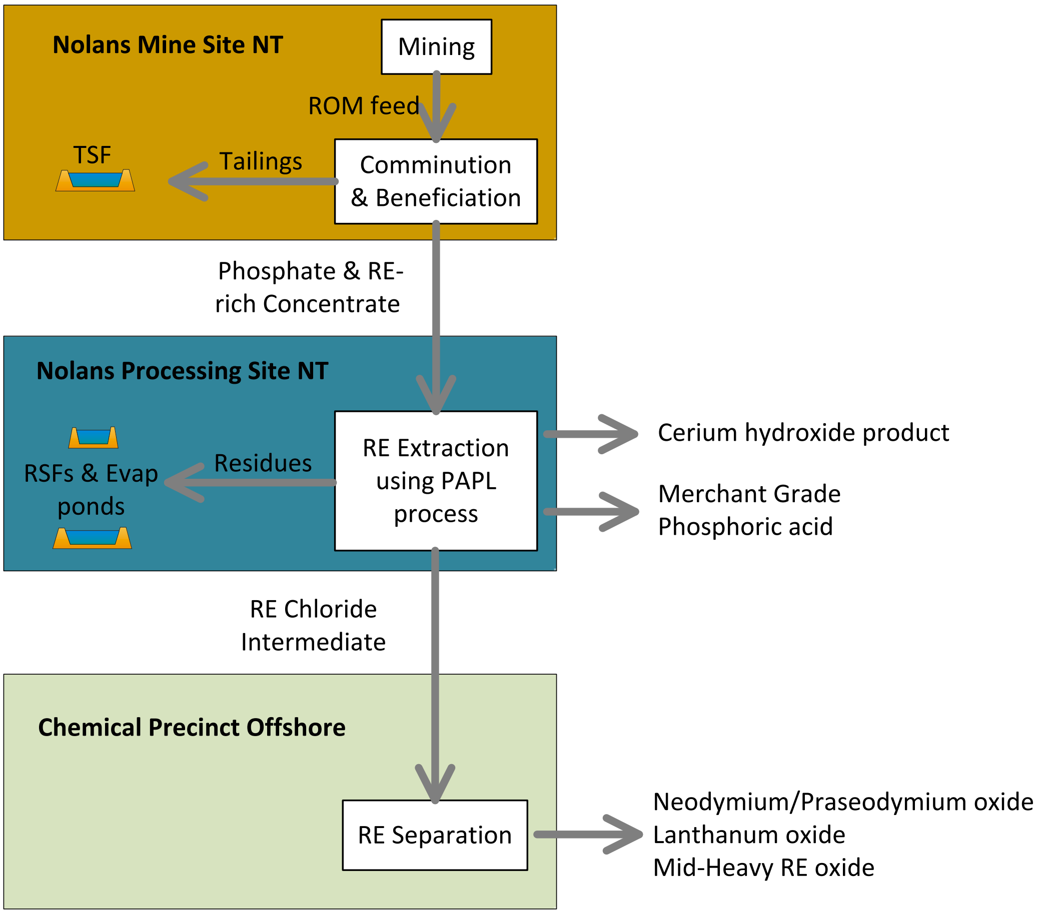


Figure 2-12 Process configuration

2.6.2 Mine site processing

Waste rock will be hauled from the pit to the planned WRD designated for that stage of the pit.

Mining operations will deliver broken ore to a ROM pad (from which a front-end loader (FEL) will feed the crushing circuit). This FEL may also transfer non-PAPL preferred ore to a long-term stockpile. Plant feed is mined from the open pit mine and stockpiled on the ROM pad adjacent to the primary crusher. The ROM plant feed is rehandled once and is processed soon after being mined.

Some lower grade material mined during the early years of the project is stockpiled off the ROM pad in the area shown of Figure 2-3. From there it will be rehandled twice – once from stockpile to the ROM, and again from the ROM to primary crusher as a blend with higher grade material. Non PAPL preferred material will be placed into WRD 2 for storage and future recovery or rehabilitation if long term processing of this material is not completed.

The concentrator comprises a comminution and beneficiation circuit (Figure 2-13). Comminution includes a single stage primary crushing circuit fed by front end loader. Crushed ore is then conveyed to either an autogenous or semi-autogenous mill for grinding. The final mill type will be determined during planned comminution test work in late 2017.

In the beneficiation circuit, crushed and ground material is passed through a cyclone cluster where the coarse material is recirculated to the mill and the fine material, <150µm moves through to a series of flotation cells where the gangue minerals are separated. The mineral concentrate from the flotation circuit is then pumped by an overland pipeline to the processing plant.

The reject from this flotation circuit is then pumped a tailings thickener to improve solids density and recover process water. The solids slurry is then pumped to a beneficiation TSF at the mine site where a water recovery system will recover additional supernatant water from the surface of the TSF and from the underflow recovery system for recycle back into the beneficiation process. Around 25% of the radionuclides in the ore will be removed during the beneficiation process and will be deposited within the tailings storage facilities.

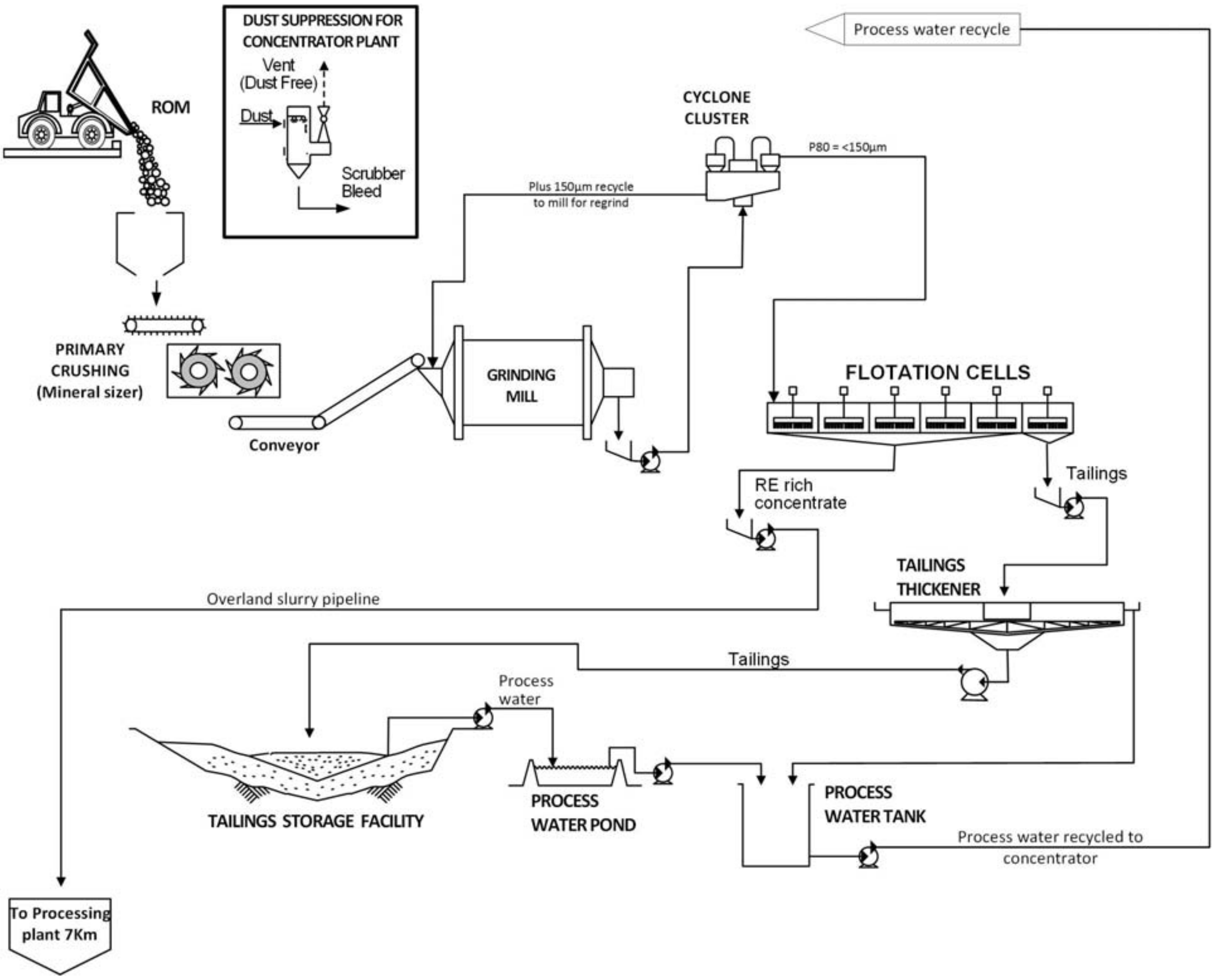


Figure 2-13 Concentrator circuit

2.7 Processing site

The processing site is located about 8 km south of the mine site and hosts RE extraction processing units, a sulfuric acid plant, a phosphoric acid plant, RSFs, evaporation ponds and other infrastructure to support the operation.

Concentrate will be pumped through an overland HDPE slurry pipeline from the concentrator to the processing site. The slurry pipeline will run above ground within a compacted earth bunded corridor, with event ponds located at low points along the pipeline alignment.

The ponds will be sized to contain a four-hour pipeline failure with contingency for a 1:25 year 72-hour rainfall event. The pipeline will have monitoring instrumentation installed which will be monitored from the plant control rooms for failure using both pressure sensors and flow meters. Additionally, the line will be visually inspected twice per 24-hour shift.

Centrifugal pumps, arranged in series will be utilised to pump the concentrate slurry along the pipeline. The pump arrangement has been specified for a head of 198 m, the primary component of which is friction losses within the pipe. The difference in elevation between the mine and the processing plant is about 15 m vertical for around 8 km of the pipeline, however a ridgeline at around the 5-km mark from the beneficiation plant the pipeline rises about 60 m vertically above the mine site over a ridgeline before running down to the processing plant. ,

The processing plant comprises the following major processing facilities (Figure 2-2):

- Phosphoric acid pre-leach (PAPL). (New process since EIS).
- Phosphoric acid plant. (New process since EIS).
- Water leach circuit (refer Section 2.7.3 below). (No change from EIS).
- RE chloride intermediate and cerium hydroxide production. (Modified process).
- Phosphoric acid storage. (New process since EIS).
- The processing plant is a continuous processing circuit comprising a number of components. It has several ancillary plants associated with it, such as a sulfuric acid plant, steam and gas power generation and water treatment as well as other infrastructure and services. The overall footprint of the PAPL processing complex is similar in size to the SAPL plant described in the EIS.

2.7.1 Phosphoric acid pre-leach (PAPL)

A high-level comparison between the SAPL process presented in the EIS and the PAPL process now proposed is shown in Table 2-9.

Table 2-9 Comparison of SAPL processing and PAPL processing (now proposed) (Source: Arafura)

	Previously proposed SAPL	Now proposed PAPL	Change
General			
Power demand (MW)[2]	18.5	12	-35%
Water demand (GL/annum)[3]	4.7	2.7	-57%
Waste rock (av. Mt /annum)	6.1	5.5	-10%
Tailings and process residues (Mt/annum)	4.62	2.26	-51%
Processing			
Mineral concentrate feed rate	454 ktpa	342 ktpa	-25%

	Previously proposed SAPL	Now proposed PAPL	Change
Process residues (dry)	1,090 ktpa	304 ktpa	-72%
Reagents			
CMC	184 tpa	101 tpa	-45%
Oleic acid	1,284 tpa	712 tpa	-45%
F8920	550 tpa	102 tpa	-81%
Sodium silicate	461 tpa	Not required	-100%
Magnesium Oxide (MgO)	75 tpa	5,535 tpa	+7280%
Sodium carbonate (Soda Ash) - dense	10,650 tpa	Not required	-100%
Barium chloride	22 tpa	5 tpa	-77%
Sulfur (solid)	87,990 tpa	57,880 tpa	-34%
Hydrochloric acid	28,710 tpa	15,563 tpa	-46%
Flocculant	268 tpa	85 tpa	-68%
Quicklime (CaO)	29,992 tpa	2,525 tpa	-92%
Caustic soda (dry prill)	26,442 tpa	801 tpa	-97%
Hydrogen peroxide (50%)	1,364 tpa	1,552 tpa	+14%
[redacted]	[redacted]	[redacted]	[redacted]
Carbonate	123,318 tpa	Not required	-100%
Other			
Diesel (average litres 4,992-3,300 Kl)	4,253	2,659	-37%
Grinding Balls	400	0	-100%
Products			
Cerium hydroxide (@53% TREO)	17,010 tpa	13,250 tpa	-22%
RE chloride intermediate (@42% TREO)	26,600 tpa	16,450 tpa	-38%
Phosphoric acid (@54% P_2O_5)	Not produced	110,000 tpa	-

Mineral concentrate is received from the concentrator as a slurry at the processing plant and following dewatering, is fed to the PAPL process stage. The PAPL process produces a solid and liquid feed. The solid feed, which contains the majority of the REs, is then dewatered prior to being transferred as feedstock to the sulfation process (Section 2.7.2).

The liquid feed is enriched in phosphoric acid but does contain a small amount of REs. This liquor is passed through a RE recovery process (to recover the REs for feed back into sulfation) and the barren phosphoric acid then goes to a regeneration process.

The regeneration process converts the calcium leached in PAPL back to phosphoric acid using sulfuric acid producing a gypsum by-product. The phosphoric acid is separated from gypsum by filtration. The gypsum will contain some thorium and is directed to the RSF via Neutralisation.

Most of the recovered phosphoric acid is recycled for use in the pre-leach phase of the PAPL process whilst the balance of the liquid stream is purified by Ion Exchange (to decrease uranium and thorium concentrations), then concentrated to produce a merchant grade phosphoric acid (MGA) product for storage, shipment and sale to domestic or international markets. The extracted uranium and thorium is directed to the RSF via Neutralisation.

2.7.2 Sulfation (acid bake)

The solid feed from PAPL together with the recovered REs from the liquors is sulfated (oxidised) using an acid bake process with concentrated sulfuric acid. This process assists liberation of the REs for subsequent processing and extraction.

2.7.3 Water leach

The sulfated material is leached with water, dewatered and washed to remove calcium and other impurities. The water leach liquor then moves onto a [redacted] (Section 2.7.4) whilst the solid residues are neutralised in an acid neutralisation process prior to final on-site disposal in the water leach RSF.

2.7.4 [redacted]

[redacted]

[redacted]

This mixed acid primarily consists of sulfuric and phosphoric acid, and contains virtually all of the uranium and most of the thorium leached in the Water Leach process step (Section 2.7.3). The sulfuric acid drives the Acid Regeneration phase of the PAPL process, and the phosphoric acid ends up in the MGA product. In the SAPL process (described in the EIS) the equivalent liquor is neutralised with limestone and lime to generate a significant solid waste stream (primarily calcium phosphate and gypsum). This is avoided by adopting the PAPL flowsheet.

2.7.5 Conversion to hydroxide

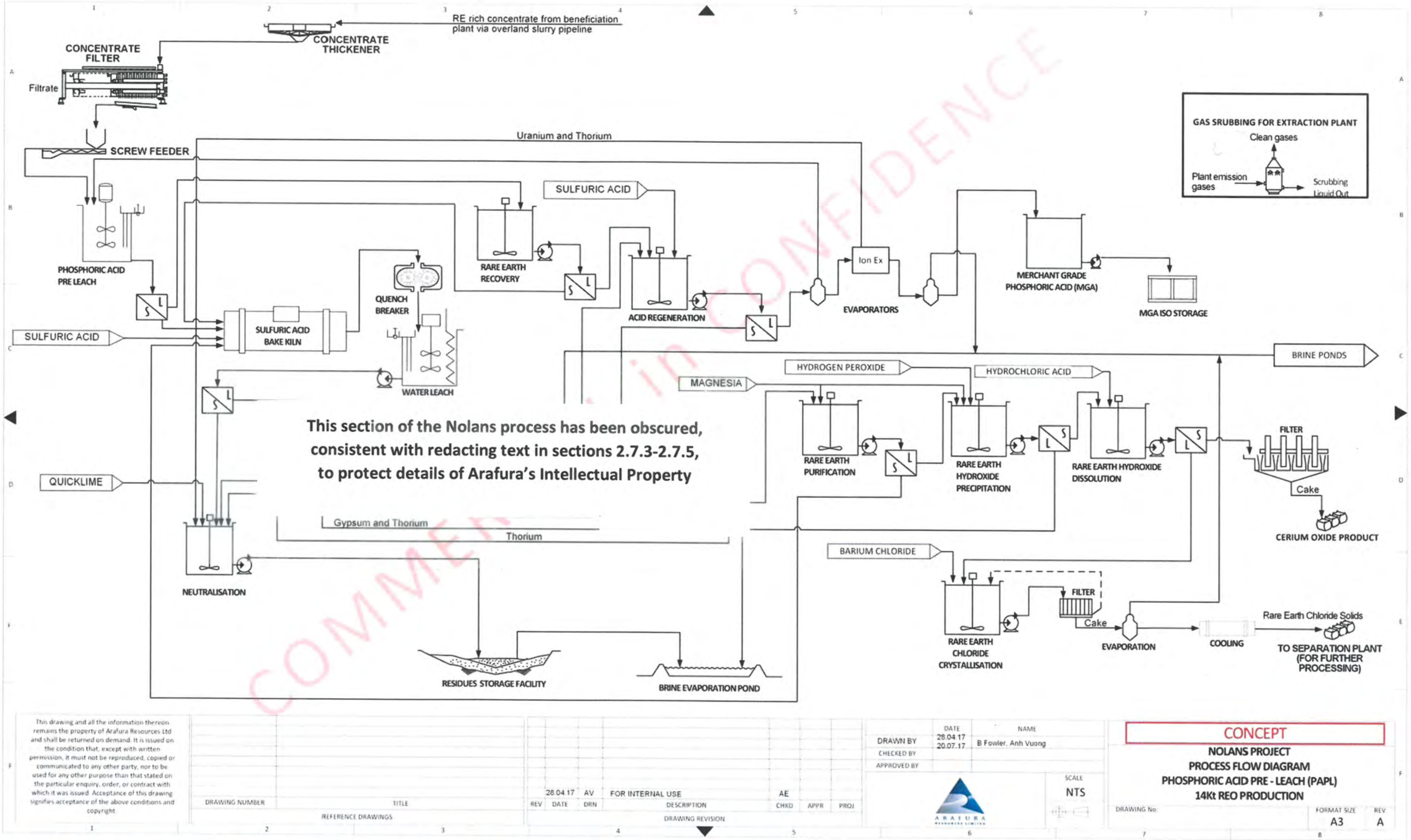
[redacted] The solid phase which contains thorium is neutralised and deposited in the RSF.

The [redacted] liquor is purified using magnesia with the resultant precipitate recycled to the Sulfation (acid bake) process stage.

The purified [redacted] solution is then precipitated as a rare earth hydroxide using magnesia. At this stage all the cerium (Ce) which is present as Ce^{3+} is oxidised to Ce^{4+} using hydrogen peroxide. This assists subsequent separation from the other REs to produce a cerium carbonate product during intermediate-stage processing. The resultant slurry is filtered and washed prior to hydroxide dissolution (Section 2.7.6). The recovered liquor is directed to the Brine Evaporation Pond.

2.7.6 Hydroxide dissolution

The dried RE hydroxide undergoes a selective re-leach with dilute hydrochloric acid to produce a mixed RE chloride liquor containing low levels of cerium. As the cerium is predominantly in the oxidised Ce^{4+} state it remains relatively insoluble in the solid phase during this selective re-leach process. The Ce product is extracted and will be packaged and transported to market. The remaining RE Chloride is then purified in one last stage utilising a barium chloride to produce the final RE Chloride intermediate product for further processing at the offshore separation plant.



This section of the Nolans process has been obscured, consistent with redacting text in sections 2.7.3-2.7.5, to protect details of Arafura's Intellectual Property

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Figure 2-14 RE extraction circuit (Source: Arafura 2017) COMMERCIAL IN CONFIDENCE

2.7.7 Intermediate processing products

The RE chloride will leave the processing site in bulk bags and stored within standard shipping containers for transport to Alice Springs by road and then onto the Port of Darwin via rail for export.

The cerium product may be directly packaged as a low-grade cerium hydroxide product, or further treated to remove the residual impurities from unreacted magnesia as a chemically stable residue which would be sent to the on-site neutralisation RSF. In the case of further purification, the cerium-rich liquor is precipitated by the addition of sodium carbonate to produce a cerium carbonate product.

The third product, a merchant grade phosphoric acid will stored in site storage tanks and then decanted into Isotainers for road transport to Alice Springs; and then onto the local market or to the port for shipment to the international market.

2.7.8 Chemical precinct

Rare earths will be separated into final products at an offshore separation plant.

The separation plant will be subject to a separate approvals process and is excluded from the scope of this EIS.

2.8 Power demand

The power demand for the Nolans site has been revised downwards from the EIS due to a simplified mine and concentrator circuit. Supply and distribution logistics remain relatively unchanged. The revised demand has been estimated from detailed load lists for the mine and concentrator, processing plant and infrastructure assets including accommodation village and water supply (Table 2-10).

Table 2-10 Power demand summary

Area	Power Demand (kW) (Presented in EIS)	Power Demand (kW) (now proposed)
Mine and concentrator	9,000	2,500
Processing plant	8,000	8,000
Accommodation village, bores, water transfer, potable water, sewage	1,500	1,500
Total	**18,500**	**12,000**

2.8.1 Power supply

There is no local grid supply opportunity in the region. Power demand will be serviced by cogeneration from the small sulfuric acid plant and gas fired on-site generation located near the processing site, adjacent to the natural gas pipeline corridor. The distance from the gas pipeline will be determined in consultation with the gas pipeline operator.

The sulfuric acid plant associated with the processing plant will generate power via a steam turbine from the steam arising from burning sulfur. This is a common feature of sulfuric acid plant design.

Acid plant vendor supplied information indicates that the new smaller sulfuric acid plant now proposed should deliver a net power output of approximately 4-6 MW over and above its internal consumption requirements.

The project will require additional power over and above that available from the sulfuric acid plant and it is planned that this will be generated by a gas turbine facility located adjacent to the processing site which is situated and adjoins the natural gas pipeline corridor within the processing plant mining lease. The facility will also maintain site operating capability during acid plant or steam turbine/generator outages i.e. maximum power output of 12.5 MW.

The load and generating capacity from the waste heat of the sulfuric acid plant leaves a normal operating natural gas fired generation requirement of approximately 8.5 MW. This is expected to provide the optimum steam/power demand flexibility for the site.

The Amadeus Basin to Darwin high pressure gas pipeline is adjacent to the Nolans site. Arafura has engaged in discussions with the pipeline operator and a number of existing and prospective gas producers regarding a long-term gas supply opportunity for the project. The close proximity of the Nolans site to the gas pipeline eliminates the need for a significant offtake connection pipeline. The supply capacity and capability easily exceed the project's process gas demands.

In addition, emergency diesel generators will be located at three of the principal Nolans site areas (mine site, processing plant and the accommodation village) to maintain safe emergency power requirements for personnel, and safety critical drives and personnel safety in the event of a major power outage. Processing plant emergency generators will also provide black start capability.

While the processing plant is under construction, power will be generated at the accommodation village using diesel or gas generator sets which will also provide it with longer term emergency backup power.

2.8.2 Power distribution

The power plant will be located at the processing site adjacent to the sulfuric acid plant. The site layout requires overhead powerlines to distribute power to infrastructure at the processing site, the mine site (approximately 8 km north of the proposed generation facility), the raw water collection pond, the accommodation village (approximately 5 km south east of the proposed generation facility) and potentially the borefield pumping station area (approximately 13 km south west of the proposed generation facility).

High voltage (HV) overhead lines from the processing plant to the site users via kiosk substations will transmit the power. In total, there could be approximately 30 km of overhead lines.

The borefield service corridor to the raw water collection pond may include a HV overhead power line. The pipeline bore field pump stations could be fed from pole mounted transformers, while the pumps in the borefield pump stations will likely be powered by diesel generators. If a decision to distribute power to individual bores within the borefield is made, the length of power lines required would increase significantly but would only result in minor additional disturbance as the cleared corridors planned for overland water pipelines could accommodate powerlines by placing the powerlines on the cleared margin of the pipeline easement and access road corridor.

Power will be transmitted to the accommodation village by overhead high voltage (11 kV) conductors. At the village there will be a kiosk substation from where power will be distributed below ground at low voltage (415 V).

2.9 Tailings and residue management

2.9.1 Configuration

The improved PAPL process and reduced production rate has reduced the volumes of material reporting to tailings and residue storage facilities (refer Table 2-2). The following data has been updated with data obtained from the August 2017 mining studies and, wherever possible, data generated from the company's extensive pilot programmes currently being undertaken.

The Nolans site requires tailings and residues storage facilities which include:

- A flotation TSF adjacent to the concentrator at the mine site (Figure 2-1).
- Separate water leach, neutralisation RSF, and evaporation ponds adjacent to the processing plant (Figure 2-2).

The LOM storage capacity and footprint of these facilities are summarised in Table 2-11 and Table 2-12 below.

The envelopes shown in Figure 2-1 to Figure 2-4 are larger than the LOM footprint areas represented in the tables below, to allow for future expansion of these facilities and extensions to the LOM should this be required.

Table 2-11 Tailings and residues storage

Facility	Embankment height (m)	Number of cells	Total footprint (ha)	Water storage capacity (Ml)	Tailings/ residue storage (Mt)
TSF	≈22	2	LOM ≈195	-	≈27 (dry)
Impurity removal residue	≈14	4-6	≈350	-	≈17 (dry)
Water leach residue					

Table 2-12 Quantities of tailings and residues

Facility	Slurry throughput (wet ktpa)	Slurry throughput (dry ktpa)	Slurry input (percentage solids)
TSF	.875	262	≈30
Impurity removal	≈915	304	≈33
Water leach			

Table 2-13 Other ponds

Facility	Embankment height (m)	Number of cells	Total footprint (ha)	Water storage capacity (Ml)
Evaporation pond	2.5	6	≈60	1,500

2.9.2 Design and operation

The TSF and RSFs will be designed and operated to maximise tailings and residue densities to enable effective closure long term. They will also have water and leachate collection systems incorporated into their respective designs. During construction, all materials being used in the construction will be placed, water conditioned and compacted to ensure that the design permeability criteria are achieved. This will minimise potential seepage during operation and maximise water return to the process.

In 2016, ATC Williams undertook a Flotation TSF Failure Impact Assessment, including a detailed population at risk assessment (excluding site personnel). The facilities were assessed as having an ANCOLD High C consequence category classification for the EIS. Since then this has been reviewed. When detailed design is completed a full assessment will be done and the appropriate rating will be applied which will be used to inform the design. This rating will influence aspects of the design, for example, freeboard containing a specific annual recurrence interval (ARI) and probable maximum flood (PMF).

Updated concepts for the TSF and RSF have been prepared. Figure 2-15, Figure 2-16 and Figure 2-17 from Appendix 2 illustrate the TSF configuration and embankments. The cell embankments will be constructed in stages. Figure 2-2 indicates the general arrangement of the process site including the RSF location. Figure 2-18 illustrates the RSF embankment zones.

The TSF will have a low permeability soil liner and the embankments will be constructed mainly from suitable mine waste material. This waste will be non-mineralised country rock. Decant water will be recycled to the processing plant. Any additional construction materials will be sourced locally from areas identified previously. A more detailed geotechnical evaluation will be completed prior to construction to locate the quantity of material required for construction. The total volumes of suitable liner materials for construction are minor compared to the bulk embankment requirements and will be subject to additional regulatory approval for extractive purposes.

The current RSF design incorporates a HDPE or low permeability soil liner system. The selection of liner system will be determined when representative tailings and residue material from the process piloting program being conducted throughout 2017, is fully assessed to inform and guide the storage designs.

The base and the inside batter of the tailings storage facilities will be lined with low permeability materials to reduce seepage vertically and laterally.

Low permeability materials will be sourced from site, conditioned and placed in layers for compaction. The material will be tested to obtain geotechnical parameters, and permeability to assess if the materials are suitable. Clay dominant material clay like material with minimum 1 x 10-8 m/s permeability will be placed in layers and compacted (refer to Appendix 2). The specified compaction for the low permeability materials is minimum 98% of the standard maximum dry density at – 1 to + 3% optimum moisture content. Compaction tests will be completed on each layer and minimum one test for every 500 m^3 compacted in place.

All storages will have water recovery systems and a monitoring system. The purpose of the water recovery system is to reduce the water head on the underlying liner and embankment and thus reduce potential seepage. The water from the collection system will report into a storage pond near the same facility and be pumped back to the concentrator or processing plant for reuse. Some water may not be recycled to the processing plant and will instead be evaporated due to the quality of the water and its detrimental impact on the operation and efficiency of the plant and process.

Seepage water could contain dissolved elements, which will be monitored in shallow seepage detection bores and piezometers installed within and near the toe of embankments.

Confirmatory detailed chemical characterisation of the process residues and tailings is ongoing throughout 2017 and will be completed when representative samples are available from the current process piloting program expected in first half of 2018. Samples of the first ten years of representative tailings material has undergone testing and this work confirms that the tailings are geochemically stable and not acid forming.

Residue streams from the previous test programs have been subjected to test work and returned results which indicate they are chemically stable. It is not expected that this will change as a result of the change to the PAPL flowsheet, however residues from the current piloting programs will be subjected to confirmatory testing once they are available.

The RSF design will incorporate a liner system but at this time the nature of the liner is not known however it will be incorporated into the planned detailed engineering design. Once all test work is completed and detailed engineering commences, the test work will be used to inform the liner design for these facilities. The life of a HDPE liner is between 20 and 200 years dependant on its application. Any proposed design concept would place greater emphasis on recovery and management of entrained water or seepage rather than containment.

The evaporation and sodium sulfate ponds will be lined with an HDPE liner. Excess process liquor plus RO plant reject will be directed to one of the evaporation ponds after which the flow will be directed to the next pond in sequence. Over time the liquor will concentrate through evaporation and the remaining brine in the cell will be pumped back to the impurity removal RSF to reduce the accumulation of precipitate in the evaporation ponds. The cell will then be available to receive excess process liquor for the next cycle.

Storage facility design drawings are presented in Appendix E of the EIS and updated concepts (including embankment heights and storage areas) are provided in Appendix 2.

The size and configuration of waste storage facilities may change with the reduced throughput scenario now proposed but the typical design features will remain the same. Design of the facilities presented are representative and capable of meeting the first 11 years of production. The concept presented also is capable of storing the LOM tailing and residue production but final design may alter footprints or embankment heights slightly following detailed site evaluation.

Completion of the current piloting program test work will enable detailed design to be undertaken.

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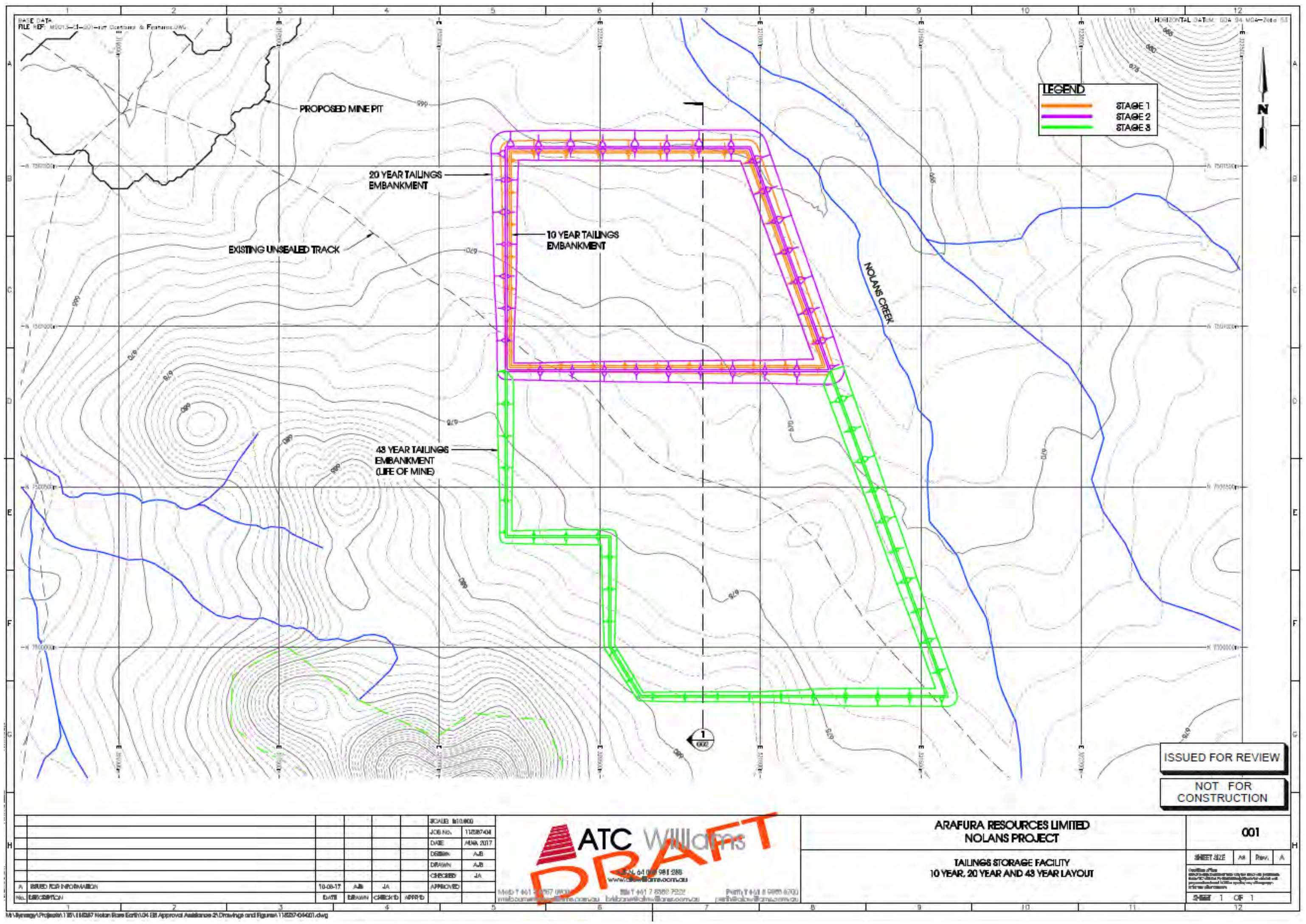


Figure 2-15 TSF layout

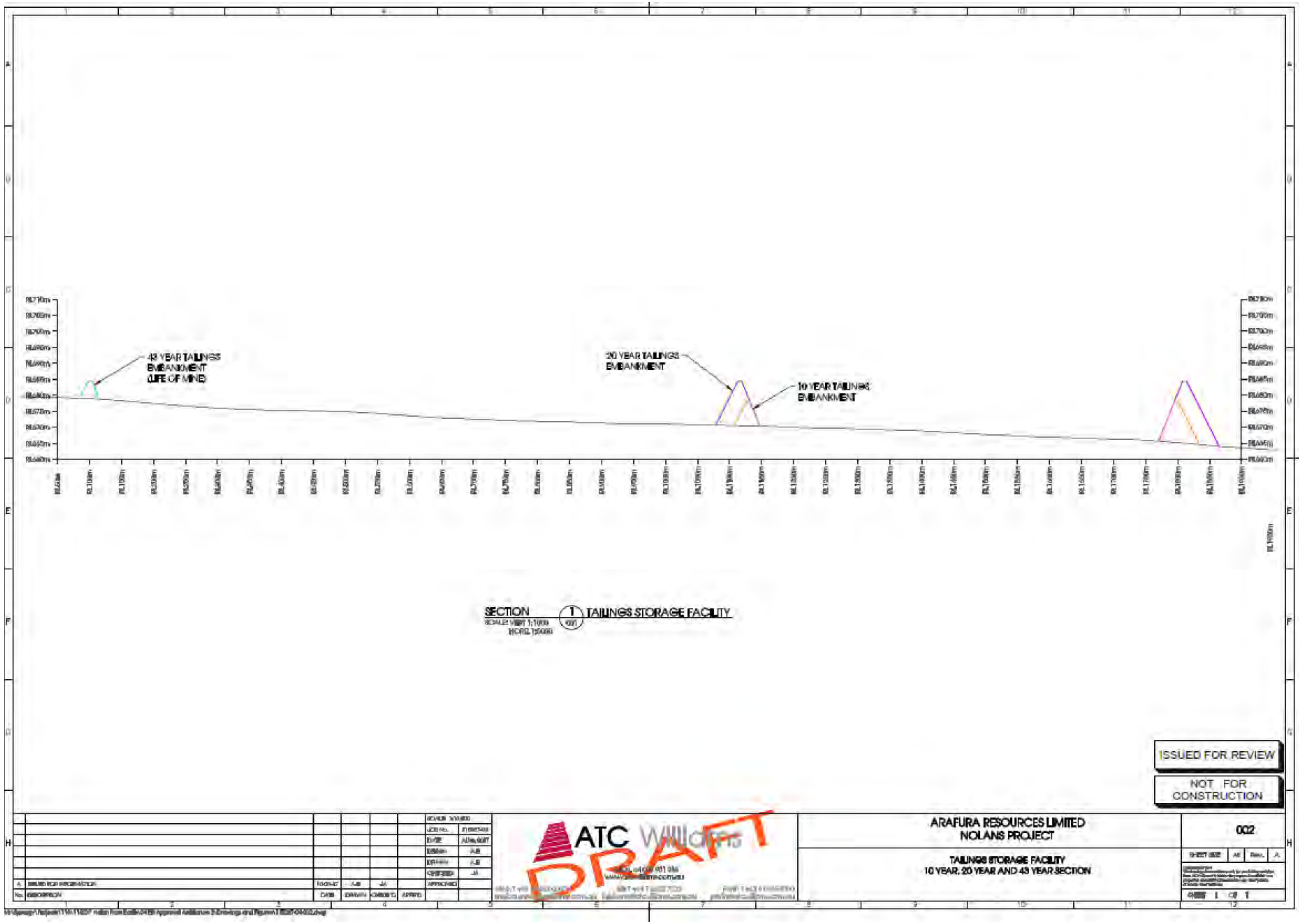


Figure 2-16 TSF Embankment Sections 10 year, 20 year and 43 year (Appendix 2)

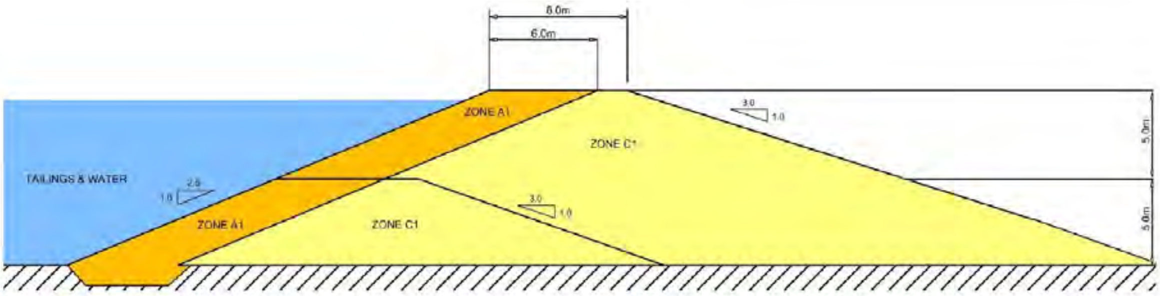


Figure 2-17 TSF embankment zones (Appendix 2)

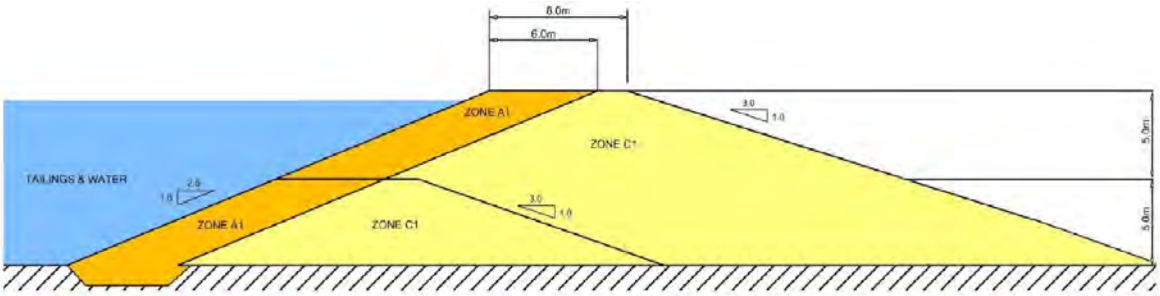


Figure 2-18 RSF Embankment zones (Appendix 2)

2.9.3 Monitoring and closure

Prior to operation, a monitoring program for the TSF and RSFs will be developed to monitor their performance and integrity during operation, and to assist management of these facilities post closure. This will include groundwater monitoring stations to ensure early detection of groundwater level and/or quality changes. Embankment piezometers and survey pins will be installed to monitor embankment stability and other parameters. Additionally, the facilities will be periodically audited by qualified geotechnical engineers to assess their integrity and check compliance with operational protocols.

If a multiple cell configuration is built it is proposed that the filled TSFs and RSFs will be progressively covered with a layer of benign stable rock during operations if practicable to limit the area of exposed residues or tailings. The thickness of the cover system and its design will be determined following additional test work. If a single cell module is selected, then it would not be possible to progressively cover the TSF and RSFs and they may remain uncovered until the site is rehabilitated. Progressive rehabilitation of the TSF and RSFs will be dependent on the configuration of the facilities. This will be determined during detailed design.

The TSF top surface and batters will be covered with top soil and then revegetated as per the intended final land use. Modelling of the proposed cover system will be completed to assess the net percolation rate and the available field capacity to sustain vegetation. Accumulation of percolated water above the clay liner located on the base of the TSF will be assessed, and the cover system adjusted to limit the development of a bath tub effect. The full details of the cover system are not currently available, and will be obtained during detail design.

Rehabilitation of surfaces would be undertaken once the area is available, of which the availability would be subject to final designed configuration of the storage facilities and operational access requirements.

Preliminary final land use is described in Section 6.2.2 of Appendix W, as livestock grazing and native grassland habitat for the WRD and TSF respectively). Cover systems would be designed to meet the final land use objectives. It is envisaged that the cover would consist of benign waste rock, low permeable material and a growth medium, of which the thicknesses will be obtained during detail design. The TSF and RSF will be covered with suitable materials and the cover system will be based on the outcome of pre-closure trials and investigations (refer Appendix W of the EIS

At closure, the TSF and RSFs will have a layer of at least two metres of benign waste rock placed over them to limit natural erosion and ensure long term security of the contained tailings and residues. Following closure of the facilities a modified monitoring program will be developed and agreed with regulators to monitor and manage the performance of these storage structures.

A draft tailings management plan is provide in Appendix A of Appendix 2. Locations of monitoring are generally not know with any certainty until the site is investigated, location selected and the design finalised. All this will be available prior to authorisation for inclusion in the mine management plan (MMP) for approval prior to operations and construction.

2.10 Wastes and hazardous material

2.10.1 Waste rock dumps

The revised mining schedule which resulted from the recent mining study has reduced the number of waste rock dumps (WRD) from six to five as presented in the EIS. The improvements are reported below based on the 2017 resources model and 14,000 tpa TREO production output in Table 2-14. Potentially the WRDs will receive a LOM waste quantity of around 133 Mlcm of waste rock.

Table 2-14 Waste Rock Dumps (volume and footprint)

WRD No.	Volume (Mlcm) presented in the EIS	Volume (Mlcm) now proposed	Footprint (ha) presented in EIS	Footprint (ha) now proposed
1	77.14	68.1	212.61	212.1
2	26.87	18.8	101.64	99.9
3	14.30	5.5	68.22	33.7
4	22.60	22.7	99.19	80.0
5	14.57	6.6	70.36	34.4
6	4.11	not required	38.04	not required
Total	**159.9**	**133.0**	**590.06**	**460.1**

The change in the WRD volumes and footprint is a result of the change in processing which produces less waste rock, subsequently reducing the footprint.

Waste rock will be hauled to the active WRD from the pit stage being mined at that time. The revised locations of the WRDs are shown in Figure 2-1.

WRD design criteria is summarised in Table 2-15 (and are the same as presented in the EIS).

Table 2-15 WRD design criteria

WRD design parameter	Quantity
Lift	10 m
Overall face angle	16 ^{o}C
Berm width	5 m
Road gradient	1:10
Road width	35 m
Stand off from pit crest	50 m
Maximum WRD height (to maximum RL)	50 (~730) m (mRL)
Swell factor	30 %

The concept for WRDs currently consists of the following:

- WRDs will be constructed to a height of about 50 m above the land surface possibly built in 10 m lifts. These maybe interspersed with 5 m-wide berms. Recent estimates provided in the mining Layout study indicate that the number of WRD can be reduced if the dump height is increased. This will be further investigated during the DFS when the final mining schedules will be available.
- Benign waste rock (i.e. NAF waste rock) will be stored in stable dump landforms allowing infiltration of rainfall, with non-erodible outer batter slopes. Geochemical and leachate testing completed to date confirms waste rock is low risk for AMD which supports the rainfall infiltration approach is appropriate.
- Waste rock (and tailings) containing radionuclides will be covered with a minimum of 2 m thick inert waste rock to reduce the emissions of radiation and radon. WRDs will be built with an outer skin of benign waste rock and the NORM waste rock placed below this skin.
- There is potentially a very small amount of PAF waste rock, which is intended to be isolated and encapsulated into a designated area within the WRDs and covered with a low permeability cover. The cover will be designed to prevent infiltration of water and oxygen.
- It is estimated that around 66 Mlcm (129 Mt) of benign waste will be mined in the LOM schedule. The 66 Mlcm is based on a conservative estimate and is likely to increase. The benign waste rock requirements for covers for the LOM are around 16.4 Mlcm.
- Clean water diversion drains will be constructed around the WRDs.
- A swell factor of 30% has been applied to designs. With dump truck traffic compaction and consolidation over time, this may actually be closer to 25% in operations. Therefore, a swell factor of 30% is expected to be an upper limit and to provide a safety margin in WRD design capacities.

A program of waste rock assessment and design will be undertaken soon after mining commences to evaluate the physical properties of the waste rock lithologies.

The final landform design will be determined when representative waste rock is available from the mining process for test work which will inform final design.

WRD design criteria are presented in Table 2 16 and provide an indication of the approach and framework to further develop the WRD design and management at various stages of the project.

It is proposed that each stage involve regulator engagement at the front end (e.g. planning of investigations and detailed design work) such that stakeholder feedback can be accommodated and investigations, plans and designs are in line with regulator and other stakeholder expectations.

A total storage area of about 114 ha has been set aside for topsoil storage (Figure 2-1). Top soil storage will be progressively stripped ahead of WRD construction and key infrastructure construction. This should ensure that topsoil remains viable, storage time will be kept to a minimum and top soil wherever possible will be used progressively as WRD outer batters are reshaped to design and are progressively rehabilitated. It is not possible to estimate storage times until the final mining schedule is available and waste rock movements are known to allow material movements into WRDs to be planned.

Table 2-16 WRD design scopes

Design input	Scope / Purpose	Potential Objectives	Timing
Waste geochemical classification and leachate testing	Further define the waste types and expected leachate to confirm the EIA phase work. Use waste geochemical classifications to update the block model. Refine the design concept for the WRDs e.g. confirm infiltration for benign WRD is appropriate.	Based on results to date, it is expected that the majority of waste produced will be benign. Therefore, an overall design concept allowing infiltration is not anticipated to adversely impact surface water and groundwater and could be considered further in design. Waste types that are not benign, with metalliferous or saline leachate potential, will be isolated (based on the block model and inpit waste characterisation, as per the waste management plan). Undertake designs to: • Encapsulate waste including a base liner for reactive material with low permeability inert clay (or artificial liner pending material availability). • Develop water management and drainage design (likely to include diversion of surface water runoff, minimise infiltration through compaction during operational phase, collection of seepage in collection dam at toe).	Mining management plan Testing continued throughout the operational phase (as per waste management plan)
Waste schedule	Using geochemical classifications input to the block model to quantify the volumes of each waste type and waste mining schedule. Provide input for waste dump staged development and rehabilitation over time.	Quantification and timing of waste types will inform when and how WRD's are developed. The resource requirement and timing for external materials will also be defined at a concept level, e.g. topsoil, low permeability materials and closure material resource investigation (UID 82).	Mining management plan Ongoing throughout operational phase
Waste geotechnical classification	Geotechnical testing program may include: drilling with core sampling, laboratory testing of undisturbed / bulk samples of waste and WRD foundation, including strength, durability, and material classification. Testing program outcomes to be utilised in dump stability, erosion and closure modelling, to refine the dump geometry.	The concept waste dump designs allow for lower batters of approximately 7 degrees (8H:1V), and upper batters of approximately 18 degrees (3H:1V). Based on hard, durable waste rock, this is considered conservative and appropriate for this stage of the design. Detailed geotechnical classification will allow for refinement of the geometry, where suitable it could be likely to steepen the overall batter profiles and thereby reduce the overall waste footprint. Any materials found to be of low strength / durability will be incorporated into the overall design by placement within the dump footprint a certain	Detailed Design - prior to mining

Design input	Scope / Purpose	Potential Objectives	Timing
		distance from the external batters, to be determined by stability modelling in detailed design.	
Foundation geotechnical investigations	Geotechnical testing program may include: test pits, drilling with core sampling, laboratory testing of undisturbed / bulk samples, including strength, permeability, and material classification. Outcomes of program to be used in the dump foundation design and overall stability.	Foundation investigations may find the following: • Areas of low strength material that require removal. • Areas of high permeability / fractured rock for which there may be a requirement to address, e.g. provide low permeability base layers to facilitate drainage to appropriate areas, or alter the dump footprint. • High strength foundations, providing a basis for stability to improve the overall dump geometry. • Materials that may be utilised for civil earthworks construction, dump cover materials, etc.	Detailed Design - prior to mining
Construction and closure material resource investigation (UID 82)	Geotechnical investigation to include: test pitting to log materials / take in-situ tests and bulk samples, laboratory testing program to assess material types, strengths, permeability, dispersion potential, soil nutrients, etc. Identify, classify and quantify materials that may be used in construction, operations and closure activities. Material balance to compare availability with design requirements. Designate stockpile areas and handling requirements for such materials.	Material balance to quantify the availability of suitable resources for incorporation into the WRD (and TSF/RSF) design against materials required for proposed designs, and identify potential shortfalls. For example, where a low permeability base / cover is required for a TSF and site resources are deficient in this material, an alternate could be sourced where appropriate i.e. artificial liner such as a geosynthetic clay liner (GCL) with protective cover material. The material balance not only confirms sufficient volumes are available to meet design but also allows closure resources to be tracked throughout life of mine such that they are best utilised and adequately/efficiently managed e.g. topsoil or low permeability material won from pit or infrastructure stripping is stockpiled in an appropriate location/manner for reuse.	Detailed Design - prior to mining
Transient surface water / dump seepage modelling	Update / calibrate water management around WRDs based on the final mine plan / site collected data / geotechnical / geochemical classification. Refine WRD seepage models' accuracy to optimise drainage and storage designs.	Refining the surface waste management plan enables informed development of surface water diversion designs around WRD footprint including; diversion sizing and detailing, materials required, alignment, operational requirements (e.g. construction methodology, offset distances from diversions). Refining the seepage models will provide a basis for WRD infiltration and storage cover design requirements to support revegetation and erosion control.	Detailed Design - prior to mining. Model refined with data during operational phase

Design input	Scope / Purpose	Potential Objectives	Timing
Erosion and closure modelling (UID 321)	On-site trials/monitoring for erosion and potential sediment load from waste dump development and proposed final landform arrangements. Trials/monitoring could include; photographic, survey, sediment load measurements from trial slopes. Provide validation of design assumptions or a basis for further design requirements. Data used to inform Landform evolution model (Siberia or equivalent) for WRD design to assess long term erosion (1,000 years).	Trials to provide data to undertake landform evolution model to confirm that assumptions are acceptable and final dump profiles do not result in significant erosion of the inert cover and / or sediment loads. Alternatively, provide a basis of design for further requirements, such as more selective use of waste rock, or geometry modification.	Operational phase

2.10.2 Naturally occurring radioactivity

This section has been updated to provide additional data received as a result of Arafura's beneficiation pilot programs.

The area of the Nolans Bore deposit, including both the surface layers and the mineralised layers, contains elevated concentrations of naturally occurring uranium and thorium. Higher uranium and thorium concentrations are associated with the RE mineralisation.

Arafura's understanding of the distribution of radioactive elements within the deposit is based on extensive monitoring of drill samples collected during many years of exploration and investigation. Every drill sample has been radiologically logged using hand held Geiger counters. Additionally, more than 56,000 m of drill holes have been radioactively logged using calibrated downhole gamma logging. This dataset together with the rock assays has been used to provide a robust estimate the radioactivity of the project's waste rocks.

Figure 2-19 illustrates the grade-tonnage curve of the Nolans Bore deposit based on the 2012 LOM pitshell. It illustrates that around 145 Mt of waste rock is below 1Bq/g. 1Bq/g or below is benign waste. Arafura estimates that around 45% or 142 Mt of all waste rock will classified as benign, thus providing a significant resource for rehabilitation and construction.

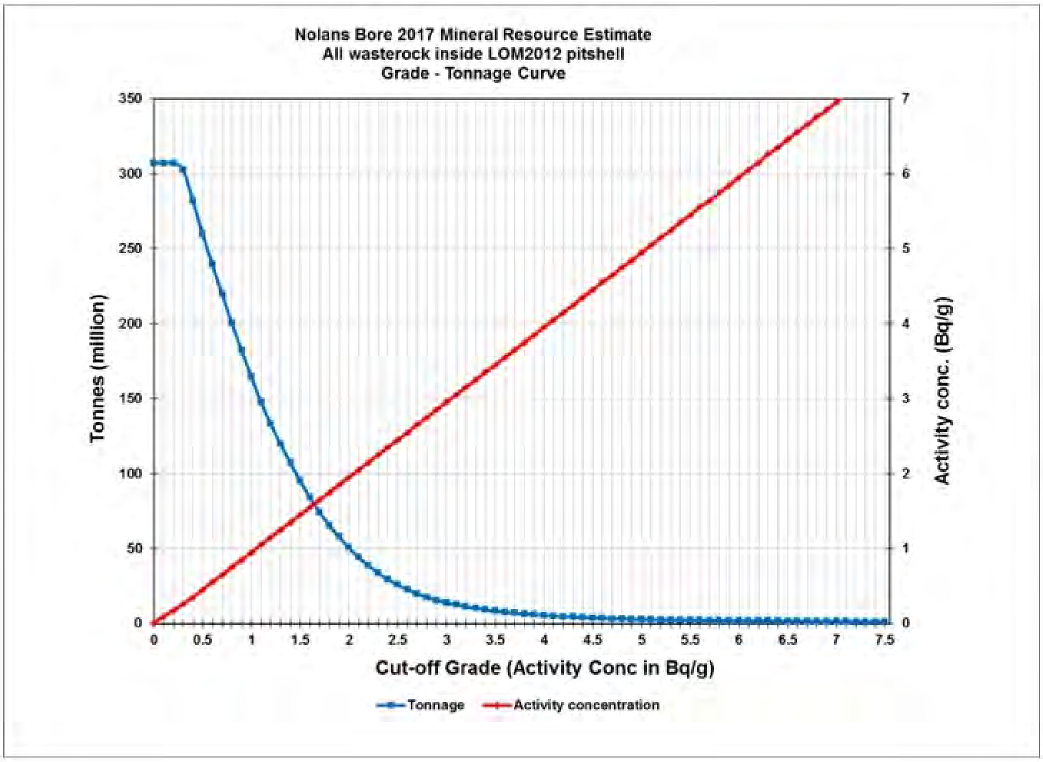


Figure 2-19 Activity concentration grade-tonnage curve for the waste rocks at Nolans Bore* (Appendix 16)

*based on the 2017 Mineral Resource model and the 2012 LOM pit shell. The values reported here will be slightly different for 2017 LOM pit shell when available however they are likely to be similar.

Table 2-17 Quantities and the radioactivity of the waste rocks for the 2017 Mineral resource model within the 2012 LOM pit (Appendix 16)

	Inside LOM12 pitshell						
Unit	**Tonnes below soil**	**Average activity in Bq/g**	**Maximum activity in Bq/g**	**Tonnes below 1Bq/g**	**Tonnes above 1Bq/g**	**Tonnes above 2Bq/g**	**Tonnes above 5Bq/g**
Gneiss	220,000,000	1.1	16.4	114,800,000	106,200,000	31,300,000	2,400,000
Pegmatite	50,000,000	1.7	14.7	3,500,000	46,500,000	15,100,000	100,000
Schist	37,000,000	0.9	7.6	24,100,000	12,900,000	4,200,000	200,000
All waste rocks	**307,000,000**	**1.2**	**16.4**	**24,500,000**	**164,500,000**	**50,600,000**	**2,700,000**
% of all waste rocks	100			46	64	16	1

The quantities reported here will be slightly different for 2017 LOM pit shell when available however they are likely to be similar. Note number may not compute due to rounding.

Arafura has conducted radiological monitoring (environmental and personal) since commencement of exploration work in the mid-2000s. Arafura also acquired a detailed low-level airborne radiometric survey over the project area for environmental purposes to determine natural baseline conditions. This airborne survey is robust and has been verified against specific environmental monitoring sites. This has enabled Arafura to characterise the natural background radiation levels, including elevated levels of uranium and thorium associated with the project, and to develop appropriate management practices (details of the existing background levels are provided in Chapter 12 of the EIS).

The project does not intend to extract and recover uranium and thorium for commercial sale. Consequently, any uranium, thorium or their radioactive decay products (known as radionuclides) in the ore are considered to be impurities, requiring removal. The rejected radionuclides will be part of the project’s waste streams that report to either the TSF or RSFs.

Recent results of Arafura’s beneficiation piloting program confirms that about 25% of all radionuclides will report to the TSF during the beneficiation process. The remaining 75% will report to the processing plant where they will be removed to the RSFs in the RE extraction processes. It is anticipated that some uranium will report to the phosphoric acid product but the accurate deportment will not be available until all current piloting phases and subsequent analysis have been completed at the end of 2017. The phosphoric acid will be subjected to purification removal to ensure it meets customer specifications. Any recovered uranium from this process will be disposed via residue streams into the RSFs.

During operations waste rock will be mined that has variable radionuclide concentrations, some exceeding 1 Bq/g. Despite this radioactivity being naturally occurring, it triggers the ARPANSA guideline requiring it to be managed as low-level radioactive waste material and therefore is subject to control (ARPANSA 2015). Any waste rock that exceeds 1 Bq/g will be encapsulated during operations and be progressively covered with inert waste rock material. This rock coming from the mining operation will be classified into its respective category (radioactive or benign) by the truck passing under a radiation discriminator. The sensor will direct the driver to the appropriate dumping location within the respective WRD.

The current radionuclide concentrations through the operation's processing circuits and in the tailings have been determined through previous test work undertaken by ANSTO Minerals. This is described in Chapter 12 and Appendix P of the EIS. Arafura is planning to repeat a radionuclide deportment review on tailings and residues when the current piloting program is completed, around the end of 2017. This review will be used to inform plant design.

At closure, the TSF and RSFs will be covered with sufficient inert waste rock material to ensure that the underlying tailings material is secured from erosion and that radiation levels are less than 1 Bq/g at surface.

As part of the environmental impact assessment, the radiological impact of the operations on workers, the public and the environment has been assessed and is addressed in Chapter 12 of the EIS.

2.10.3 Potential acid forming material

Acid forming material risk assessment and management is addressed in Chapter 8 and Appendix L of the EIS. Acid and metalliferous drainage assessment. The assessment reveals that both the orebody, waste rock, tailings and residues contain very low sulfur content (see Table 2-18 below) and in addition have neutralising capacity in most lithologies and waste streams. The static and kinetic AMD and geochemical testing indicates that the proposed waste rock, ore and pit wall material has a low risk of generating acidic, metalliferous or saline leachate.

The assessment used samples selected across the lithologies and spatially in a vertical sense to ensure they are representative of the deposit and associated waste lithologies. In total Arafura has completed >99,000 m of drilling and costeans from which these samples were collected. More than 29,000 geochemical assays have been completed, and of these over 4,700 have been used to estimate deleterious elements within the resource model. In addition to these analyses several thousand local and regional geological observations have been recorded to underpin Arafura's understanding of the geology.

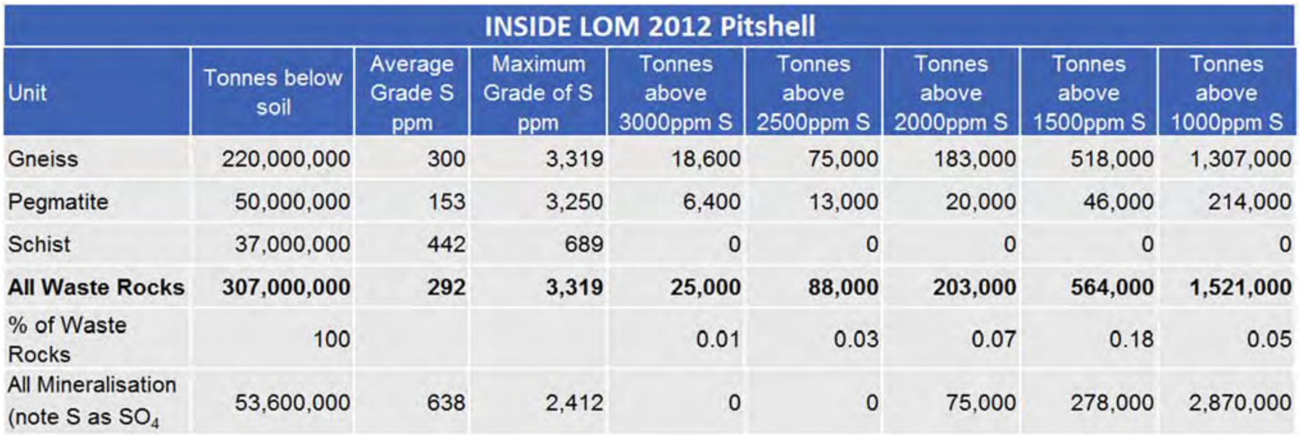
There are very few sulfides at Nolans Bore or in the surrounding region. The country rocks surrounding the deposit contain only trace amounts of disseminated pyrite. The deposit itself is predominantly apatite, with RE oxides, silicates and carbonates. The mineralisation formed as part of an oxidised mineral system hence sulfur in the mineralisation is already oxidised and occurs as non-acid generating sulfate in apatite, gypsum and barite. Trace pyrite occurs in the mineralisation but again this is rare and occurs in specific areas of the deposit.

A total of 3,473 whole rock assays have been used to estimate sulfur distribution in the resource's block model. The highest single assay is 2% sulfur in mineralisation, and the highest in waste rock is 0.74% sulfur. Only 40 of the 3,473 assays exceed 3,000 ppm sulfur, with 29 of them in mineralised apatite-rich rocks where sulfur occurs as non-acid forming sulfate minerals. One hundred and ninety-four of the 3,473 assays exceed 2,000 ppm sulfur, but again 177 of these are in mineralisation so won't end up in the waste rock.

Table 2-18 provides a summary of the LOM 2012 pit shell and shows the distribution of sulfur within the lithologies. It is evident that there are very small amounts of waste rock which contain elevated sulfur.

Conceptually, potential acid forming (PAF) material will be contained and encapsulated within benign waste into designated areas of the WRD. Based on the waste rock characterisation assessment completed for the project there is a very low risk of acid metalliferous drainage resulting from waste rock associated with the project.

Table 2-18 Distribution of sulfur within the lithologies



INSIDE LOM 2012 Pitshell								
Unit	Tonnes below soil	Average Grade S ppm	Maximum Grade of S ppm	Tonnes above 3000ppm S	Tonnes above 2500ppm S	Tonnes above 2000ppm S	Tonnes above 1500ppm S	Tonnes above 1000ppm S
Gneiss	220,000,000	300	3,319	18,600	75,000	183,000	518,000	1,307,000
Pegmatite	50,000,000	153	3,250	6,400	13,000	20,000	46,000	214,000
Schist	37,000,000	442	689	0	0	0	0	0
All Waste Rocks	**307,000,000**	**292**	**3,319**	**25,000**	**88,000**	**203,000**	**564,000**	**1,521,000**
% of Waste Rocks	100			0.01	0.03	0.07	0.18	0.05
All Mineralisation (note S as SO_4	53,600,000	638	2,412	0	0	75,000	278,000	2,870,000

2.10.4 Process waste streams

Three waste streams will be generated by processing plant operations with each waste stream reporting to an individual storage facility (see Section 2.9):

- Flotation tailings from the concentrator.
- Impurity removal residue from the processing plant.
- Water leach residue from the processing plant.

Expected slurry volumes are summarised in Table 2-12 and the location of the TSF and RSFs is shown in Figure 2-1 and Figure 2-2.

The project's process flowsheet shows gypsum, process solids following neutralisation, uranium and thorium reporting as waste streams to residue storage.

2.10.5 Hazardous process materials

Detailed logistics modelling indicates that the project will have annual movements of approximately 90,000 tonnes of in-bound raw materials to the Nolans site, and these will predominantly be in the form of standard intermodal cargo. Details of inbound proposed reagents and outbound products are provided in Table 2-19. Many of the proposed reagents present low safety and environmental risk. In Arafura's discussions with NT Worksafe, the volumes of reagents classified as hazardous that are proposed to be stored at site will not trigger a major hazard facility assessment requirement.

Arafura has engaged with the major operators and service providers to assess and ensure access to the required infrastructure and to incorporate the most efficient solutions for cargo movements. The transport impact assessment is described in Chapter 17 and Appendix V of the EIS. There will be three outbound products from the project as indicated.

Table 2-19 Freight movements to and from Nolans site

Freight movements to from the project		
	PAPL tonnes	% Change
Road freight in-bound per annum		
Reagents		
CMC	101	-45%
Oleic Acid	712	-45%
F8920	102	-82%
Sodium Silicate	0	-100%
MgO	5,535	7280%
Sodium Carbonate (Soda Ash) - dense	0	-100%
Barium Chloride	5	-77%
Sulfur (solid)	57,880	-34%
Hydrochloric Acid	15,563	-46%
Flocculant	85	-68%
Quicklime (CaO)	2,525	-92%
Caustic Soda (dry prill)	801	-97%
Hydrogen Peroxide (50%)	1,552	14%
[redacted]	[redacted]	[redacted]
Carbonate[4]	0	-100%
OTHER		
Diesel (average litres-4,992Kl to 3,300Kl)	2,659	-37%
Grinding balls	0	-100%
Road freight out-bound per annum		
Product suite		
-RE Chloride Concentrate	16,810	
- Ce oxide product (TREO equivalent 6,949)	13,250	
Phosphoric acid (merchant grade)	110,000	-
Total	**140,060**	

Sulfur and sulfuric acid

Sulfuric acid will be required both for the start-up of the acid plant and during the initial stages of ramp-up until phosphoric acid production occurs following digestion of ore. The sulfuric acid plant will be smaller than that described in the EIS, being re-sized to meet the requirements of the sulfation process for the reduced RE production scenario of 14,000 tpa TREO. Arafura is working with the NT based owners and the operators of the bulk tank facility at the Port of Darwin to investigate handling, storage and distribution of internationally sourced concentrated sulfuric acid via existing established infrastructure. Where transport volumes justify the investment, Arafura will work with the owners and operators of existing bulk handling installations to facilitate investment in additional capacity as required.

Caustic soda and hydrochloric acid

It is expected that hydrochloric acid will be sourced from a regionally based supplier and delivered in ISO tank containers. Alternatively, internationally sourced hydrochloric acid will be delivered in bulk to Darwin for subsequent transfer to ISO tank containers.

Caustic soda will be procured on the international market and delivered in bulk to Darwin for subsequent transfer to ISO tank containers.

This dedicated fleet of ISO tank containers will be transported on standard rail and road intermodal services between Darwin and Alice Springs and the Nolans site (see Section 2.12).

2.10.6 Other raw materials and reagents

All other inbound raw materials and reagents such as soda ash will be containerised and transported using intermodal services. This maximises the use of standard services while maintaining flexibility and minimising cost. Sourcing of other critical raw materials will include a matrix of local, regional, national and international suppliers in order to manage the supply related risk. Diesel for the Nolans operation will be delivered by road tankers directly from Alice Springs (refer Chapter 17 and Appendix V of the EIS.)

2.10.7 Rare earth and phosphate products

Out-bound RE product from Nolans will utilise existing road and rail capacity in addition to the Port of Darwin infrastructure. The products from the processing plant will be packed in bulk bags and transported in standard shipping containers via Darwin and international shipping routes. Two RE intermediate products, a cerium hydroxide (13,250 tpa) and a mixed RE chloride (16,810 tpa) will be shipped via standard existing container freight routes, the latter to an offshore separation plant. Around 110,000 t of phosphoric acid will be shipped annually to either domestic customers or to international customers via Alice Springs and Darwin Port in ISO containers.

2.10.8 Wastewater and water treatment

Non-process wastewater from the processing site, mine site and accommodation village, will be pumped to packaged sewage treatment plants located adjacent to these facilities then recycled into the processing circuit or disposed of into TSF or RSF. A pipeline will be required to transfer this water back to the processing site for reuse.

The sewage treatment plant will be a package type unit providing the appropriate level of treatment compliant with Australian Standards for such facilities. Treated effluent may be disposed of within the RSFs or recycled through the processing circuits. Sludge residues will be disposed of by a local (Alice Springs) contractor on regular basis as required.

Raw water demand for potable uses will be treated by a filtration and treatment system rated at approximately 150 m^3 per day.

2.11 Water management

2.11.1 Water balance

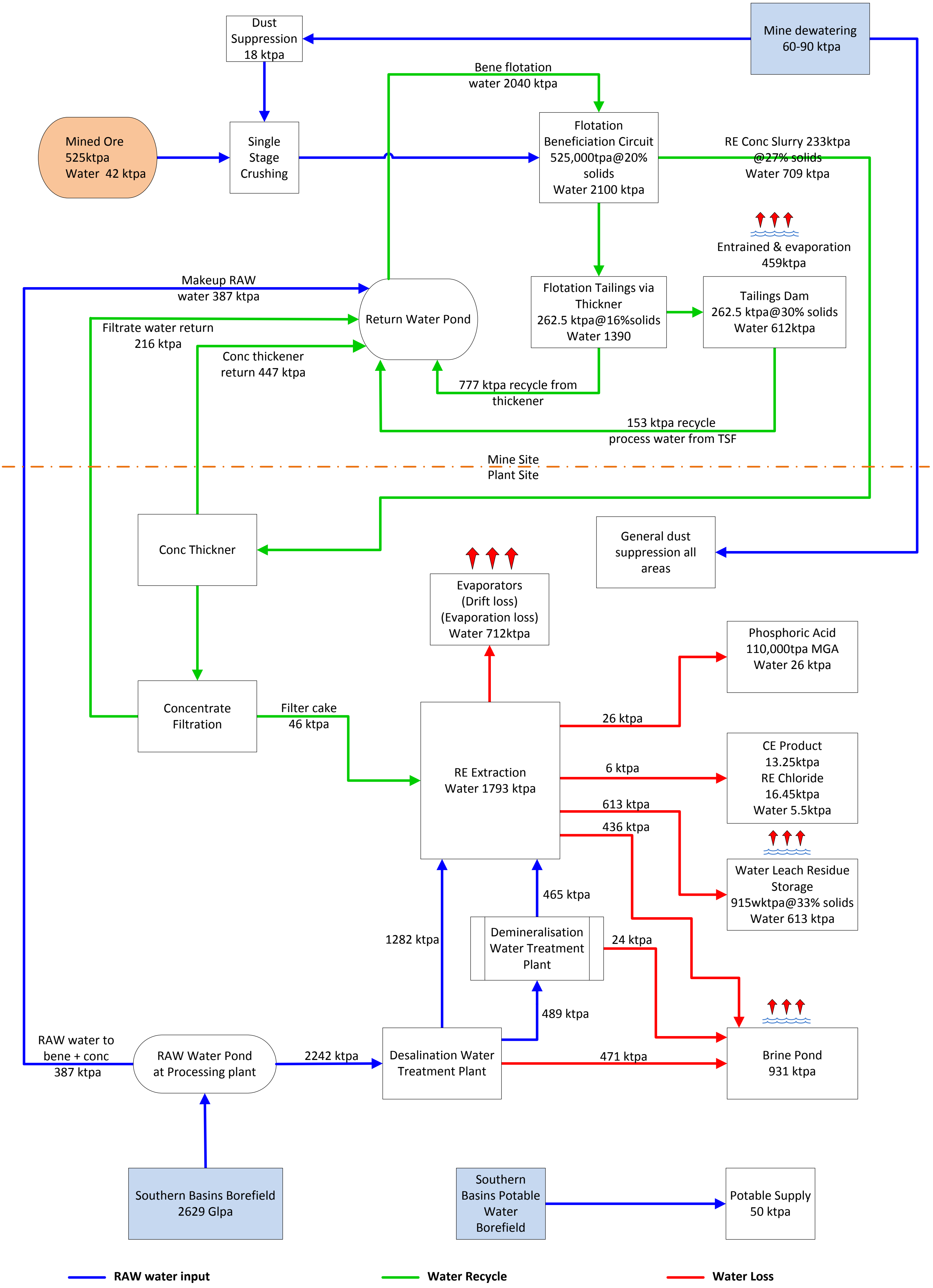
Arafura intends to design, operate and manage the Nolans site as a zero-surface water discharge operation for potentially contaminated areas i.e. to limit the potential release of contaminants into natural drainage features downstream of the mining operation. However, once the water is monitored for quality and deemed acceptable for release it may be released if permitted per the conditions of any waste discharge licence. Surface water from designated clean areas may also flow naturally into existing natural drainages at the site during rain events. The overall site raw water demand is projected to be about 2,700 ML/y. This includes a demand for processing plant process water of 2,200 ML/y, potable water 50 ML/y, and water for general dust suppression 120-250 ML/y (Figure 2-20).

On-site water resources will be available from pit dewatering which, due to the limited spatial extent and porous and transmissive nature of the ore body, will be achieved through pumping from bores and/or from in pit sumps to on-site turkeys nest dam.

Also available on-site is the recycling of tailings supernatant water that collects within the TSF ponds. Further improvements in water recycle have been incorporated by introducing thickeners and filters into the process design to facilitate water recovery and recycle. Further work is planned during detailed designed aimed at achieving further reductions in water project demand.

Additional on-site water may be available from stormwater management ponds but this is likely to be less significant due to the low frequency of rainfall events and limited volumes.

The revised mine site water balance is presented in Figure 2-20 (replacing Figure 7-8 of the EIS). The mine site water balance per stage and component is expected to change from that presented in the EIS, due to the change in the LOM and reduction in water demand for processing. Table 3-15 of the EIS is no longer relevant. The details of the mine site water balance per component and stage will be developed during the project's DFS. The overall water demand for the LOM 55 is 56% of the water demand for the LOM 43 (i.e. a reduction in water demand of 2,098 ML/y).



Note: Until final engineering is completed the water balance is as shown. There are opportunities to reduce consumption but additional test work and engineering solutions have to be investigated and evaluated.

2.11.2 Water supply

Raw water to supply the processing plant and the concentrator will be pumped from the Southern Basins aquifers located in the borefield approximately 25 km to the south west of the processing site. Water will be supplied from multiple production bores within the Reaphook Hills borefield area pumping variable rates in accordance with the operation's needs using an approved groundwater management plan to ensure the long-term sustainability of the borefield aquifer system.

The actual number of production borefields to be developed will depend on the results of future borefield groundwater investigations planned to be completed during the mine development phase. The combined maximum demand of the bores is 2.7-3.2 Gl/y. As stated above, it is intended that each borefield will extract water from a production area within the basin aquifer system of around 100 km^2. There is a management strategy to establish 4-5 production bore areas in accordance with the 80/20 principle in the NT DENR guidelines (refer to the Appendix 3). This strategy is based on groundwater investigations undertaken to date and is aligned with similar water supply practices in the nearby Ti Tree Basin. It will allow Arafura to distribute production over a large area of the basin thus spreading potential localised drawdown cones.

The borefield pumps will be located within fenced compounds containing the head works, manifold, power and control equipment and power supply. A staged pumping system with an intermediate pond and transfer pumping facility has been selected to reduce pump size and pipeline pressure ratings. This system and the associated network of bores will be controlled remotely from the processing plant using telemetry. The transfer pipeline from the intermediate pumping station to the processing plant will run within the access track and overhead power line corridor.

It is anticipated that the raw water demand for potable uses can be supplied from the northern part of the borefield area via a dedicated small transfer pipeline to a treatment facility (size 0.15 Ml/day) at the processing plant. An alternative option of using the main raw water supply is also available. The raw water will be treated by a filtration and treatment system. Once treated, the potable water will be stored in a potable water tank located within the processing plant. This tank has been sized for two days' storage to cater for unplanned outage events.

Potable water from the tank will be pumped to tanks located within the concentrator / mine services area and accommodation village via HDPE piping. These transfer pipelines will be located within the road service corridors. All tanks will be fitted with chemical dosing and ultraviolet (UV) treatment facilities and have protected water reserves for connection to fire systems, safety showers, etc.

2.12 Transport and communications

The materials transport and logistics strategy will use, wherever possible, standardised equipment to optimise performance within the existing regulatory framework.

Additionally, the proximity of the Nolans site to both Alice Springs (135 km to the south-southeast along the Stuart Highway) and Ti Tree (55 km to the north-northeast along the Stuart Highway) facilitates:

- A bus-in bus-out (BIBO) transport philosophy for the movement of mine personnel to and from the accommodation village.
- An opportunity to base significant maintenance and operations logistical infrastructure associated with the road transport operation in Alice Springs utilising existing infrastructure and local suppliers.

- The use of the Darwin to Adelaide rail line, and railway infrastructure in Alice Springs to support the total rail transport requirements of the project.

The rail corridor provides direct linkage to the Port of Darwin which is approximately 1,400 km to the north. Port Adelaide to the south offers an alternative back up port facility with very good infrastructure and a similar haul distance, thereby substantially enhancing the security of the supply chain.

Vehicles that are too wide to travel on normal roads will be serviced on site at the mining workshop.

2.12.1 Mine haulage roads

The mining method is based on a drill, blast, load, haul and dump to ROM pad or stockpiles or waste dumps involving:

- Up to 11 x Caterpillar 777F, 90 t class haul trucks.
- Up to 3 x Hitachi EX1200, 110 t class, diesel hydraulic excavators with 6 m^3 buckets.

All dual pit access ramps have been designed at 30 m width to allow safe two-way access for mine trucks up to 150 t class. One-way pit ramps have been designed with 16 m width.

A short haul road from the pit to the ROM pad will be constructed. Interaction with light vehicles and other mine vehicles will be strictly controlled with standard industry traffic management protocols to ensure the safety of all personnel and equipment.

2.12.2 Materials transport

The under-utilised capacity on the south bound Darwin – Alice Springs – Adelaide train route will be used to transport quicklime, reagents, and sulfur to the mine site from Darwin. Rare earth chloride intermediate product, cerium hydroxide and phosphoric acid from the processing site will also utilise the railway to Darwin via Alice Springs.

Outbound product will be trucked to Alice Springs in shipping containers or ISO containers. Containers that require cleaning will be cleaned at the processing plant following unloading of reagents. The RE intermediate product within these containers will be contained in 1 tonne bulk bags. Outbound product will be transported from Alice Springs by rail to Darwin whilst inbound materials are transported by rail from the Port of Darwin.

Once operational the processing plant demand for sulfuric acid will be serviced by a small on-site sulfur burning acid plant. Inbound sulfur will be procured on the international sulfur market and it is proposed that bulk shipments be containerised in Darwin for ease of transport by rail to Alice Springs and then road to the Nolans site.

The delivery of reagents and materials for the project will be managed from Alice Springs by an existing logistics operator. Transportation of these materials and reagents will be by standard road trains or B-double truck configurations with 2-3 trucks completing two trips per twelve-hour cycle from Alice Springs to the Nolans site. The quantities of reagent and materials are included in Chapter 17 of the EIS and the new quantities based on the PAPL process are provided in Section 2.7.1.

Historically the Port of Darwin has handled solid sulfur shipments and Arafura is working with the Port Authority and port operators to finalise the optimal location for a transfer facility.

The Nolans site will have designated dirty and clean zones. These zones will be determined on the basis that a vehicle entering the zone could come into contact with contaminated material e.g. radioactive material. All vehicles leaving the designated dirty zone at the Nolans site will be required to be washed prior to leaving that zone. All 20 ft containers will be washed internally, unless dedicated to a specific material, e.g. quicklime. No ISO container will require internal washing. It is not intended to further restrict vehicle movements and have dedicated vehicles for dirty zones other than mining equipment. Mining equipment or processing equipment that must be removed from site will be required to undertake a cleaning protocol which requires a contamination clearance certificate to be issued prior to it leaving the site.

A summary of the annual material movement between the mine site and transhipment facilities is provided in Figure 2-21 and Figure 2-22.

2.12.3 Communications

The Nolans site communications networks will comprise multiple systems designed for the required functionality, security and integrity. These systems include:

- Nolans site-wide control system network including telemetry links for remote control and monitoring.
- Wide area network linking national network and corporate functions.
- Local area network (business).
- Telephony and VOIP.
- Radio system.
- Mobile phone network.
- Village entertainment network.

The cable infrastructure for these systems will use defined access and infrastructure corridors. Other radio/microwave transmission and receiving structures will be mounted wherever possible on existing other multiuse structures or sites.

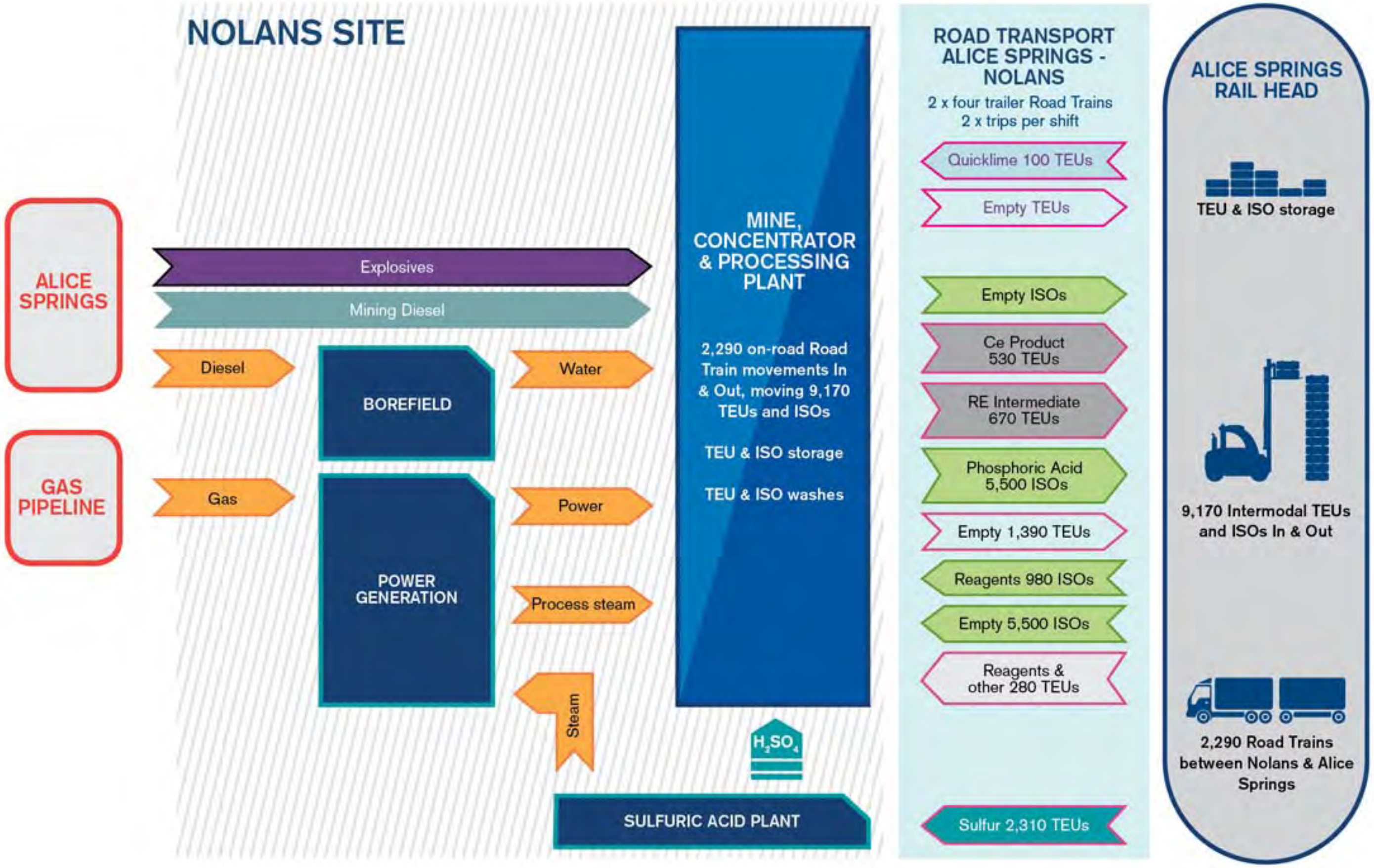


Figure 2-21 Nolans site - Alice Springs transportation (Source: Arafura 2017)

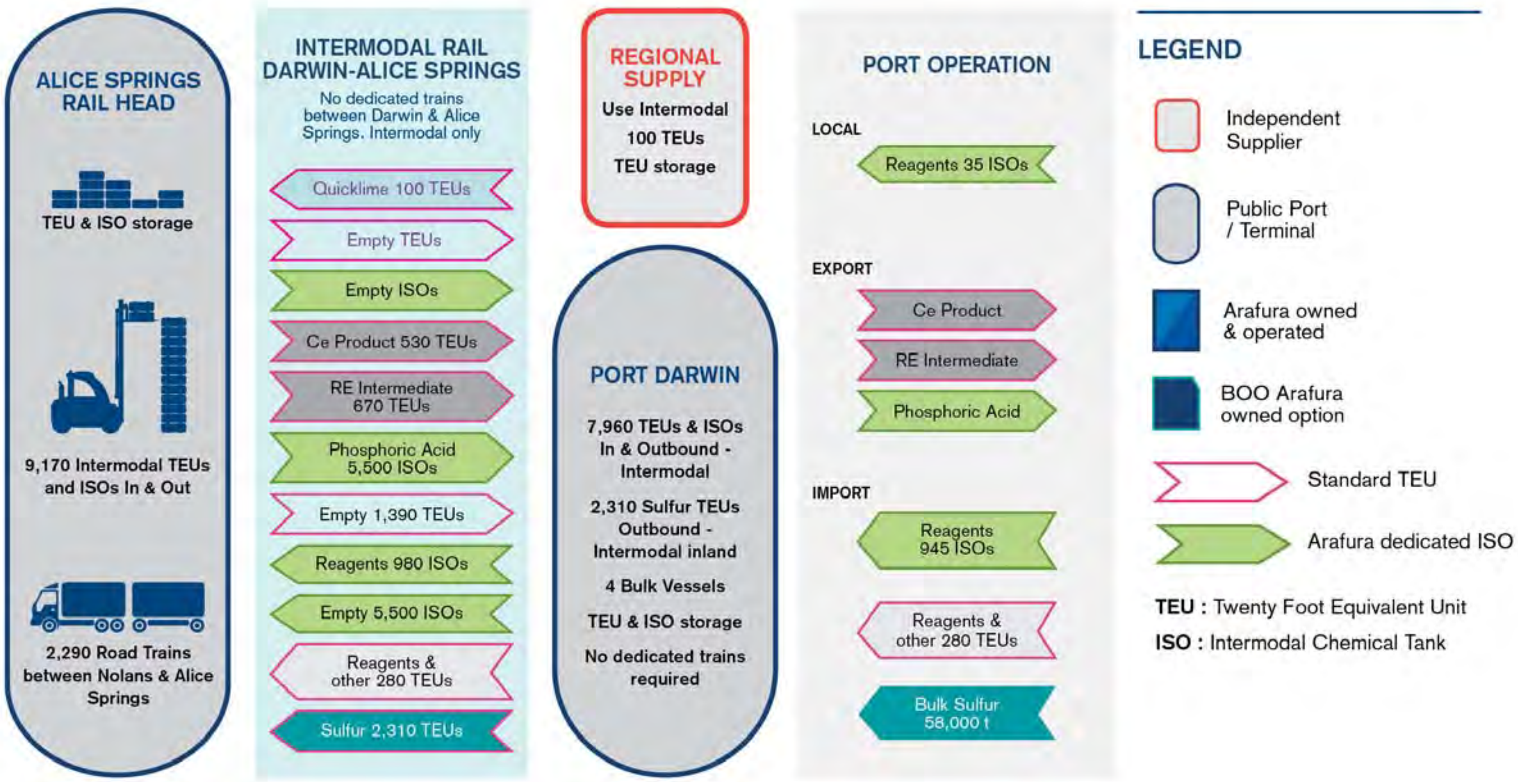


Figure 2-22 Alice Springs – Darwin transportation (Source: Arafura 2017)

2.13 Air

2.13.1 Inventory of air emissions

The inventory of air emissions for the project (detailed in Chapter 13 of the EIS) comprises dust and gaseous generating sources.

Dust generating sources

Dust generating sources are limited to the mine site and include:

- The open pit and mining environment

  The ore body generally contains the main aquifer on the mineral lease. As this aquifer will be gradually dewatered ahead of mining, it is envisaged that the ore mined will have high moisture content and dust generation when mining will be lower than when mining waste. Mining will use conventional drill and blast followed by excavators, dump trucks and dozers. Blasting will use low powder factors, relying mainly on emulsion because of the wet nature of the orebody. Waste rock will likely use ammonium nitrate fuel oil (ANFO) for blasting as this has limited groundwater within the waste rock mass. Based on the LOM 55 schedule, mining will progress through the eleven pit stages, and peak years have been identified for each stage (corresponding to nominal year of mine operation) to identify material transfer to be used in developing the emission inventory across seven worst-case scenarios.

  As very little freely excavated material exists at Nolans, drilling and blasting is the primary mining method. It is likely that ANFO will be used in the waste rock because it is hard and relatively dry, while emulsion will be used in the ore as it is porous and a wetter material.

  Whilst dust modelling presented in the EIS was based on the 2014 LOM 43 year schedule the recent 2017 LOM 55 year schedule produces almost identical total material movements (within 1%) therefore the predicted dust emissions are comparable. The variance is smaller annual movements over an additional 12 years of operation.

- Haul road network within the mine site

  Overburden and waste material will be deposited in WRDs using haul trucks. Dust suppression for haul roads and operating areas (in pit as well as waste dumps and ROM pad and general mine roads) is required to limit dust generation and possible inhalation by mining personnel (radiation requirements) and provide safe visual operating conditions. (Vehicle movement to the project site associated with the Stuart Highway will be via a sealed access road).

- Stockpiles and concentrator plant

  Mining operations will deliver broken ore to a ROM pad (from which a front-end loader will feed the crushing circuit) as well as to the long-term stockpiles.

  Tailings are transferred (pumped) to a TSF as a slurry (30-40%% solids). The tailing will be wet and so dust emission from these will be insignificant. Given the nature of the tailings the surface will tend to crust which also retards the production of nuisance dust.

  Thorium and uranium will be present in material that is feed to the beneficiation plant and in material that is both stockpiled and/or disposed to waste dumps. Radiation (as Bq/g) will be emitted and these are to be modelled as area sources from stockpiles and waste sources and processing circuits. Dust emissions from these stockpiles will be managed using sprinklers to suppress fugitive dust.

A slurry transfer pipeline feeds concentrate overland from the mine site concentrator to the processing plant at a rate of around 100 m^3 per hour.

- Wind erosion from the mine site

  A number of topsoil storage areas have been designated on the mine site with an overall footprint area of about 114 ha and a maximum planned height of three meters. These will be used and refilled progressively as dumps are built and closed as areas that can be rehabilitated become available. Soil that is removed from WRD footprints will be added into the stockpiles for reuse or respread to rehabilitation areas. Not all designated areas will be used at any one time as progressive rehabilitation will recycle soil as required.

- Processing plant

  This plant consists of a totally wet process so the potential for dust generation is very limited. If warranted in designated areas extraction systems will be included. The process RSFs and evaporation ponds are both wet storage areas. The process residues are a chemical precipitate and typically fine in nature meaning they will crust and retain a relatively high moisture content and therefore be unlikely to generate dust. A topsoil storage area of about 30 ha will be required to manage topsoil removed from the plant site and the RSF and evaporation pond footprints.

Gaseous generating sources

Gaseous generating sources will be based at the processing site and include

- RE processing plant

  All emissions sources in the processing plant that require emission control systems will have scrubbers incorporated into the design that are purpose built to ensure compliance with relevant standards for that particular emission source/type.

- Sulfuric acid plant

  Once operational the processing plant demand for sulfuric acid will be serviced by the proposed small on-site sulfur burning acid plant. It is assumed that the sulfuric acid plant will have a standard arrangement for generating SO_2 emissions of 4 lb/ST (2 kg/MT) or 99.7% conversion. Given the sulfur feed rate (7.7 t/hr) the emissions of sulfur dioxide can be calculated.

- Power station

  Power demand will be serviced by cogeneration from a sulfuric acid plant and gas fired on-site generation supplied by a group of combined cycle gas turbine based generators. The primary pollutants of concern from a gas fired plant are nitrogen oxides and carbon monoxide. Emissions of particulate matter, sulfur dioxide and other substances have not been considered due to a low emissions value.

2.13.2 Emission controls and dust suppression

Dust emissions from haul trucks can be minimised using various control techniques (discussed in Chapter 13 of the EIS), however, emissions from dumping waste rock have no controls. Only unquantifiable operational controls can be applied to waste rock dumping.

These operational controls include short dumping of overburden on the waste rock dumps and dozing material which can limit dust generation. Roads to, from and on waste dumps will be regularly watered. The road connecting the mine site with the processing site will be routinely watered prior to peak traffic periods. It is intended that the use of dust suppressants will also be investigated to improve suppression and reduce water usage and watering requirements.

A summary of the controls applied for the air emissions modelling are provided in Chapter 13 of the EIS. A maximum 74 per cent reduction in emissions from mining activities was found to be achievable with the application of the proposed control measures.

2.14 Workforce and accommodation

2.14.1 Workforce

The construction and operations workforces are expected to peak at 500 and 300, respectively; however, until detailed engineering and construction schedules are finalised, it is likely the construction numbers may increase. It is anticipated that the operational workforce would include approximately fifty specialist / skilled positions.

It is expected that the workforce will comprise approximately 70% fly-in fly-out (FIFO) ex Alice Springs, and 30% BIBO ex Alice Springs and other local communities. It is anticipated that the BIBO component of the operations workforce will comprise 1/3 local workers (i.e. from Alice Springs and surrounding communities), 1/3 NT workers and 1/3 interstate workers who will be encouraged to move to the region to live. The project is committed to maximising both local (Alice Springs region) and Northern Territory-based employees. The proportion of the workforce that will be FIFO may also increase if other projects come on line and are competing for local and NT workers.

Workers will likely work a two week on, one week off roster although no firm roster arrangement have yet been decided. All permanent site personnel will be housed in the dedicated accommodation village, with overflow accommodation needs likely to be met by the nearby Aileron Roadhouse during operations. An additional 200 room temporary accommodation camp will be leased over the project’s construction period and will be removed following project commissioning.

Workers will be required to use a dedicated bus service to travel to and from the Nolans site to Alice Springs or their local community at the beginning and end of their roster. This arrangement is being considered to limit the chance of motor vehicle accidents arising from fatigue at the end of rosters. Contractors completing short term work at the project site are expected to be able to use their own vehicles to get to and from the site. Roster changes will be timed to coincide with flights in and out of Alice Springs to minimise the amount of time FIFO workers have to wait in Alice Springs.

2.14.2 Accommodation

The accommodation village will be laid out to make use of the natural surface grade for drainage and earthworks and will be subject to a detailed site survey and geotechnical investigation.

The accommodation buildings have been set back from the main project access road to the rear of the site of the planned village area and the central facility buildings and utilities have been located at the front where they will be easily accessible for delivery vehicles. A light vehicle parking area will be located in front of the facility, as will bus drop off and pick up areas.

The most practical construction system for the village will be offsite prefabricated transportable buildings. These buildings are mostly of a modular type construction with larger buildings being multi-module style.

The buildings will use a range of noise and thermal insulation techniques to provide comfort and maximise energy efficiency. The central facility buildings will include the following:

- Kitchen dining building complete with freezer and cool room storages for food. The kitchen will have capacity to comfortably cater for up to 300 people at up to 100 percent occupancy.
- Village administration building, office and shop.
- Recreation building that provides a range of functions including inductions during construction, meeting hall and general assembly building.

Accommodation buildings will generally be provided as single module structures with a number of accommodation units per building. Each unit will comprise a bed sit room and an ensuite bathroom with shower, toilet and basin. A small number of larger size rooms will be provided and these rooms will have separate bed and sitting rooms with facilities to allow personnel to use the accommodation as office space. Accommodation rooms for disabled persons have also been included in the building design. A gymnasium and lap swimming pool have been included for recreation.

Utilities services to be provided to the accommodation village include:

- Potable water; treated water (filtered and chlorinated) will be pumped from the processing plant to the village where it will be stored in a single tank. The tank has been sized for two days' storage and will be divided into a higher level off take for potable supply and a secure (protected) lower level off take for fire systems. A constant pressure variable flow pump system will deliver potable water around the village using a buried pipe reticulation system. The water will be UV treated by lights in the line as part of the pump system. A temporary water supply will need to be established as an interim measure until the main plant supply system is commissioned. Depending on the timing for establishment of bores, it may be necessary to truck potable water to site during the initial months.
- Fire systems will include detection systems and active fire suppression systems. Detection systems will include hard wired smoke detectors to all buildings and break glass audible alarms. Suppression systems will include extinguishers fixed outside all buildings, full hose reel coverage of the village and several hydrants located strategically around the core facilities. The hydrants will be supplied from a dedicated electric / diesel fire pump system. A fire break will be maintained around the outer perimeter of the village to minimise the risk from grass/wild fires. Hydrant / hose reel coverage of the perimeter around the village will also be provided. Fire support will be available from a fire unit located at the processing plant.
- Sewerage will be reticulated around the village using a conventional gravity reticulation system. This will drain to a single pump station within the village compound. From the pump station, sewage will be pumped to a packaged treatment plant located within the village precinct. Clean effluent from this plant will be pumped to the treatment plant for recycle.
- Power will be generated at the processing site and transmitted to the village by overhead high voltage (11 kV) conductors. At the village, there will be a kiosk substation from where power will be reticulated below ground at low voltage (415 V). Sub mains will lead from the substation to local distribution panels, which will in turn feed the individual building modules. While the process plant is under construction, power will be generated at the village using temporary diesel gensets. One or two of these gensets will be retained in the longer term to provide temporary backup power for essential village services in the event of a power outage at the main power plant.

- Communications in the village will comprise mobile telephone services, two-way radio, data / internet services, and television / entertainment services. The provision of head services has been included in the mine and concentrator estimate scope. Reticulation of communications around the village will be achieved using a fibre backbone system installed in common trenching with other utilities. A separate communications building will be established.

Application of the *Department of Health Fact Sheet No. 700 Requirements for Mining and Construction Projects* will be considered during detailed design and operation of the project.

3. Response to submissions

3.1 Arid Lands Environment Centre

UID	Summary of submission	Response
32	The proposed clearing of 4161 ha of native vegetation is a concern as there are no clarity either in the Northern Territory or Nationally as to the offset requirements for a proposal of this scale. The potential for the spread of weeds, changes to natural processes within the Project area and the increased risk of fire.	The applicability of offsets under the EPBC Act is yet to be determined (refer to UID 34 below). The proponent is committed to ongoing land management within the project site, as detailed in the EMP, including the management of fire, weeds, feral animals.
33	The presence of a range of threatened species leads to the suggestion that independent surveys be carried out prior to any more work occurring in the proposed bore field area.	Independent, targeted threatened species surveys have been conducted in the project area, including the borefield. The surveys were conducted by experienced ecologists, CLC rangers and species experts including from APY lands and the Alice Springs area. Extensive baseline fauna surveys, as described in the EIS, were also conducted in 27th April – 3rd May 2016 in addition to the targeted surveys conducted in 21st to 26th of July 2015 for: • Black-footed Rock-wallaby (including the Reaphook Hills adjacent to the borefield) • Great Desert Skink • Brush-tailed Mulgara. It is intended that further survey work will be completed by appropriately experienced ecologists in the borefield areas at a micro-scale, once the precise location of proposed infrastructure in known. The surveys are intended to refine the existing ecological information and further tailor any mitigation measures to avoid significant impacts to threatened species. Additional monitoring of Great Desert Skink burrows will be conducted using remote fauna cameras. Pre-clearance surveys will also be undertaken prior to all vegetation clearing and/or infrastructure development. This has been included as a commitment.

UID	Summary of submission	Response
34	Recommend that the Proponent work with local and regional partners to develop a mechanism to offset the impact through supporting local land management and biodiversity conservation work.	The applicability of offsets under the EPBC Act is yet to be determined. Should offsets be required by DoEE, Arafura will develop an offsets strategy, which may include local land management and biodiversity conservation work, for submission to the DoEE.
88	ALEC recommends that the pit be backfilled at the end of the mines economic life and the area be restored as much as possible to the natural state it is currently in. Given the scale of the Project, ALEC also recommends that the NT Government ensure that an adequate environmental bond is received that reflects the potential risks associated with a mine of this nature.	Refer to Section 4.1.1 regarding the backfilling of the pit, determined by Arafura as a non-viable option. The resource has been defined to 220 m vertical RL and Arafura is confident (from drilling) that the resource extends far below this level, which can potentially be exploited by open pit means. Additionally, Arafura recognises that it may be possible in the future to recover discarded resources from tailings and process residues, if they remain on surface rather than be sterilised by burying back into the open pit. Existing Northern Territory legislation requires an operator to calculate closure costs regularly, and there is a robust process to assist guide this calculation. The DPIR independently completes their calculation and then the results are compared, and a security is agreed and subsequently lodged.
107	Currently the lack of clarity as to who the responsible agency is for assessment, approvals and compliance combined with the upcoming NT election risks the politicisation of this project. It is in the best interests of the Proponent and the environment to consider this EIS a Draft, and resubmit post NT election.	The responsible agency for State/Territory assessment, approval and compliance of the Project is the NT Department of Primary Industry and Resources under the Mining Management Act. The DPIR process for this project includes, in addition to the NT environmental impact assessment regulatory process, assessment by Federal Government DoEE under the Commonwealth EPBC Act. Under a bilateral agreement this is also co-ordinated by the NT EPA. The EIS is a draft document (however as clarified in Chapter 1 of the EIS, for ease of reference the EIS is referred to as EIS).
108	ALEC recommends that the EIS document as presented be considered as a Draft as per the usual process which allows the Proponent to refine and finalise the unfinished aspects of the EIS and resubmit once completed.	As clarified above and in Chapter 1 of the EIS, the EIS is a Draft EIS but is considered ‘final’ in that an updated EIS will not be submitted to the regulators (which is consistent with the NT environmental assessment process). Additional information is provided to address comments received and requests for additional information in this Supplementary Report.
273	ALEC does not support this Project proceeding until further clarity on the issues raised is provided and the EIS is resubmitted with a Water Management Plan, Radioactive Dust Management Plan and is engaged in a process to develop an offsetting mechanism for this project.	Arafura will be required to submit various management plans, for formal regulatory approval, to the DPIR, as part of the mine authorisation and compliance process. An overview of the plans is provided in the EIS in Appendix X and includes a WMP, Air Quality and Dust Management Plan and Radiation Management Plan. In addition, Arafura will submit a Radioactive Waste Management Plan. The Water Management Plan that was presented in the EIS has been updated to incorporate information from supplement

UID	Summary of submission	Response
		responses to submissions where relevant, and to reflect changes discussed above in Chapter 2 Project Description. Further discussion regarding offsets is provided in Appendix 5.
292	The Project should be looking at options to reduce its fossil fuel dependence through installing renewable energy to complement to co-generation plant.	Energy sources were assessed in the feasibility phase of the project. As the Mine is located in close proximity to an existing natural gas pipeline, it is the preferred energy source. It is expected that there will be opportunities for use of renewable energy such as solar systems for components of the project. Solar will, for example, be used for facilities with a smaller energy demand such as borefield monitoring, telemetry and potentially for the pumping of the potable water to the project. The ore processing facility concept design has been further developed in the last 18 months. Waste heat from the treatment process will be captured and utilised. This heat energy will be used to provide approximately 5 MW of power generation and will result in a significant reduction in overall energy requirements. Arafura will continue to seek reduction in energy requirements, use high efficiency power generation equipment and seek alternative power sources that can meet its operating requirements and reduce operating costs.
293	The bore field should not be powered using diesel, and instead use solar with a gas back-up	The power supply for the borefield has not been determined yet. The final design and layout is required prior to a decision. Upon final design, the pumping rates will be confirmed from which the pump sizes and most appropriate power system can be determined. Based on the current supply volumes it is unlikely that solar energy will be able to provide sufficient energy cost competitively. Solar will, however, be used for borefield facilities with a smaller energy demand such as bore monitoring, telemetry and potentially for the pumping of the potable water to the accommodation camp.
294	Supports the intention of this Project not to be a Uranium or Thorium mine	Arafura is seeking approval to mine rare earths and phosphate only. Uranium and thorium would be managed as a waste product with other residue materials in well-engineered and constructed storage facilities.
313	The main concern is the residue leachate containing hexavalent Chromium - a known carcinogen, and the raised levels of radioactive strontium, fluoride, zinc, copper, aluminium and lead in the leachate. The hardness of the water will impact on the reticulation systems and no doubt other aspects of	Part A The likelihood of residue leachate containing hexavalent Chromium is highly unlikely given the absence of strong oxidising agent and near neutral pH. Naturally occurring strontium is primarily a mixture of its four stable isotopes: 84Sr (0.56%), 86Sr (9.86%), 81Sr (7.0%) and 88Sr (82.58%) (USGS, 2016). In the absence of large quantities of nuclear fuel waste or fallout from nuclear explosions, radioactive strontium (90Sr) is not likely to be present in significant concentrations.

UID	Summary of submission	Response
	the process, which will require vigilance in its management. ALEC has some concerns about the 'fluid' nature of the process and the lack of inclusion of the PAPL process in the rest of the EIS. The Phosphoric Acid Plant does not register in the EIS and the associated impacts are not captured in this additional report.	Fluoride is consistent with the ambient groundwater and both leachate and groundwater have various metals exceeding relevant guidelines. Refer to Section 4.26. Part B Noted. Existing groundwater is relatively hard and will be managed with appropriate piping design. Part C Arafura submitted a notification under Section 14A of the Environmental Assessment Regulations and Section 156A of the EPBC Act. Further information of the PAPL process, and its differentiation from SAPL is presented throughout Chapter 2.
378	The creation of radioactive dust that will be stored as part of the waste rock piles surrounding the pit is a concern. The prevailing wind in the area is from the south east and therefore both Laramba community and Pine Hill are at risk of being directly to the radioactive dust. It is not clear in the EIS that this risk is being adequately considered.	Laramba is located 50 km to the west and Pine Hill 29 km to the north. Air quality modelling is reported in Chapter 13 and Appendix Q of the EIS. Worst-case emission scenarios were selected based on amount of material moved, maximum mining rate and throughput. The modelling indicates that impacts from dust beyond the mine site are very low to negligible. A conservative radiological dust assessment was also conducted and concluded that the impacts of radioactive dust (measured as member of the public doses) at the closest sensitive receptor (the accommodation village, located 5 km from operations) would result in radiation doses of less than 100th of the member of the public dose limit. Impacts from radiological dust beyond this distance would be lower.
379	The Proponent needs to prove to the Department of Health and the Department of Lands Planning and Environment that a series of 50m high waste rock dump piles that contain radioactive elements will be no risk to the communities of Laramba and Pine Hill.	Refer to UID 378 above.
419	It was indicated that the exact chemistry for the separation of target minerals from the spoil was not yet confirmed and would be submitted as an addendum to the EIS. Given the 4% risk of a catastrophic 1:1000 year flood event, it is critical that the geochemistry and the risk to the environment of these waste by-products is known and infrastructure is constructed to ensure that the risk of contamination by leachate is low.	An addendum to the EIS was submitted including further information on geochemistry in tailings and residue. Refer Section 2.10 or further information on waste management and Section 4.12 for further information on the impact of TSF failure.

UID	Summary of submission	Response
446	Recommend that the proposed water use is considered as part of a new water control district to ensure that the use of groundwater in the region does not adversely impact on other potential consumptive uses.	Declaration of a Water Control District over the Southern Basins or their sub regions is a matter for Government.
447	Concerns about the lack of data to support the modelling and the lack of contingency should more data disprove the current modelling.	Refer to the Water Resource Assessment (Appendix 3) and Section 4.22.
448	An independent or Government verification of the water resource should be conducted to confirm or deny the accuracy of the modelling and proof that the assumptions are correct.	The modelling was created, conducted and peer reviewed by appropriately qualified independent consultants. As part of the EIS assessment process data was reviewed (as presented in the EIS) by multiple agencies including the DENR who are responsible for groundwater resources. As part of the Supplementary reporting process, the Water Resource Assessment was submitted to DENR on 29/8/17 for review. Further information was requested on 19/9/17 as part of that review. Arafura provided the further information on 20/9/17. Comments from DENR have not yet been received.
449	A contamination risk due to Probable Maximal Flooding (1:1000) should be considered in the EIS and ensure that the TSF and associated mining infrastructure is designed to withstand an event such as this.	Appendix I of the EIS provides details of pre and post mining flooding. The 1 in 1000 year ARI event was assessed and results obtained for the increase in water levels and the potential velocities near mine infrastructure. As part of the Supplementary Report, new flood modelling was undertaken for the new LOM 55 post-closure scenario. The new LOM 55 no longer includes a WRD at the southern boundary of the site. Flow velocities near the TSF and associated mining infrastructure are generally below 0.5 m/s and less than 1 metre deep. It is unlikely that the toe of the TSF embankment, which would be constructed from NAF waste rock, would significantly erode. Some unprotected soil surfaces around mine infrastructure area where flow velocities are expected to be in excess of 0.5 m/s will be rock armoured. All storage facilities will be designed and operated in accordance with ANCOLD Guidelines. Refer to Section 2.9.2 and Appendix 2 for further information.
450	The ore body may continue to depths beyond that which is currently known which could push the life of the mine beyond 80 years. This needs to be considered as part of the application as it increases the risk of the mine being subjected to a major flood event.	The LOM for the Project is now 55 years. Flood modelling has been conducted, including for a post-closure period of 1000 years. Refer to Section 4.14.

UID	Summary of submission	Response
451	A final WMP needs to be provided to all parties who have made comments on this EIS prior to submission to the Minister	An updated WMP has been developed during this Supplementary Reporting period. A copy of the WMP is provided in Appendix 4.
452	The redirection of the Kerosene Camp Creek is an essential part of the mine design. It is not clear that the ecological function will be maintained with the redirection.	Refer Section 4.15. A majority of the new diversion is unlikely to replicate ecological function of the existing Kerosene Camp Creek due to the geology and gradient.

3.2 Australian Radiation Protection and Nuclear Safety Agency

UID	Summary of submission	Response
1	Appendix Q: Air quality modelling for TSP and PM10 shows extensive areas off the mineral lease above the set criteria. Justification that no human receptors will be in these areas needs to be provided.	The TSP and PM10 assessment criteria for environmental impact are based (in the absence of Northern Territory criteria), on Victorian, New South Wales, Queensland and other jurisdiction definitions of where the concentration limit applies. The Queensland Environment Protection (Air) Policy 2008 has a useful definition of the environmental value being protected, in this case "(human) health and wellbeing". This is defined in Clause 7(b) of the Queensland Air Policy as "the qualities of the air environment that are conducive to human health and wellbeing." Implicit in this definition is that, at the point of assessment, the (human) environmental impact is a "sensitive receptor". This cannot be a casual or ad-hoc location that is infrequently visited and/or visited for short duration as the risk of harm is related, in the instance of particulate matter impact, on daily or annual exposure. The Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales have the definition of a sensitive receptor as "a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area." This definition applies at the mining accommodation camp, the Aileron Roadhouse and regional communities – all of these are identified in the EIS in Chapter 13 and Appendix Q. The nominal exceedances of criterion beyond the site boundaries occur in uninhabited areas where human receptors that comply with the above definitions will not be located.
14	Ch 9: Number of footnotes throughout the chapter are for Chapter 10	Noted.

UID	Summary of submission	Response
15	Section 9.6.3 & App N: Mentions the low chance of Princess Parrots or other threatened species to drink at TSF/RSF. Differs from the assessment provided in Appendix N which notes there is a risk of mortality and the risk is proven from other arid region operations. Appendix N notes that they do not know the susceptibility or tolerance of birds to drinking at these types of water sources yet control is to keep the toxins at a low level to prevent poisoning. Consistency required across the documents. Review and update controls to be used for the protection of threatened species drinking contaminated water. Define limits of toxicity for threatened species and apply quantitative commitment to keeping water quality below the limits.	<u>Part A</u> Both Section 9.6.3 and Appendix N of the EIS state that would be an extremely low chance that passing Princess Parrots would stop for a drink at a tailings dam. <u>Part B – C</u> Refer to Section 4.19.
16	Section 9.7.11: No clear commitment to bird deterrent methods. Review risk and results from similar operations in environment and commit to bird deterrent if risk requires.	The risk identified by other operations in the region (i.e. gold mines) is not directly comparable because of the expected low toxicity of the water at this mine. The Acid, Metalliferous Drainage Report (Appendix L) characterises waste rock material and identifies exceedances in aluminium and zinc. The TSF and RSF will be monitored to establish if any toxicological risk exists as detailed in the Surface Water Sampling Procedure. Refer to UID 15 and Section 4.19 for further information on controls to be used for the protection of threatened species drinking contaminated water.
61	There is no discussion of alternative closure and rehabilitation strategies. The proposed strategy does not align with international best practice, in particular with regard to returning waste to the mined pit.	Refer to Section 4.1.1.
62	The proposed closure and rehabilitation strategy appears to be deficient, in particular with regard to the capping layer.	Refer to Section 4.1 for further information on capping and closure.
63	Ch 12 & 18: The discussion in these chapters is not consistent with the information presented in the tables. The units vary from one table to the next (μSv/h, Bq/kg, ppm). Make the units consistent throughout. This option does not appear to have been considered.	The units used in the radiation chapter in the EIS (Chapter 12) and the associated appendix (Appendix P) are representative of the quantities being presented. The units have been applied as follows: • A unit of Bq/kg (or Bq/g) has been used where a radiometric analysis has been conducted

UID	Summary of submission	Response
		- A unit of ppm has been used when a chemical analysis has been conducted. Only one unit is used in Chapter 18 (Table 18.1 - line item headed Radiation from post closure sources). It is noted that there has been a typographical error where the text notes ""1 m/Sv per year"". This should read ""1mSv/year"".
64	Ch 18: There is no discussion of alternative closure strategies. Best practice is to return excavated material to the mined out pit(s). This has the advantage of returning the site to (approximately) its original configuration, and significantly reducing the possibility of erosion.	Refer to Section 4.1.1.
65	Ch 18: The wastes resulting from this project will be extremely long lived (radiologically). Therefore model predictions will not be able to be checked. This suggests a strongly precautionary approach should be taken in dealing with these materials. This needs to be discussed.	Refer to Section 4.1.3 and 4.1.4 for further assessment of capping WRD and other waste storage facilities post-closure.
66	Table 18.3: The plan for managing waste during and after closure should be drafted prior to the commencement of operations to check if there is any possibility that the closure and post-closure stages will not meet legislative and regulatory requirements. This plan can be updated as the project proceeds.	A Closure Plan will be finalised on completion of the detailed mine design. It will then be submitted to DPIR as part of the mining authorisation phase. The Plan will require approval from DPIR prior to the commencement of operations. Refer to Section 4.1 for further information on closure.
67	Appendix W: For rehabilitation, it is recommended that capping is used with an impermeable layer (e.g. clay layer). The 1 meter of waste rock is not an adequate layer of cover to the TSF and RSF. The final rehabilitation of the TSF and RSF waste areas by covering with one metre of clean waste rock and topsoil does not seem to take into account the possibility of infiltration and “bath tubbing” of the waste due to the clay lining below. No commitment to clay capping of the TSF or RSF runs the risk of water ingress, erosion and failure of the facilities. It is acknowledged that closure plans will be developed depending on the availability of materials.	Refer to Sections 2.9, 4.1.3 and 4.1.4 for further information on TSF/RSF design and rehabilitation. A Closure Plan will be submitted to DPIR for approval prior to the commencement of operations.

UID	Summary of submission	Response
68	App W 2.2: What does long term storage mean in this context? Since most of the materials to be stored contain elevated levels of thorium-232, which has a radioactive half-life of 14 billion years, long term storage is meaningless. Best practice with this type of material is near surface disposal, which for this situation would mean returning wastes, residues, tailings, etc., to the mined out pits and covering with clean soil. The reasons for rejecting this approach need to be discussed.	Long term storage, in accordance with ANCOLD guidelines, and consistent with good mining practice, is 1000 years. Refer to Section 4.1.1 for further discussion on closure options including in-pit disposal of waste material.
69	App W Table 2.1 Row 1: How can surface water runoff be re-established into natural drainage, when the presence of the pits has altered the surface landforms?	Row 1 relates to the pit and haul road domain. The closure design concept for the for the pit and haul roads is to remove cut-off drains and associated water storage ponds re-establish 'natural' drainage by re-profiling these areas. This concept relates to cut-off drains and associated water storage ponds only and not the pit.
70	App W Table 2.1 Row 1, p. 19 Flows - para 5: If the pits are not filled, and groundwater is allowed to flow into the pit and form a lake, then since the evaporation rate is several times higher than the rainfall rate there could be a net loss of groundwater from the local aquifer(s).	Yes, this is almost certain given the climate and geometry of the proposed pit. Refer to the model document presented in Appendix K of the EIS. Refer also to the post closure pit water levels and quality presented in Section 4.1.5.
71	App W 6.1: The overarching objective of closure should be to leave the site in such a condition that further remediation will not be required under reasonably foreseeable circumstances.	Agreed. The objectives of mine closure and rehabilitation are: • To establish a safe and stable post-mining land surface which supports vegetation growth over the long-term • To return the land, as close is reasonably practical, to its pre-disturbance land use • To make the site suitable for future leaseholders likely uses for the site. It is anticipated that meeting these objectives would result in a condition that further remediation will not be required under reasonably foreseeable circumstances.
72	App W 3.2.3: "The number of days above 35 ºC is expected to increase from its present mean of 38 to between 43 and 53 days (Loechel et al. 2010)." What does this mean?	Appendix W states: The number of days above 35 ºC is expected to increase from its present mean of 38 ºC to between 43 ºC to 53 ºC days (Loechel et al. 2010). This means that the mean temperature of all days with maximums greater than 35 ºC increases from a mean of 38 ºC to a mean between 43 ºC to 53 ºC.

UID	Summary of submission	Response
117	Water table: There is only one actual water table depth (28 m) given (for one site only) in Chapters 1 to 18.	Standing water table levels are presented in Appendix A of Appendix K of the EIS. Standing water table levels represent the depth (or elevation) of the water table relative to the standard of mAHD. Table 3-1 has been updated to include: • Monitoring Point (MP) elevation in mAHD • Standing Water Level (SWL) expressed as metres below monitoring point (mbMP) and • Date each MP was sampled

Table 3-1 Water levels and 'depths'

RC ID	Easting (MGA Z53)	Northing (MGA Z53)	Monitoring Point (mAHD)	Date	SWL (mAHD)	SWL (mbMP)
1	313937.128	7479631.23	625.268	19/12/2015	600.858	24.410
4	307763.181	7486548.519	631.576	18/12/2015	602.436	29.140
7	316193.433	7483227.035	633.425	18/12/2015	605.695	27.730
8	308126.126	7479251.362	613.993	19/12/2015	594.633	19.360
12	310991.304	7479445.326	618.724	19/12/2015	598.124	20.600
13	308091.879	7474063.312	608.306	19/12/2015	591.606	16.700
14	307457.233	7477916.769	611.313	19/12/2015	593.023	18.290
15	301281	7479871	606.894	19/12/2015	587.884	19.010
17	307457.233	7477916.769	604.696	19/12/2015	587.806	16.890
18	294438	7480880	602.432	19/12/2015	585.862	16.570
19	293705.95	7482183.292	601.229	19/12/2015	586.089	15.140
20	294453	7482367	601.747	19/12/2015	585.687	16.060
21	294442.718	7482392.172	601.937	19/12/2015	585.877	16.060
22	301305.332	7479870.455	606.354	19/12/2015	587.564	18.790
23	284426.599	7481960.191	595.331	19/12/2015	583.991	11.340

RC ID	Easting (MGA Z53)	Northing (MGA Z53)	Monitoring Point (mAHD)	Date	SWL (mAHD)	SWL (mbMP)
26	281259.794	7488103.722	608.684	19/12/2015	580.764	27.920
27	304170.922	7484940.241	622.566	18/12/2015	601.336	21.230
28	308061	7479250	613.698	19/12/2015	593.818	19.880
30	359007.351	7461773.977	650.350	10/12/2015	623.65	26.700
31	360006.955	7461763.174	651.930	10/12/2015	623.92	28.010
32	362000.709	7461724.592	653.838	10/12/2015	624.608	29.230
33	363007.234	7461735.596	653.973	10/12/2015	623.873	30.100
35	360192.973	7465800.151	644.479	10/12/2015	624.259	20.220
36	359390.384	7464709.727	644.556	10/12/2015	624.046	20.510
37	358688.893	7463770.304	645.890	10/12/2015	623.82	22.070
39	356684.288	7461773.42	646.474	10/12/2015	622.824	23.650
40	347809.473	7467735.722	642.184	31/12/2015	621.054	21.130
41	348499.777	7468478.228	641.954	31/12/2015	621.304	20.650
42	349511.307	7469502.876	641.571	31/12/2015	622.601	18.970
43	350298.54	7470360.367	641.176	31/12/2015	623.496	17.680
44	350998.974	7471508.62	640.993	31/12/2015	623.773	17.220
45	351618.94	7472424.615	640.442	31/12/2015	620.542	19.900
46	343182.469	7470504.25	655.404	17/12/2015	617.704	37.700
47	345191.373	7472372.745	654.005	31/12/2015	618.205	35.800
48	348193.362	7464455.988	637.654	31/12/2015	620.134	17.520
49	353372.977	7464688.678	646.656	10/12/2015	622.386	24.270
50	355190.779	7466064.356	652.790	10/12/2015	622.28	30.510
52	358698.361	7467381.303	651.747	10/12/2015	622.207	29.540
53	351733.895	7472642.787	640.876	31/12/2015	623.576	17.300
54	354698.774	7465767.002	650.677	10/12/2015	622.017	28.660
55	356693.785	7466884.594	654.305	10/12/2015	623.195	31.110

RC ID	Easting (MGA Z53)	Northing (MGA Z53)	Monitoring Point (mAHD)	Date	SWL (mAHD)	SWL (mbMP)
56	359875.715	7467968.413	645.482	10/12/2015	620.582	24.900
58	343705.573	7471008.3	654.842	31/12/2015	617.392	37.450
60	313034	7478052	620.909	19/12/2015	598.609	22.300
61	308822	7481504	627.787	3/01/2016	608.277	19.510
64	317941	7499867	663.705	18/12/2015	645.065	18.640
70	318757.8	7502084	658.119	18/12/2015	642.159	15.960
92	344181	7503511	603.372	17/12/2015	563.542	39.830
98	349526	7465263	638.035	10/12/2015	621.115	16.920

Table 3-2 Quality, depth and location

	Mine Site	Processing Site	Southern Basins Borefield Area
Quality	The quality of the groundwater in the mine site area is summarised and compared to guideline in Table 5 of Appendix K of the EIS. An extract of this is re-provided below.	Of note RC00078 and RC000079 groundwater bores underlie the processing site and the quality of the groundwater in the processing area (Southern Basins Basement) is summarised and compared to guidelines in Table 5 of Appendix K of the EIS. An extract of this is provided below.	Of note RC00027 is planned to be used as drinking water and this is isolated out of the Southern Basins Basement dataset. The quality of the groundwater in the southern basins area is summarised and compared to guidelines in Table 5 of Appendix K of the EIS. An extract of this is re-provided below.
Depth	RC00064 18.64m RC00070 15.96m	No depth data.	See Table 3-3
Location	RC00064 317941.0 7499867.0 RC00070 318757.8 7502084.0	RC00078 315680 7495342 RC00079 315680 7495342	See Table 3-3

Table 3-3 Southern Borefield depth and location

Name		Easting	Northing	Depth to groundwater (m)
RC000	01	313937.1	7479631	24.41
RC000	04	307763.2	7486549	29.14
RC000	07	316193.4	7483227	27.73
RC000	08	308126.1	7479251	19.36
RC000	12	310991.3	7479445	20.6
RC000	13	308091.9	7474063	16.7
RC000	14	307457.2	7477917	18.29
RC000	15	301281	7479871	19.01
RC000	17	307457.2	7477917	16.89
RC000	18	294438	7480880	16.57
RC000	19	293706	7482183	15.14
RC000	20	294453	7482367	16.06
RC000	21	294442.7	7482392	16.06
RC000	22	301305.3	7479870	18.79
RC000	23	284426.6	7481960	11.34
RC000	26	281259.8	7488104	27.92
RC000	27	304170.9	7484940	21.23
RC000	28	308061	7479250	19.88
RC000	60	313034	7478052	22.3
RC000	61	308822	7481504	19.51

Australian Radiation Protection and Nuclear Safety Agency cont.		
UID	Summary of submission	Response
118	Section 3.5: Veins of ore go down to 250-430 metres. What is the depth of the local water table? What volume of water will need to be pumped from the pit, and at what rate?	The depth of the local water table varies from 18.64 m to 15.96 m at RC0064 and RC00070 respectively in the mine area. Further investigation into the dewatering requirements of the pit has been undertaken (peak inflows are modelled in the EIS at approximately 40L/s (or closer to 45L/s) at full depth). The investigation concluded that although a dewatering rate of 10 L/sec (864 m3/day, 0.32 ML/a) would likely be required for a period of months to draw the groundwater level down by 100+ m using bores within the ore body, a more “as needs” approach (e.g. sump pump) is likely to be feasible (Appendix 6).
335	The EIS document is extensive, and is supported by many appendices produced by different authors; a lack of consistency makes it a difficult document to review	Noted.
336	Inadequate information on baseline studies of the proposed processing plant and accommodation site.	The modelling presented in the EIS demonstrates that both the processing site and the accommodation have low (<0.25Bq/g) U and Th activity concentrations. Therefore, baseline concentrations at these locations pose a low risk to personnel (Appendix F). A detailed baseline study was not required to be able to identify and assess the potential impacts of the project due to the low risk to personnel. No specific monitoring sites have yet been established at either of processing site or accommodation because, geologically, these locations have normal background levels. This has been confirmed by the detailed high resolution low level airborne radiometric data (see Appendix P). Arafura will continue to collect baseline radiological data prior to the commencement of the operations. The monitoring will continue in order to determine the actual project impacts during operations. The proponent will collect baseline radiological data prior to the commencement of the operations. This has been included as a commitment. Monitoring of radiation will be implemented as per the Radiation Management Plan (refer Table 2). Implementation of the Plan will commence prior to construction commencing.
337	Inadequate information on the effect of degradation over time on engineered barriers and tailings capping and subsequent radionuclide mobilisation.	Refer to Section 4.1.4 for further information the longevity of capping.
338	Ch 12 & App P: More detail on assumptions, factors applied and assessment methodologies is required so	Refer to Section 4.11 for further detail on radiation.

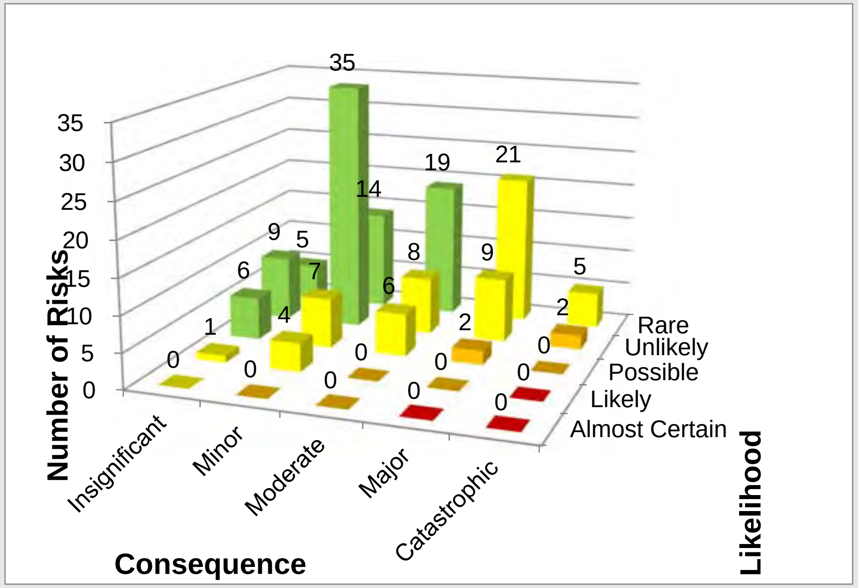
Australian Radiation Protection and Nuclear Safety Agency cont.		
UID	Summary of submission	Response
	that the reader can reproduce the calculations provided.	
339	App P: Improve cross-referencing and labelling	Noted.
340	Ch 12 & App P: The ICRP conversion factors for assessing inhalation doses from radon progeny exposure will be higher than current values. The dose coefficients applied and a discussion on the potential impacts of the future changes to these values needs to be included.	Refer to Section 4.11.3.
341	Ch 12: What is the specific relevance of the Transport Code RPS 2 in the operation of the mine? It is mentioned as a piece of relevant regulation but there is no mention of it in the rest of the document. The radionuclide content of the product to be shipped for processing means that the material that leaves the area and onto public roads and rail is exempt. Clarification as to the application of RPS 2.	The relevance of the Transport Code is that it provides guidance on surface contamination clearance levels, which are used by practitioners to ensure that plant, and equipment leaving an operation are free from removable radioactive contamination. Reference to the Code will be included in the Radiation Management Plan.
342	Ch 12: It is unclear why the uranium and thorium activity results of the ANSTO study for soil and flora have been presented separately from the more extensive environmental study conducted by Arafura in which more statistically significant results were gathered across a wider geographical area. The Aileron roadhouse result seems to be peculiar. These results do, however, show secular equilibrium with decay products. Site characterisation based on all data should be presented as a consolidated assessment, rather than in separate studies. In particular the soil and sediment samples.	The earlier ANSTO results were used to determine whether secular equilibrium for the U_{238} and Th_{232} decay chains was present in the soils. The more recent and more abundant Arafura results then provide information on the variability of the radionuclides across the region using the uranium and thorium concentrations alone. Chapter 12 of the EIS provides a summary of the radiation characteristics of the site. Chapter 12 summarises the findings detailed in the Radiation Reports (Appendix P).

Australian Radiation Protection and Nuclear Safety Agency cont.		
UID	Summary of submission	Response
343	Ch 12: It is stated that the project would comply with all relevant NT legislation. The EIS should demonstrate that all stages of the project (including closure and long-term post-closure) have a high probability of complying with all relevant legislative and regulatory requirements (both NT and Commonwealth) under all reasonably foreseeable circumstances.	Noted – all applicable NT legislation will be complied with. This has been included as a commitment.
344	Ch 12 & 18: The discussion in these chapters is not consistent with the information presented in the tables. The units vary from one table to the next (μSv/h, Bq/kg, ppm). Make the units consistent throughout. The readability of the document would be enhanced if the units were consistent throughout.	The units used in the radiation chapter in the EIS (Chapter 12) and the associated appendix (Appendix P) are representative of the quantities being presented. The units have been applied as follows: • A unit of Bq/kg (or Bq/g) has been used where a radiometric analysis has been conducted • A unit of ppm has been used when a chemical analysis has been conducted. Only one unit is used in Chapter 18 (Table 18.1 - line item headed Radiation from post closure sources). It is noted that there has been a typographical error where the text notes ""1m/Sv per year"". This should read ""1mSv/year"".
345	Ch 12: The assumption that the radionuclide concentration per unit mass at a point in air due to airborne dust is the same as that on the ground at the same point may not be valid, because the airborne dust at a point has usually come from an upwind point some distance away. Therefore direct measurements of airborne radionuclide concentrations in airborne dust give a much more reliable estimate of the dose resulting from inhalation of the dust. Measurements should be made of both mass loading and activity concentration of dust.	The method for estimating the potential doses from the inhalation of dusts is based on the results of the air quality modelling. This gives a modelled dust concentration at any point surrounding the operation. The dust concentrations are then converted to a radionuclide concentration based on an estimate of the specific activity of the dust. The method involves a number of conservative assumptions to ensure that the potential dose is not underestimated. This is described in detail in Chapter 12 and Appendix P of the EIS. It is noted that during operations, project dust emissions will be monitored and radionuclide analysis of the dust would occur for both dust concentrations (which would be sampled environmentally using a high-volume dust sampler) and for dust deposition (which would be sampled using dust deposition gauges).
346	Appendix X - J: There is no clear commitment to the application of dose constraints or action levels. Operational dose constraints for both workers and the public should be included in the radiation management plan and waste management plan.	Arafura will develop radiation action levels that will be used to trigger internal investigations or other controls based on the results of the baseline monitoring. The final levels, for both workers and the public, will be included as part of the final radiation management plan submitted for approval by the appropriate regulatory authority. This has been included as a commitment.

Australian Radiation Protection and Nuclear Safety Agency cont.		
UID	Summary of submission	Response
347	Appendix X - J: The Australian Radiation Dose Register (ANRDR) is not mentioned in the EIS. The ANRDR is mentioned in page 8, of Appendix X-J "on for input to future epidemiological studies; for example, the Australian National Dose Register." Confirmation in the radiation management plan that Radiation Doses will be incorporated into the ANRDR	Arafura recognises the importance of the ARPANSA ANRDR and will provide dose information. The provision of dose information will be included in the final Radiation Management Plan. This has been included as a commitment.
348	Table 6.1: Incorrect terminology "During operations all workers will be monitored regularly to record the level of radiation they are exposed to so Arafura can ensure this exposure does not exceed approved public health levels." Use correct terminology for member of the public exposure levels	Noted. The term ""approved public health levels"" is intended to refer generally to publicly accepted health limits. The terminology in Chapter 12 is more specific noting that there are internationally and nationally legislated occupational and member of the public annual dose limits.
349	Tables 12.8 & 12.9: The summary below Table 12-9 is not defensible on the basis of the data provide in these two tables (two data points in Table 12-8). Two groundwater samples are not enough to draw general conclusions. More data are needed to support the conclusion that radionuclide concentrations are elevated and highly variable.	Baseline radionuclide concentration in groundwater sampling will be undertaken as per the Water Management Plan (Appendix 4). The results of sampling that has been completed since 2015 is detailed in the Water Resource Assessment (Appendix 3).
350	Figure 12.3: The vertical axis label is ambiguous and confusing If there is a secondary axis (which is the logical inference) – the label should be put on the right hand side for clarity	The figure is intended to illustrate two phenomena - the diurnal variation in both radon and thoron concentrations, and the inverse relationship between wind speed and radon and thoron concentrations. The x-axis is the time axis. The y-axis presents three different variables: • The blue and red lines represent the radon and thoron concentrations (in Bq/m3) respectively. • The green line represents the wind speed, which has the units of '100 kph'. The actual wind speed at any point on the graph is determined by reading the y value and dividing by 100.

Australian Radiation Protection and Nuclear Safety Agency cont.		
UID	Summary of submission	Response
351	Section 12-12: 2 hours in still air may not be the worst case for radon. This is because, although the radon concentration is controlled by the ventilation rate, the rate at which the radon concentration increases with time when the ventilation is turned off may be such that in 2 hours the radon concentration will not reach levels of concern. It could be that working in a reduced ventilation rate for a month could give higher doses. This argument does not apply to thoron because of the much shorter decay time. Clarification required.	Refer to Section 4.11.1.
352	Section 12.4.2: It is not clear in some cases (e.g. consumption of bush tucker) whether the doses presented in the EIS are background doses, or due to the mining operations, or a mixture of the two. Clarification required.	The assessment of potential impacts in all cases is for project originated (i.e. mining operations) radionuclides and does not include the dose that would be received from the natural background radiation levels.
353	Section 12.4.2: Member of Public exposure to bush tucker >0.3 mSv/y but no control noted. Implementation of controls should be considered.	Section 12.4.2 of the EIS details that the estimate of the potential bush tucker dose was undertaken using conservative assumptions to assess a 'worst case' scenario. These conservative assumptions include: • Consumption rates • Radionuclide deposition for life of mine • The improbability of bush tucker consumption. It is noted that the estimated dose is quoted as 0.329mSv/y, however, it is considered highly unlikely to ever reach this level in practice. The assessment shows that the potential estimated doses under these assumptions the risk associated with the consumption of bushtucker is low. Therefore, no additional controls are warranted.
354	Section 12.4.4: Another way to establish closure criteria is to set goals which if achieved will mean that the site will not require future attention under all reasonably foreseeable conditions. Should be considered	Noted.

Australian Radiation Protection and Nuclear Safety Agency cont.		
UID	Summary of submission	Response
355	Section 12.4.1 & App P: Shielding factors are quoted as 50% for gamma doses. Justification or references are not provided for this value. Justification required	The attenuation figure / shielding factor is based on unpublished experimental work undertaken for the proposed ERA Ranger 3 Deeps project. Web reference is http://www.energyres.com.au/uploads/general/Appendix_08_Radiation.pdf
356	Ch 12 & App P: Dose estimates and calculations are on occasions inconsistent between main report and appendices. Values used should be consistent between the main chapter and supporting appendices.	There is a discrepancy between the occupational dose estimates in Appendix P (Table 9.2) and the estimates in Chapter 12 (Table 12.12). The correct results are shown in Chapter 12, Table 12.12 with the error occurring in Table 9.2 of Appendix P. The correct results reported in Table 12.12 reflect the commentary in the text of both the chapter and the appendix in the EIS.
357	Table 12.18 & App P Table 20: Post closure dose assessments based on failure scenarios have been provided. There is inadequate information to determine the validity of these calculations. Other scenarios where the site is used for recreation with failure should also be considered. Provide additional information showing the assumptions that were used in these calculations to establish the validity of the assessment.	Refer to Section 4.9.
358	Ch 12: No baseline radiological surveys of the processing plant or accommodation areas have been performed - focus on the mine site only Complete comprehensive surveys of the processing and accommodation areas for rehabilitation comparison.	The modelling presented in the EIS demonstrates that both the processing site and the accommodation have low (<0.25Bq/g) U and Th activity concentrations. A detailed baseline study was not required to be able to identify and assess the potential impacts of the project due to the low risk to personnel. A baseline dataset for the processing and accommodation sites will be determined prior to operations. This has been included as a commitment.
359	Appendix F: Risk 72 in the risk register implies that construction workers will be treated as members of the public unless their doses exceed the 1 mSv limit. In this case they will be treated as radiation workers with extra surveillance. It would be more prudent to treat them as radiation workers from the outset OR put into place measures to ensure that their doses do not exceed 1 mSv, e.g. limiting time in higher radiation work areas, rotational duties etc. The residual risk is listed as medium so it may be inferred that the	The overall intent of treating construction workers as ""members of the public"" is as a control measure. In this way, it would be expected that doses would be managed during construction to ensure that they remain less than 1 mSv per year. It is considered possible that construction worker doses would exceed 1 mSv/y and could occur but not expected or could occur up to once every 10 projects of this nature. If there are situations where the annual dose may exceed 1 mSv/y, then either additional controls would be implemented or the construction workers would be treated as radiation workers. Controls are detailed in the Radiation Management Plan (Appendix X_J of the EIS).

Australian Radiation Protection and Nuclear Safety Agency cont.		
UID	Summary of submission	Response
	exceedance of dose constraint of 1 mSv is a real possibility. Rationale for dose limit strategy for construction workers.	
394	Section 5.4, Figure 5.2, Table 5.6 and Figure 5.4: The risk summaries presented in the figures do not match the numbers presented in the Table 5-6	Whilst the total is the same, an error was made in the Figures 5.2 and 5.4 presented in the EIS – these are reproduced with corrections below.  Figure 3-1 Initial risk rating (after planned measures)

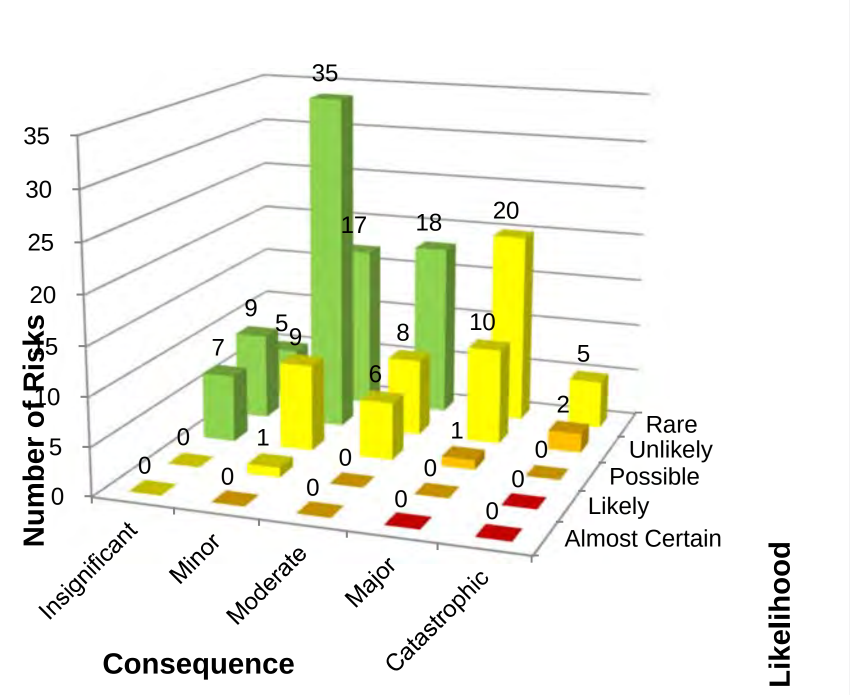
<table>
<tr><th colspan="3">Australian Radiation Protection and Nuclear Safety Agency cont.</th></tr>
<tr><th>UID</th><th>Summary of submission</th><th>Response</th></tr>
<tr><td></td><td></td><td>


Figure 3-2 residual risk rating (after additional control measures)
</td></tr>
<tr><td>418</td><td>Appendix L: There is not a complete dataset of geological samples. Figure 4 focuses on the ‘Pit’ and not on the other areas of the mine site. Further geochemical studies (kinetic leach tests) should be considered regarding the waste products in WRD, TSF and RSF.</td><td>Refer Sections 2.10, 4.23, 4.24, 4.25, 4.26, 4.28 and 4.29.</td></tr>
</table>

3.3 Central Land Council

UID	Summary of submission	Response
9	Better fauna management is required in relation to open water bodies on the mine site.	Refer to Section 4.19.
10	The whole of ecosystem study across the project footprint should include baseline invertebrate studies and data collection. Reasons of relatively few data or identification tools available for terrestrial invertebrates in the region should initiate or trigger baseline studies. Major projects and biodiversity studies are an opportunity to undertake a detailed invertebrate baseline study which provides a whole of ecosystem dimension in assessing all potential risks posed by the project.	There are no known or predicted threatened invertebrates within the study area apart from NT-listed land snails. A targeted survey in rocky habitats was completed as part of the initial 2010 surveys (no threatened snails were recorded). The requirement to survey for invertebrates was not included in the Terms of Reference for the Preparation of an Environmental Impact Statement, Nolans Rare Earth Project, Arafura Resources Limited NT EPA (May 2015) and no threatened invertebrates were known or predicted to occur in the study area (including a 20 km buffer) from the Federal DoEE's Protected Matters Search Tool (PMST). The NT EPA Guidelines for Assessment of Impacts on Terrestrial Biodiversity (2013) does not address invertebrate sampling in detail, and invertebrate surveys are not generally undertaken as part of a standard NT biodiversity assessment.
11	The EIS states that it is unlikely that avian migratory or endemic species will visit the TSF, RSF or other pond facilities at the Project area to drink. This is not the experience of the CLC and TSFs in its region. A management strategy to prevent visitations if they occur using appropriate controls should be developed.	Refer to Section 4.19.
12	Invertebrates have not been studied in sufficient detail in the project area.	Refer to UID 10.
13	Reasons of relatively few data or identification tools available for terrestrial invertebrates in the region should initiate or trigger baseline studies.	Refer to UID 10.
59	Mine closure should include traditional owners as post-mining land users.	Future users and land users, as detailed in the Rehabilitation, Decommissioning and Closure Report, is considered inclusive of Traditional Owners. Traditional Owners will be considered post-mining land users in the Mine Closure Plan. This has been included as a commitment.
60	The Preliminary Post-Rehabilitation Land Uses and Target Ecosystem table fails to include TOs as post mining land users	Refer to UID 59.

UID	Summary of submission	Response
110	Management strategies should be adopted to mitigate varied aspects and impacts arising from construction in light of the fact that the Project seems to be evolving and lacks detail and certainty in regards to the operation (mine footprint, ore beneficiation and general scale of the mine). It is noted that a change to the Project parameters was announced by Arafura during the EIS public comment period.	A construction management plan will be developed to ensure construction proceeds in accordance with Commonwealth and NT Regulations and Arafura's internal requirements. The project will be built, operated and managed in compliance with the NT and Commonwealth legislative requirements and regulations and in accordance with commitments made within the EIS.
115	Further detail regarding the limitations of the groundwater modelling is sourced to ensure project risks are appropriately addressed in relation to protection of local community water supplies.	Refer to Section 4.22 regarding further information on the groundwater model.
116	Concern as to whether groundwater modelling gives sufficient confidence in protecting Aboriginal community water supplies	Refer to Section 4.22 regarding further information on the groundwater model. The numerical groundwater modelling is a useful assessment and management tool. It allows for the identification of risk, the level of risk and how this risk could be mitigated. The numerical groundwater modelling provides a level of confidence in protection of the groundwater resources being used as the water supply to those Aboriginal Communities in the region that are directly connected to the aquifers to be utilised by the Mine. Arafura is not just relying on outputs from the groundwater model to quantify the level of risk and has examined the water supply of local communities within a radius of 80 km including: • Alyuen / Aileron Homestead / Aileron Roadhouse • Laramba Station • Napperby Station • Injulkama Outstation • Communities in the Ti Tree Basin (commencing about 40 km north of the mine site). Arafura has assessed impacts and proposed mitigation measures including contingency measures over the life of the mine including using multiple production bores and a series of borefields (refer Section 4.22.7 for further information). Ongoing groundwater monitoring and validation of the groundwater model will be undertaken for the life of the Mine. This has been included as a commitment.

UID	Summary of submission	Response
203	All cultural information be treated to the highest standards of confidentiality.	Agreed - Figure 16-2, Figures 16-4 to 16-7 and the Aboriginal and Historic Cultural Heritage Assessment (Appendix U) was not included in the EIS issued for public consultation to respect the sensitivity and confidentially of the cultural information.
204	Further sacred site and archaeological consultations are undertaken with traditional Aboriginal owners (TOs) prior to any works being undertaken for the Nolans Project.	Further sacred site and archaeological consultations will be undertaken with TOs prior to any works being undertaken. This has been included as a commitment and in the Cultural Heritage Management Plan (confidential) provided in Appendix 7.
205	Sacred site clearances be carried out prior to any activity associated with extractive material required for project construction.	Sacred site clearance (both AAPA and CLC) will be sought prior to the commencement of construction and will include any areas to be impacted outside of the immediate project area (i.e. material borrow pits for construction activities). This has been included as a commitment.
206	EIS should acknowledge the existence of confidential sacred site information provided by the CLC to Arafura	It is acknowledged that information associated with sacred sites was obtained from both the CLC and AAPA. Information presented in the detailed (and confidential) Aboriginal and Historic Cultural Heritage Assessment (Appendix U) has been interpreted from the AAPA Authority Certificates C2008/205 and C2013/205.
207	EIS should acknowledge that Arafura and the CLC will develop a management plan for protecting sacred sites as the project approvals are finalised and mining agreement settled.	It is acknowledged that Arafura and the CLC will develop a management plan for protecting sacred sites prior to the commencement of construction. This has been included as a commitment.
208	AAPA site RWA 8 and Artefact scatter NP-1 to NP-3 are contiguous to a CLC exclusion zone protecting a sacred site and are located in close proximity to the proposed infrastructure corridor.	RWA 8 has an existing station access road running through it. It is proposed to potentially upgrade this road to facilitate traffic flow from the mine site to the processing site. Natural terrain in this area is the limiting factor in developing alternate alignments that avoid RWA 8 in its entirety. The proponent intends, during final project design, to fully investigate options to locate the access road to completely avoid this site. This has been included as a commitment. In the event that direct impacts to RWA 8 seem unavoidable, the proponent will continue to engage with CLC, TOs and AAPA to discuss further options.
229	It is not reasonable to identify pit or bore field water as 'clean' due to the naturally elevated uranium levels in the groundwater and rocks and soil	Noted – ‘natural’ will be used in future references.

UID	Summary of submission	Response
230	Other sections of the EIS refer to pit water as contaminated; greater detail and clarity is required about the use of this water	Pit water is not considered to be contaminated as a result of mining processes but rather 'contaminated' from naturally occurring contaminants such as salts and radionuclides. Water sourced from mine dewatering will be utilised for dust suppression. Roads requiring regular watering are limited to mine haul roads, pit ramps, pit floor, and the ROM pad and access road from the mine to the processing site. water runoff from these areas will be managed by the sediment management system, therefore, any 'contaminants' (including radionuclides) will be contained within the dirty water management system, including during storm events up to the 100 year 72-hour design storm event.
231	CLC does not support the discharge of contaminated water to the environment under any circumstances	'Contaminated' water in the context of potential discharge to the environment is surface water from rainfall and naturally occurring sediments. The discharge of water is from sediment ponds only and is an event that is considered to be unlikely. Refer to the Water Management Plan (Appendix 4) for further information on water management.
232	Further studies are required into the risks associated with the use of water treated by Reverse Osmosis filtration	Potable water will be sourced from the borefield then treated (filtered and chlorinated) at the Desalination Water Treatment Plant prior to distribution across the Project as required. All water produced for potable use will meet Australian drinking water guidelines. This has been included as a commitment.
274	Limited detail is provided regarding planning or construction of permanent impermeable storage and transfer facilities for hazardous materials and hydrocarbons	All hazardous goods and materials (i.e. reagents) will be stored in compliance with Australian Standards. This is mandatory as part of the authorisation issued under the Mining Management Act. Storage and transfer areas will include hardstand areas with appropriate bunding and management controls.
275	Insufficient detail oily-water separation at vehicle wash down bays, hydrocarbon storage sumps, drainage systems for vehicle workshops or other areas dealing with contaminated water.	All hazardous goods and materials (e.g. oily-water) will be designed and managed in compliance with Australian Standards. This is mandatory as part of the authorisation issued under the Mining Management Act.
329	More information and detailed risk assessment is required prior to use, dispersal or management of pit water, groundwater and RO waste water due to analysis exceedances with respect to uranium.	Water sourced from mine dewatering will be utilised for dust suppression. Roads requiring regular watering are limited to mine haul roads, pit ramps, floor, and the ROM pad and access road from the mine to the processing site. Runoff from these areas is managed by the sediment management system, therefore, any contaminants (including radionuclides) will be contained within this management system during storm events up to the 100 year 72-hour design storm event.

UID	Summary of submission	Response
		The use of recycled water in operations has been captured in the Radiation Report – Occupational and Environmental Radiation Measurements and Predictions (Appendix P of the EIS). The Report determined that the predicted project increment (additional) radiation will be small compared with the natural background and also small compared with the variability in natural background. The use of recycled water, including risks associated with radionuclides, is detailed in the Risk Register (Appendix F of the EIS).
330	As planning towards mining is finalised and when there is more certainty, a review of personnel dosage rates of radionuclides should be undertaken.	Personnel doses will be assessed in line with advice of the Regulator and with reference to ARPANSA RPS 9.1 (Safety Guide for Monitoring, Assessing and Recording Occupational Radiation Doses in Mining and Mineral Processing (2011)). This has been included as a commitment.
331	Requests more detail about the management strategy for groundwater use and the removal of potential risk to humans or the environment from uranium exceedances in groundwater chemistry.	Refer to UID 329.
332	The mine closure provisions should include more detail on the management of contaminated infrastructure and the build-up of radionuclide materials across the site.	The primary closure aim, from a radiation protection perspective, is to return the site to a situation where radiation levels are consistent with preoperational levels. The key elements to achieve this include: • Remnant process material and contaminated soils would be disposed in tailings facilities, • Stockpiles containing radionuclide concentrations above 1Bq/g would be encapsulated in at least 2m of inert mined rock (note that this would occur progressively over the life of the project) • The tailings would be covered with at least 2 m of crushed inert mine rock • Infrastructure such as plant and equipment and mining equipment would be cleaned and undergo a radiation clearance procedure with the aim of recycling as much material as possible • Plant and infrastructure that cannot be cost effectively decontaminated will be buried either within the tailings or in the waste rock stockpiles. This will be done in accordance with directions of the appropriate competent authority.

UID	Summary of submission	Response
		• Contaminated liquids would be allowed to evaporate and the remnant solids disposed into the tailings facilities • It is expected that the plant site would be free from contamination once rehabilitated. Accordingly, it is expected that there would be no long term radiation exposures to the public following closure. • Monitoring would occur for a period agreed to by the Regulator to confirm the conclusion. This has been included as a commitment.
333	Review of personal dosage rates will need to be undertaken prior to final approval	Refer to UID 330.
334	Mine closure provisions should include more detail on the management of project contaminated infrastructure Monitoring of operations needs to demonstrate no long term issues with any build-up of radionuclide materials across site.	Refer to UID 332.
397	A more sensitive approach in reporting is implemented for this SIA, ensuring internal and external statements released are of sound quality and do not imply negative perceptions about the Aboriginal community	The Social Impact Assessment provides an accurate record of the comments collected through the assessment process, as expressed by those stakeholders consulted. Interviews were undertaken both opportunistically and formally to ensure that a broad range views and perceptions about the project and its potential impacts were gathered. To censor comments and findings made in good faith would not be an accurate reflection of the SIA process. These are the views of the community in which the project will operate, the SIA was simply the process and vehicle that enables the collection and reporting of these. The comments detailed in the SIA are the opinion of those stakeholders consulted rather than those of Arafura.
398	SIA makes some generalisations and uses negative stereotypes about Aboriginal people	Refer to UID 397.
399	Management of royalties is a matter for traditional Aboriginal owners	Agreed.
416	The Tailings Storage Facility (TSF) and Residue Storage Facility (RSF) plans should be updated in the EIS amendments showing any design changes as a result of tailings characterisation analysis.	A draft Tailings Management Plan is provided within the ATC report in Appendix 2.

UID	Summary of submission	Response
417	Assessment of TSF-RSF residues is in progress and therefore being assessed without all the essential information	Refer to the Section 2.9, 4.23, 4.24 and Chapter 5.
467	Questions the certainty and comprehensiveness of the assessment given that the Project is still evolving and considers further assessment to be necessary once the Project design is finalised.	The Project is described in Chapter 2 and has been updated to include design details of the main components of the mine. Should the project vary outside the scope of what is presented, Arafura will comply with the necessary regulatory notification processes and procedures.
468	Recommends that best practice landfill management be adopted.	Arafura will conduct landfill management in accordance with the NT EPA Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites (2013) and Waste Management Guidelines for Small Communities in the Northern Territory (2009). This has been included as a commitment.
469	The coverage of risks and issues in the Environmental Impact Statement and the quality of information provided in the document is satisfactory for the Project description currently available	Noted.

3.4 Department of Business

UID	Summary of submission	Response
94	Key economic indicators used in the EIS are dated 2013-2014 and should be updated to 2014-2015 to accurately reflect the current NT economy	The economic modelling was undertaken in late 2015 and, at that time, the 2013-2014 figures used were the most recent figures available from the Australian Bureau Statistics. Many of the other parameters used in the modelling are also subject to change over time and therefore the Economic Impact Report should be read in the context of the 2013-2014 economic climate.
95	Encourages the pursuit of local regional employment and business opportunities where appropriate	Noted.

3.5 Department of Environment

UID	Summary of submission	Response
2	Climate change a) Discuss how a changing climate may impact on operations and the management of impacts to MNES. b) Provide discussion on emissions including but not limited to carbon emissions, nitrous oxide and sulphur dioxide emissions of the project and how these have been considered and addressed. Discuss what measures have been taken to reduce the emissions of the project.	Part A Potential impacts from climate change are anticipated to be at a greater scale (regional) than the project. Refer to the Biodiversity Management Plan (Appendix X-D of the EIS) management of impacts to MNES. Management plans will be updated as relevant through the life of project. Part B Carbon (CO) and nitrogen dioxide (NO_2) emissions are anticipated from the power station. Estimates of emissions have been calculated based on three gas turbines, of 5 MW capacity each, as a conservative estimate for this assessment to represent the 12.5 MW loading required for the plant. Estimated carbon and nitrogen dioxide emissions are presented in Table 12 of the Air Report (Appendix Q of the EIS). A gas-fired power station is the preferred power generator fuel as it burns ‘cleaner’ than for other available fuels such as coal or diesel. A reduction in the sulphur input to the processing plant, as a result of a change from a SAPL to PAPL process, will result in a linear reduction in sulphur dioxide (SO2) emissions. The emission rate will reduce from 20g/s to 13g/s. A PAPL process is now the preferred method for processing ore due to the reduction in sulphur input (and subsequent reduction in sulphur dioxide emissions). No part of the operation will produce nitrous oxide (N_2O) as an emission source. The operation of the processing plant and power station have been shown to be well within compliance limits.

UID	Summary of submission	Response
17	Additional disturbance required to distribute power to individual bores. a) Discuss the likelihood that power lines will be required to link to each individual bore. b) Quantify the additional disturbance required in the bore field if the option to link powerlines to each individual bore was selected. c) Discuss any impact this would have on habitat for the Great Desert Skink. d) Confirm whether surveys for the Great Desert Skink have been undertaken along the potential alignment of the powerlines.	Part A Powerlines may be required to link each bore as illustrated in Figure 3-3 of the EIS. If required the powerlines would be located within a common utility corridor and will be installed parallel to the water supply pipeline. Part B – C & D The current burrows occupied by Great Desert Skink will not be impacted by any planned borefield development. The targeted surveys for the Great Desert Skink included the corridor (Figure 3 – Appendix N). Potential impacts associated with disturbance have been captured in the risk assessments completed for the borefield in the Fauna and Threatened Species Report (Appendix N).
18	Assessment of impacts in regard to Significance a) As outlined in the comments provided at the Adequacy review stage, determination of whether the project will result in a significant impact to MNES was determined at the referral stage. All discussion regarding the impacts to MNES in the EIS should be around whether or not the impacts are acceptable given their scale, context, magnitude and proposed mitigation/management.	Conclusions regarding significant impacts on listed threatened species at the time of referral to the DEE (EPBC Ref: 2015/7436, 16 March 2015) pre-dated field surveys. Prior to field survey, it was only possible to suggest that the project had the potential to have a significant impact based on the likelihood of occurrence of threatened species. Since then, additional baseline and targeted surveys were conducted from 27th April – 3rd May 2015 and 21st to 26th July 2015. The surveys included targeted survey effort for Black-footed Rock-wallaby (*Petrogale lateralis* MacDonnell Ranges Race), Greater Bilby (*Macrotis lagotis*) and Great Desert Skink (*Liopholis kintorei*). The results of the surveys indicated a widespread population of Black-footed Rock-wallaby including juvenile animals in the locality (Section 4.5.6 of Appendix N of the EIS); however, the majority of records came from outside the mine footprint, with old scat only recorded (i.e. no fresh or juvenile scat observed) within the project footprint. No favoured food plants were observed. As suggested by the results of the surveys, it is likely that the Black-footed Rock-wallaby passes through the mine area on a transient/infrequent basis and unlikely that it resides or breeds within the proposed mine footprint. The targeted surveys also identified a single Great Desert Skink warren, with several individuals present including at least one juvenile; but no signs of the Greater Bilby were detected. The initial risk to these species posed by the proposal has been reduced through appropriate mitigation and management actions, including: • Preparation of a Biodiversity Management Plan for implementation, thereby actively avoiding known Great Desert Skink burrows when clearing sandplain habitat,

UID	Summary of submission	Response
		• Preparation of a Bushfire Management Plan for implementation, with actions to minimise probability of extensive wildfires, • Establishment of a predator-proof compound for domestic waste landfill, and • Preparation of a Traffic and Road Safety Management Plan for implementation, to reduce the likelihood of vehicle collision with wildlife. As proposed in the EIS, these actions are expected to reduce the residual risk to 'Medium' or 'Low' for both the Great Desert Skink and Black-footed Rock-wallaby. Additional or alternative actions are considered unlikely to reduce the residual risk further. It is proposed that a ‘Low’ residual risk (with mitigation) is an acceptable level of risk, considering scale, context and magnitude, and that additional mitigation will not reduce the rating any further. Australian Standard Risk Assessment Methodology consistent with AS/NZS ISO 31000:2009 ‘Risk Management – Principles and Guidelines’ were employed for the risk assessment process in ‘Appendix N – Biodiversity, fauna and threatened species report’. Impacts from clearing, dust, noise, light, exotic plants and animals, waste water, lowering or contamination of water table and traffic mortality are all indicated as having a ‘Low’ residual impact to MNES following mitigation. This suggests that these impacts will be managed to an acceptable level with mitigation. Unplanned wildfire is the only impact that, even with mitigation, continues to result in a ‘Medium’ impact rating. However, fire is a difficult threat to control completely in arid environments where fires can burn uncontrolled for months, burning thousands of hectares of habitat. The areas of flammable long unburnt spinifex habitat will require careful management by the proponent (e.g. habitats where the Great Desert Skink resides), which may include the establishment of fire breaks to reduce the chance that wildlife will reach these important areas of habitat. A precautionary approach has been applied for the risk assessment, therefore the Significant Impact Criteria for Critically Endangered and Endangered species was used rather than criteria for Vulnerable species only.
19	Consideration of Conservation Advice, Recovery Plans and Threat Abatement Plans for listed species. a) Please demonstrate how relevant conservation advice and recovery plans been considered when undertaking the risk assessment and impact assessment for listed species. b) Please demonstrate how the threat abatement plans	Numerous Commonwealth and NT government publications, documents and websites that were considered directly or indirectly relevant to the species were consulted, including the Commonwealth Species Profile and Threats Database (SPRAT), NT NRMaps, conservation advice statements, species fact-sheets and Recovery Plans. A completed list of resources utilised is provided in the reference Section of Appendix N of the EIS. There is no Recovery Plan for the Brush-tailed Mulgara as it is not listed under the EPBC Act nor is there such a Plan for the other Mulgara species, which are listed under the Act (i.e. the

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	for land degradation by rabbits and impacts to Northern Australia's biodiversity by five listed grasses have been considered.	Crest-tailed Mulgara which is not expected to occur within the study area). Given the historical uncertainty regarding species identification of Mulgara, conservation information pertaining to the Crest-tailed Mulgara was used also when evaluating potential impacts and mitigation for the Brush-tailed Mulgara. It is expected that the species are likely to encounter similar threats and risks, and successful management of those factors for the two species is likely to follow similar approaches. Threat Abatement Plans relevant to the Great Desert Skink and the Brush-tailed Mulgara (and many other fauna species that occur within the site) include the Plans for Feral Cats, European Red Foxes and European Rabbits. All of these were considered when developing the approach and methods for future monitoring and management of impacts on these threatened fauna species. The DOEE document 'Threat abatement plan to reduce the impact on northern Australia's biodiversity by the five listed grasses' (2012) was also consulted in the development of mitigation and monitoring for threatened species and the development of the Weed Management Plan. In particular, management actions will be implemented to prevent the spread of Buffel Grass in Rock-wallaby habitat, which will be covered in a weed management plan. The 2015 document by DOEE 'Threat abatement advice for ecosystem degradation, habitat loss and species decline in arid and semi-arid Australia due to the invasion of Buffel Grass (*Cenchrus ciliaris* and *C. pennisetiformis*) was also consulted for the EIS. Despite extensive survey effort over multiple years and in a range of seasons, the European Rabbit was only recorded incidentally on one occasion on-site in 2010. Biological assessment of the study area does identify the Rabbit as being an ecological issue. The Rabbit is included within the Biodiversity Management Plan (BMP) pest animal monitoring and pest animal register, therefore through the implementation of that Plan, increases in Rabbit abundance would be detected, reported and addressed. Control measures will be implemented if an increase is detected via the pest animal register and will include warren fumigation and/or ripping as detailed in the BMP. Prior to control methods being used on a suspected rabbit warren, motion-sensing cameras must be deployed at warren entrances for at least 30 days during the warmer months (October to March) to make certain that the burrows aren't used by Mulgara, Great Desert Skink or any other threatened fauna species. If any burrow is found to support a native threatened species, then fumigation and warren ripping are not suitable and will not be done. Other rabbit-control methods would be established (e.g. trapping, shooting).

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20	Environmental offsets. Offsets to compensate for residual impacts to MNES may be relevant to this proposal as outlined in Appendix N. However, no further discussion is provided in the EIS or the Biodiversity Management Plan. a) Please provide consideration how the Commonwealth offset policy applies to this project. b) Provide discussion on the potential to source and secure offsets for impacted matters including availability of suitable land, land tenure and possible mechanisms to deliver offsets for the project.	Part A An analysis of how the Commonwealth offset policy applies to this project has been completed, and is provided in Appendix 5. Part B Should it be determined by the DoEE that offsets are applicable to this project under the EPBC Act, then Arafura will provide an offsets proposal. This has been included as a commitment.
21	Impacts to MNES require more clarity The discussion of impacts to threatened species requires more clarity on the outcome for species. The section should discuss the likely impacts, describe proposed mitigation measures and then provide a summary of the outcome for each species. The sections currently do not provide a final discussion of the outcome for species of concern following the application of mitigation and management measures. The rating for risks identified to MNES should be reviewed. Risks relating to the loss of habitat and loss of individuals are not given enough weighting in the assessment (refer to Comment 27). The assessments do not provide adequate assessment of the likelihood of fragmentation to species habitats and the impacts associated with this. a) Provide further justification for why clearing of dispersal and foraging habitat is considered unlikely for the BFRW and GDS when section 10.7.3 states known habitat will be lost. Appendix N (P.74) notes that with their specific habitat requirements BFRW can be limited in their ability to disperse.	The objective of the risk tables presented in Chapter 10 (Tables 10-8 and 10-9) is to assess whether the action is likely to trigger any of the Significant Impact Criteria that were assessed individually against key threats for each species (Tables 10-10 to 10-27). The risk assessment determines that it would be 'unlikely' that the removal of habitat would lead to a long-term decrease in the size of the Black-footed Rock-wallaby population; the chance of this occurring is rated as 'low'. It is also rated 'unlikely' that clearing of dispersal habitat for the Great Desert Skink would lead to a significant impact on the species. The risk register in Appendix F of the EIS outlines the likelihood and consequence of vegetation clearing resulting in the loss of possible breeding, foraging and dispersal habitat for listed threatened species resulting in adverse effects to the survival of population of species is 'unlikely' and 'minor', respectively, resulting in a 'low' risk ranking. Part A -B Marginal transitory dispersal habitat for Black-footed Rock-wallaby will be lost (234.64 ha). As discussed in the Biodiversity Report (Appendix M in the EIS), impact to dispersal habitat for Black-footed Rock-wallaby (i.e. the proposed mine footprint) is considered 'unlikely' to be of significant consequence to the species. The justification is that the footprint is surrounded by higher quality foraging/breeding habitat that is more likely to be used and relied upon by the species. The lower quality habitat within the proposed mine footprint only revealed old scat, suggesting only transient and infrequent activity. Food plants (i.e. foraging habitat) were not recorded on the mine site footprint. The relatively small footprint of the proposed borefield is unlikely to significantly impact Great Desert Skink movements in the sandplain habitats of the study area. Dispersal by Great

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	b) Provide further discussion on potential impacts to dispersal of the BFRW and the GDS. c) Clarify what the area of habitat (ha) is for the BFRW and the GDS that may be impacted by indirect impacts such as dust deposition and artificial light spill. i. Discuss what mitigation measures will specifically be implemented to minimise indirect impacts to MNES. General mitigation measures only are discussed in the EIS. d) Discuss what the outcome for each species will be following the application of the mitigation and management measures proposed. Clarify whether the project will result in a residual impact to MNES.	Desert Skink is likely to be largely unaffected by the proposed borefield construction and operation, particularly given the habitat is expected to regrow over the pipeline once installed. Part C For dust, PM_{10} levels exceeding 50 ug/m^3 (human recommended levels) are unlikely to occur beyond 1 km from the mine site. This equates to an area of approximately 314 ha in the immediate vicinity of the proposed mine site could be impacted by dust levels exceeding 50ug/m^3. A small proportion of this area could be considered transitory/dispersal habitat for Blackfooted Rock-wallaby. Dust impacts on species that occur in the borefield area are expected to be negligible as PM_{10} levels exceeding 50 ug/m^3 are unlikely to occur beyond 1 km from the mine site. Species known to occur in the borefield area have nearest records that are in excess of 12 km (Brush-tailed Mulgara) and 25 km (Great Desert Skink) respectively from the mine site. Specific mitigation measures for dust are discussed in the Biodiversity Management Plan (BMP) and include: • Development of a dust management plan • Vehicle speed limits. Light impacts are more difficult to ascertain, however they are likely to be negligible for borefield associated fauna (including the Great Desert Skink) as no permanent lighting structures will be erected in this part of the project area. Access to the borefield is expected to occur during daylight hours only. Light impacts to Black-footed Rock-wallaby are likely to be low following mitigation. The July 2015 survey indicated that this species occurs in suitable foraging/breeding habitat in excess of 2 km from the proposed mine footprint and in elevated rocky habitats. Both of these factors are expected to reduce the potential for light impacts to this species. Specific mitigation measures for light discussed in the BMP include: • Limit artificial light to areas where it is essential • Turn off lights when not required • Avoid the flood of light into natural habitats and limit the escape of light into surrounding areas of fauna habitat (i.e. using shields/deflectors) • Ensure that artificial lighting is not directed upwards or laterally (i.e. should be directed towards the ground) • Use lower (i.e. closer to the ground) rather than higher lighting installations • Use lower wavelengths of light wherever possible i.e. red/yellow lights • Use light intensities that are as low as possible without reducing safety or efficiency • Avoid painting large structures bright or reflective colours and minimise use of bright or reflective construction materials and finishes for large structures.

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		Part D The risks to threatened species have been assessed in the EIS. The risk posed by the development has been further reduced through appropriate mitigation and management actions, including: • Biodiversity Management Plan • Actively avoiding known Great Desert Skink burrows when clearing sandplain habitat • A Bushfire Management Plan with actions to minimise probability of extensive wildfires These actions are expected to reduce the residual risk to 'Medium' or 'Low' severity for the Great Desert Skink and Black-footed Rock-wallaby. It is unlikely that additional or alternative actions will further reduce the residual severity, therefore a Medium to Low residual risk remains for these two species, which in turn is unlikely to be significant as per the EPBC Significant Impact Guidelines. The acceptability of the residual impacts to these MNES is discussed further in UID 18 above.
22	Trigger Points a) Provide further justification for why the first trigger point for further mitigation require both a nil detection result and road kill incidents to occur before action is taken. This could result in action being taken too late to prevent further impacts. Trigger points should consider a broader range of factors which also allow for consideration of indirect impacts. b) Discuss how weed monitoring and habitat monitoring feed into the trigger levels for these species.	Part A The first trigger for the Black-footed Rock-wallaby is a level of change in population size or activity patterns greater than moderate. The monitoring methodology is detailed in the Biodiversity Management Plan and further described in Section 4.20. Threats that have the potential to have the greatest impact on the population include introduced/native predators (cats, foxes, dingoes) and wildfire and potentially weed invasion by Buffel Grass (which can increase the incidence of fire within habitats). Additional triggers have been included in the TARP, based on these threats, to increase the sensitivity of the trigger point through the inclusion of a broad range of factors. These additional triggers include: • Vehicle strike and no detection of individuals in the outcrop near the Mine • Predator numbers have increased or increased greatly • Wildfire in the rocky areas and no detection of individuals in the outcrop near the Mine Additional triggers will be considered for Black-footed Rock-wallaby once further monitoring of the population has been undertaken. Additional triggers may include: • Recruitment triggers could be used for population monitoring, although this should be established following the first round of remote camera data analysis. To this point, only five sites were found to support juvenile wallabies (based on scat collection and

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		analysis) and camera data may reveal additional sites supporting juvenile animals such as the Reaphook Hills where fresh scat was observed. Trigger levels could then be set for contingency action, should changes in recruitment be detected. • Observed reduction (e.g. 20%) of sites where rock-wallabies are recorded. Caution would be needed to determine an appropriate trigger, as other factors such as drought could result in a population decline – the chosen trigger (e.g. 20% reduction) would need to be supported by data from monitoring (e.g. increase in incidence of fire, predators). The inclusion of further triggers in the BMP, developed in consultation with a suitably qualified and experienced professional, has been included as a commitment. Triggers for weeds are detailed in the Weed Management Plan and include: • Spread of environmental weeds to areas previously weed free. • Introduction of Class A, B and C weeds and WoNS to areas previous weed free • Triggers for wildfire are detailed in the Fire Management Plan and includes a bushfire within the vicinity of the Project. Part B Weed monitoring does not directly feed into the trigger points set for Black-footed Rock-wallaby. Weeds will be monitored quarterly or following rain events and managed to meet the objective of no new Declared weeds and no spread of existing Declared weeds within the Project area. Weed trigger points initiate the additional chemical control as required and increase frequency of surveillance monitoring. The threatening process associated with weeds is the potential increased the incidence of fire within habitats. This threatening process is monitored through the wildfire trigger point detailed above. Future monitoring of the Black-footed Rock-wallaby will also consider: • The incidence and extent of fire (remote sensing and rock-wallaby monitoring sites). • Predator abundance/diversity as discussed in BMP using motion sensor remote cameras • The incidence and abundance of weeds with a focus on Buffel Grass (habitat assessments at rock-wallaby monitoring sites). • Dust/noise/light levels at rock-wallaby monitoring sites to determine impacts to wallaby populations.

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		The consideration of habitat in the Black-footed Rock-wallaby monitoring program has been included as a commitment.
23	Open speed limit on approach to Nolans turn off a) Describe what measures will be implemented to warn approaching motorists travelling at speed (open speed limit) of the intersection to the Nolans site and potential hazards e.g. turning trucks.	Open speed limits are no longer applicable on Northern Territory roads. The intersection will be upgraded to meet the requirements of the DIPL. This has been included as a commitment.
24	Biodiversity management plan e) Define 'reduced' speed limits for areas adjacent to known ecologically sensitive areas. f) Assessment criteria should also consider time over which the change has occurred – gradual or abrupt. Small incremental changes year on year may not trigger action in any one year but cumulative reduction over time be still be substantial.	The speed limit on the bitumen access road will be 100 km/h and on gravel roads will be 80 km/h. The speed limit will be reduced to 60 km/h when the road passes in close proximity to sensitive areas and on all gravel roads between dusk and dawn. Refer to UID for 488, Figure 3-12 for a map of sensitive areas. Triggers in the EMP will be updated to consider cumulative impacts over time. This has been included as a commitment.
25	Mitigation measures to minimise impacts to fauna associated with the TSF a) Detail specific mitigation measures that will be implemented to deter birds and other fauna from the TSF. b) Describe the proposed fence around the TSF and whether the fence will be constructed to a standard which is considered man-proof or kangaroo proof.	Part A Refer to Section 4.19. Part B Stock fencing will be installed around the TSF, RSF and ponds to prevent kangaroos, stock and other larger fauna entering the area, and therefore a measure to limit opportunity to drink the pond content. A water trough will be installed outside perimeter fencing at the water storage pond at the borefield to provide water for wildlife to reduce the likelihood of fauna breaking the fence. There are also numerous watering points for stock, which are currently used by native fauna, which are located across the project area. Alternate water sources will also be provided adjacent to the facilities.
26	Clearing of habitat for Great Desert Skink a) Section 10.8.3 states that the vegetation to be cleared is low quality habitat. Provide further	The Great Desert Skink occupies a range of vegetation types, with its main habitat being sandplain and adjacent swales. Great Desert Skinks prefer a landscape that supports a mosaic of differently-aged vegetation, and typically inhabit sites that have been burnt in the

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	justification for why the habitat is considered to be low quality.	previous three to fifteen years (McAlpin 2001). Vegetation usually consists of hummock grassland (*Triodia basedowii, T. pungens* and *T. schinzii*), with some scattered shrubs and occasional trees (e.g. *Acacia spp., Eucalyptus spp., Hakea spp., Grevillea spp*. and *Allocasuarina decaisneana*) (Cogger et al. 1993; McAlpin 2001). The active warren is located in the older spinifex to the far west of the borefield. Large components of habitat of the borefield are comprised of recently burnt sandplain habitat (last burnt in 2011, Dr R. Paltridge pers. comm.). The age class of the vegetation that occupies the sandplain across large areas of the borefield is considered to be too young and lacks the floristic diversity/cover to support this species. Therefore, the habitat of the borefield for this species is considered to be currently of low quality. Extensive searches by teams of (a minimum) four people failed to yield additional active/disused burrows within the borefield and further supports the assessment that the borefield is currently of low quality.
27	Assessment of impacts to Black-footed Rock Wallaby states: “This suggests that it is unlikely that the planned removal of ‘transitory’ habitat for black-footed rock-wallaby may result in a minor impact to the long-term size of the local population.” (Emphasis added). a) Review the assessments provided in table 27 to ensure that the message is consistent and correct. b) As per comment 14, the assessment of risk for clearing of habitat needs to be reviewed. Based on the risk classification used in the report the likelihood of clearing foraging and dispersal habitat should be considered ‘almost certain’ as it will occur as a result of this project. That would give a rating of 5, which would mean that clearing of habitat is classified as a high risk activity. This should be reviewed for all species throughout all documents.	The assessment provided in Table 27 have been reviewed and remain unchanged. The objective of the risk table is to determine the risk that the action will have a significant impact (according to EPBC Significant Impact Criteria) rather than the risk of the action occurring. In this instance, it is rated as ‘unlikely’ that the removal of transitory habitat will lead to ‘minor’ impact to the long-term size of a population. The source of impact for each significant impact criteria has been itemised for the purpose of completing the assessment. The risk of the action occurring (i.e. vegetation clearing) and the subsequent impact to threatened fauna is captured in the Risk Register (Appendix F of the EIS). The Register outlines the likelihood and consequence of vegetation clearing impacting threatened fauna as ‘unlikely’ and ‘minor’, respectively, resulting in a ‘low’ risk ranking.
28	Night Parrot a) Potential habitat for the Night Parrot occurs within the study area as noted in Appendix N. Please provide further discussion on the likelihood of occurrence, possible impacts and mitigation for this species.	The following assessment of the likelihood of occurrence of the Night Parrot within the Nolans study area was made by Dr Rachel Paltridge from the Night Parrot Recovery Team as follows: *I have reviewed the habitat types present in the vicinity of the Nolans Project area (Borefields Area, Processing Facility and Mine Site) and I do not consider it likely to support a Night*

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		Parrot population due to an absence of suitable roosting habitat. Where Night Parrots occur in spinifex habitats they require very old-growth stands to roost and breed in, and the spinifex species used forms large compact hummocks or rings. Suitable spinifex habitat tends only to occur on rocky or gravelly substrates where large areas of bare ground halt the passage of fire and allow stands of spinifex to remain unburnt for many decades. Although the Borefields Area of the Nolans Project Site is dominated by spinifex, it is a fire-prone Triodia basedowii sandplain, most of which last burnt in about 2011 and the oldest patches may date back to 2001-02. To my knowledge Triodia basedowii is not a species that Night Parrots have been recorded using either recently or historically, and is structurally unsuitable for their requirements. I note very small areas of Triodia spicata occur in the rocky habitats around the Mine Site. This species of spinifex may provide suitable nesting and roosting sites for Night Parrots however I do not believe there is enough of this habitat to support any Night Parrots at this site. The area also lacks suitable feeding habitat for Night Parrots. If there was any suitable productive habitat it is likely to have suffered from the impacts of a long history of cattle grazing. Of course our understanding of Night Parrot habitat requirements is based on a very small known area of current occupation, and historical records from a long time ago, and its full range of potential habitats will never be known, but based on current knowledge I do not consider the Nolans Project Area supports suitable Night Parrot habitat.
111	Overview of the geology of the local area a) Please provide a brief summary of the geological context of the Nolans site.	A brief summary of the geological context is provided in Hussey (ARU-15/008), which is attached to Appendix P in the EIS, although it does not appear in the table of contents contained in Appendix P. A regional geological map is also provided in Figure 27 in Hussey (ARU-15/008) attached to Appendix P, showing the location of the deposit and the mineral lease. The geological legend for Figure 27 in Appendix P is as follows: • Reds and pinks are various granitic or felsic gneisses • Browns are metasedimentary schists/gneiss units • Blue is marble and calcsilicates • Purple is mafic rock unit • Pale blue is alluvium • Greenish beige is red soil • Cream is sheet sand. The deposit occurs in the Aileron Province of the Arunta Region. The Aileron Province is dominated by moderate- to high-metamorphic grade 1860-1720 Ma metasedimentary rocks

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		with the widespread emplacement of granitoids and lesser mafic-ultramafic bodies during the Stafford (1815-1795 Ma), Yambah (1780-1750 Ma) and Strangways (1735-1695 Ma) events. The Ordovician-Carboniferous Alice Springs Orogeny exhumed the Arunta Region and is largely responsible for the current geological framework. Cenozoic basins occur across the region and regolith studies imply that the deposit and the surrounding metamorphic rocks have been actively weathering and eroding since the Mesozoic. The 1860-1820 Ma Lander Rock Formation is the oldest unit in the Aileron Province. It comprises intercalated psammitic and pelitic metasedimentary rocks, which are correlated, at least in part, with the Aileron and Nolans Dam Metamorphics to the east and southeast of the deposit. The outcropping psammopelitic and pelitic granulites west and northwest of the deposit, and the psammitic and psammopelitic schists to the south, are all mapped as Lander Rock Formation. Later felsic orthogneisses occur across the northern part of the deposit and form significant intrusive bodies, which can be traced using aeromagnetic data to outcropping Boothby Orthogneiss in the north, dated at 1806 Ma. A number of different granitic phases have been recognised in the area and it is possible that some may be contemporaneous with the nearby 1770 Ma Napperby Gneiss. The Strangways Event is thought to be a low-grade event in this area, which is most likely responsible for the deformation, and folding in the Reynolds Range Group, given the subsequent overprinting metamorphism. The southeast Reynolds Range area is characterised by high-temperature, low- to medium-pressure granulite facies metamorphism. A large amount of research has demonstrated that widespread high-grade metamorphism last occurred in this area during the 1595-1550 Ma Chewings Event. 1550-1510 Ma pegmatites, which are overprinted by the mineralisation at Nolans Bore, intrude these high-grade rocks and cut the regional gneissic fabrics. These pegmatites are related to the last stages of the Chewings Event. A separate 1550 Ma U-Pb monazite age from a pegmatite at Nolans Bore, and a 1525 Ma U-Pb allanite age from the Nolans Bore mineralisation constrain the primary mineralising event to the latest stages of the Chewings Event. The Reynolds Range region is cross-cut by steeply dipping shear zones that were active during the Ordovician-Carboniferous Alice Springs Orogeny. Greenschist facies mylonites and schists zones have retrogressed the relatively anhydrous high-grade host rocks and also significantly affected mineralisation in parts of the deposit. The Alice Springs Orogeny overprint constrains both the primary mineralisation, and the extensive shearing, brecciation and hydrous alteration assemblages observed in parts of the deposit. The current landscape expression around the deposit is subdued and mostly corresponds to a low-lying broad open valley in an area dominated by alluvial sediments and colluvial sheet

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		flow fan sediments of the Kerosene Camp Creek drainage system. The low-lying setting of the area has persisted since at least the mid-Tertiary, and is largely due to the extensive development of weathering. The ferruginous weathered rocks on the nearby bevelled rise summit possibly define a mid-Tertiary palaeo surface in the area that was then stripped and incised by a south to north palaeo-drainage system. This palaeo-drainage system has since been incised and many of its remnants have been topographically inverted by contemporary lateral drainage channels. Nolans Bore and its surrounds have been weathering and eroding since the Mesozoic and this eroded material has been ultimately deposited in the Ti Tree Basin to the north.
119	Potential impacts of TSF failure/overtopping on downstream environment. The WMP notes (s5.2.3, p.35) that up any time up to the end of the operational LOM that seepage from TSF and WRD will discharge away from the mine site. a) Further discussion on the potential impacts of seepage from TSF and WRD should be provided. b) Please provide discussion on the impacts to downstream ecosystems in the case of failure of the TSF including i. Extent of contamination ii. Whether or not contamination would reach the Woodforde river system and Ti Tree Basin, and iii. likely impacts of that scenario.	Refer Sections 2.9, 4.12, 4.13 and Appendix 2.
120	Water resource a) Discuss how has the project been designed to minimise water use. b) Given the current water scarcity within the region of Nolans (e.g. current issues with Yuelamu water supply) discuss how future uses (not just commercial) of the southern basin have been considered and the likely cumulative impact.	Part A The overall water demand for the LOM 55 is 56% of the water demand for the LOM 43 (i.e. a reduction in water demand of 2,098 ML/y). Arafura has been able to reduce water demand during project development including: • Changing from a SAPL to PAPL process resulting in a reduction of ≈2000 ML; • Introducing thickeners into the tailings and concentrate circuit as well as introducing filter presses to improve water recovery • Incorporated water efficiency devices into design within the accommodation village resulting in a reduction of 8ML Arafura will investigate further efficiencies during final design to further reduce water consumption particularly focused on the processing plant.

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		Part B There are no drinking water users in the mine area and existing groundwater is not of a quality that drinking water could be a future beneficial use. There are bores that are/have been utilised for stock watering but interpretation of the groundwater analyses indicate this water is not currently suitable for stock watering.
121	Ground water draw down a) Clarify the area expected to be impacted by the groundwater draw down (ha) at both the mine and the borefield over the time series shown, and how the draw down is likely to impact on vegetation communities within these areas. Provide discussion on the impacts to vegetation noting the timeframes required to 'rebound.' Refer to figure 8-9. b) The WMP notes that riparian vegetation is considered likely to be capable of extending root systems during the extraction period. Provide justification for this statement. c) Provide further discussion of the predicted 1.5m drawdown on GDEs along Day Creek and the potential impacts to these communities.	Refer to UID 487 (in Section 3.16) for further information on drawdown impacts on groundwater dependant vegetation.
122	Impacts to Lake Lewis and surrounds. The EIS notes that Lake Lewis is considered to be an area of Conservation Significance. The EIS and WMP note that impacts to Lake Lewis are unlikely to be measurable, however the WMP states that peak evapotranspiration will be affected by 3%. Impacts to this feature have not been adequately addressed in the EIS. a) Given that the proposed action has the potential to result in some direct and indirect impacts to Lake Lewis. Please provide further discussion in relation to this feature. Further discussion should include: i. Description of the hydrology of Lake Lewis	Part A – C Refer to Section 4.3. Part D From Duguid 2005 - The first specimens of L. unicolor were collected from Day Creek in 1970 by Latz and Howe. There is a series of rockholes with the upper and lower ones marked on the 1:250,000 scale topographic maps as North Twenty Mile and South Twenty Mile Waterholes. North Twenty Mile is considered to be the longest lasting and may be permanent (M.Lines pers. comm.). Although quite small, it is deep and well shaded. Day Creek is not mapped as having channels connecting to Lake Lewis on the 1:250,000 scale topographic map, but in large flood events surface waters do connect it to the lake (M.Lines pers. comm.) and are evident from satellite imagery as shown in Appendix 16. The longest lasting waterhole is probably in Day Creek (North Twenty Mile Waterhole; M.Lines pers. comm.) and although not large may be permanent.

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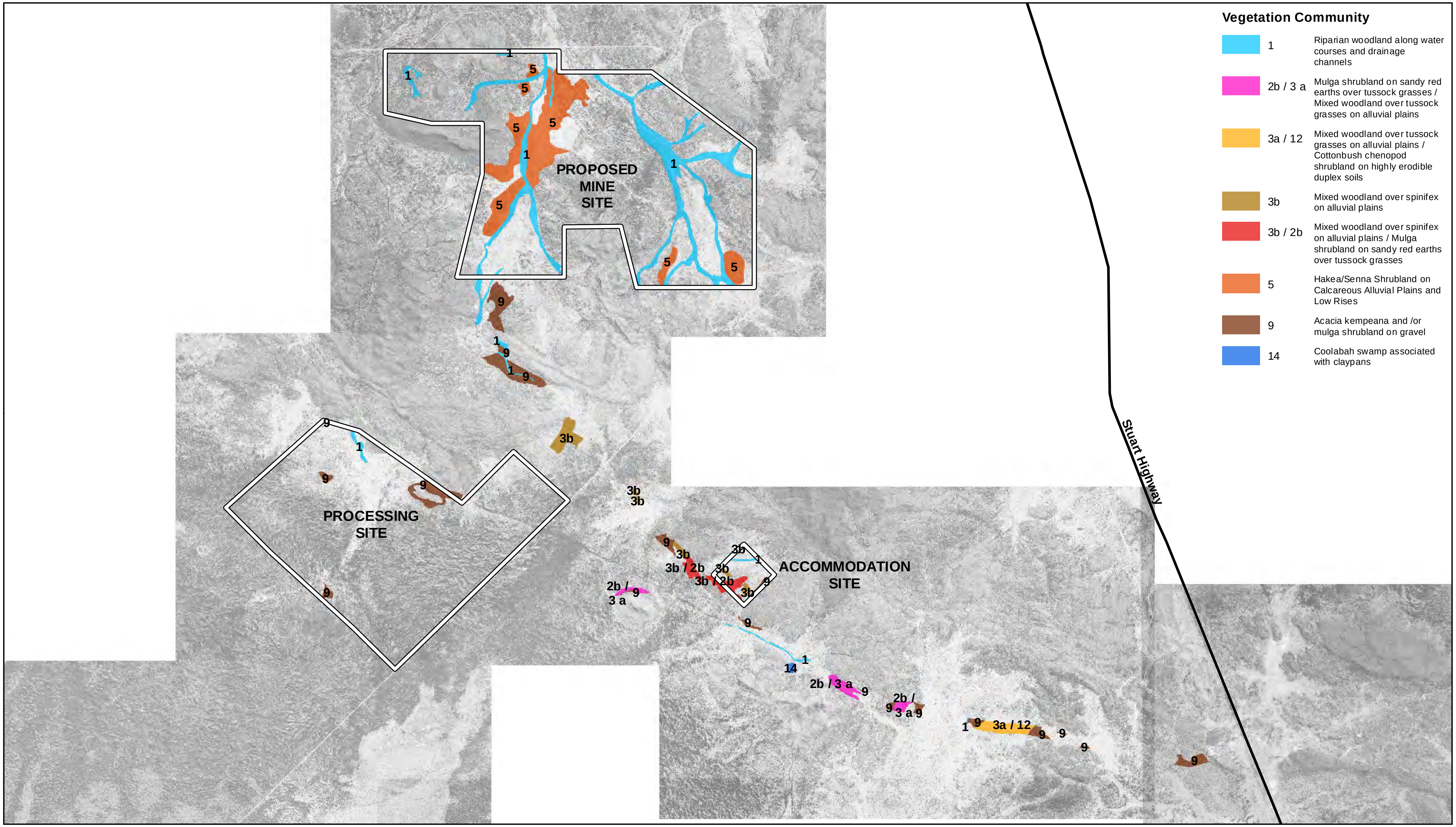
	ii. Description of the ecology and conservation significance of Lake Lewis. iii. Description of the potential impacts to Lake Lewis as a result of the project and any necessary mitigation measures. b) Clarify the difference between the peak evapotranspiration measure and groundwater drawdown in relation to impacts to Lake Lewis. c) Discuss what the 'worst case scenario' impacts are to Lake Lewis as a result of the proposed action. Discussion should specifically cover groundwater related impacts and disruption of surface flows. d) The WMP notes that Lake Lewis is important as it supports a fish population during flood. A report by the NT (Duguid, 2005) notes that Day Creek is the only likely drought refuge for Spangled Perch of the three creeks which flow into Lake Lewis. Discuss how groundwater draw down may impact on these drought refuges in Day Creek and subsequently the source population of fish for Lake Lewis during times of flood. i. Confirm whether an aquatic ecology assessment been undertaken for any parts of the study area.	However, there is a possibility that the current population of *L. unicolor* in the Burt Basin is also a result of translocation or recent migration. Aquatic ecology was not included in the biodiversity survey. Amphibians were targeted in the survey effort across the Mine site. During the survey period some ephemeral waterways flowed for a period of 1-2 days. Refer to Section 4.16. Arafura has reviewed the DENR Fauna Atlas and has verified that there are no official recorded observations of the Spangled Perth within any of these semi-permanent water bodies located in the project area (Figure 4-41). Anecdotally we are aware of some unofficial sightings of this fish species in the 20 mile waterhole which is above Napperby Station homestead in the Napperby Creek headwaters (Figure 4-42) and long distance and upgradient of the project. No aquatic ecology field assessment has been undertaken (or is planned) as all waterholes are outside the project area and upgradient (Figure 4-42).
233	Flood characteristics –post mining. Noted that some of this information is available in WMP. a) Please provide a map displaying the modelled flood characteristics post-mining in the same format as that provided for the pre-mining flood levels. In both 1:100 and 1:1000 models. b) Provide further discussion of potential impacts of flooding post-mining under both 1:100 and 1:1000 models to downstream ecosystems – particularly downstream areas impacted by the creek diversion.	<u>Part A</u> Refer to Section 4.14. <u>Part B</u> Refer to Section 4.14.
234	Abrupt change in direction of Kerosene Camp Creek (3rd Paragraph, page 7-20) a) Given the potential negative impacts of an abrupt	Preliminary drawings of the Kerosene Camp Creek diversion are provided in Appendix 13. The changes that the proposed creek diversion will cause include an abrupt change in the direction of Kerosene Camp Creek. A number of diversion options were considered during the early stages of the project. The proposed creek diversion was considered to balance the

UID	Summary of submission	Response
	change in direction of the diverted creek described in the report, please discuss why this was selected.	demands of the project and to minimise the risk of contaminating creek flows, without significantly effecting the proposed mining operations. Additionally, the topography, drainage and hard rock suit a diversion in this location. The proposed diversion will include flood protection bunds to separate the clean water within the diversion from the dirty water generated by the adjacent mining areas. The final detailed design will be designed by a suitably qualified engineer to provide adequate erosion and scour protection.
235	Riparian vegetation impacts a) Clarify what the area (ha) of riparian vegetation is which will be irreversibly impacted by the Kerosene Creek Diversion.	The riparian vegetation corridor along Kerosene Camp Creek is variable in width. In some places it is constrained and limited to a narrow ribbon along each side of the creek, in other places it widens a little or is spread out as the creek itself opens into multiple flood out channels. Riparian vegetation has been mapped in the project footprint (Figure 3-3). The riparian vegetation immediately adjacent to the mine area, both upstream to the point of the diversion and downstream in Kerosene Camp Creek to the confluence of Nolans Creek is likely to be significantly impacted by the mining operations (i.e. riparian vegetation will die and not recolonise the area).This is depicted in Figure 3-4 as the brown area. A reasonable estimate for the down gradient extent of this impact is based on the point where Kerosene Camp Creek receives additional surface water flow from adjacent catchments. This point is the confluence with Nolans Creek. This length of Kerosene Camp Creek beyond the mining area is approximately 1 km long. The estimated total area of impact is 11 ha, therefore approximately 11 ha of riparian vegetation will be irreversibly impacted by the Kerosene Creek Diversion.



Vegetation Community

🟦	1	Riparian woodland along water courses and drainage channels
🟪	2b / 3 a	Mulga shrubland on sandy red earths over tussock grasses / Mixed woodland over tussock grasses on alluvial plains
🟨	3a / 12	Mixed woodland over tussock grasses on alluvial plains / Cottonbush chenopod shrubland on highly erodible duplex soils
🟫	3b	Mixed woodland over spinifex on alluvial plains
🟥	3b / 2b	Mixed woodland over spinifex on alluvial plains / Mulga shrubland on sandy red earths over tussock grasses
🟧	5	Hakea/Senna Shrubland on Calcareous Alluvial Plains and Low Rises
🟫	9	Acacia kempeana and /or mulga shrubland on gravel
🟦	14	Coolabah swamp associated with claypans

1:40,000 @ A4

0 1 2 3 4

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

—	Existing Roads
▭	Site Boundaries

Arafura Resources Limited
Nolans Project

Job Number	4322301
Revision	0
Date	12 Oct 2017

Riparian Vegetation

Figure 3-3

G:\43\22301\GIS\Maps\4322301_308_VegetationMappingQuadrats.mxd

Data source: Google Earth Pro - Imagery (Date extracted: 16/06/2015). GA - Roads (2015). GHD - Vegetation Data (2015). Created by: CM

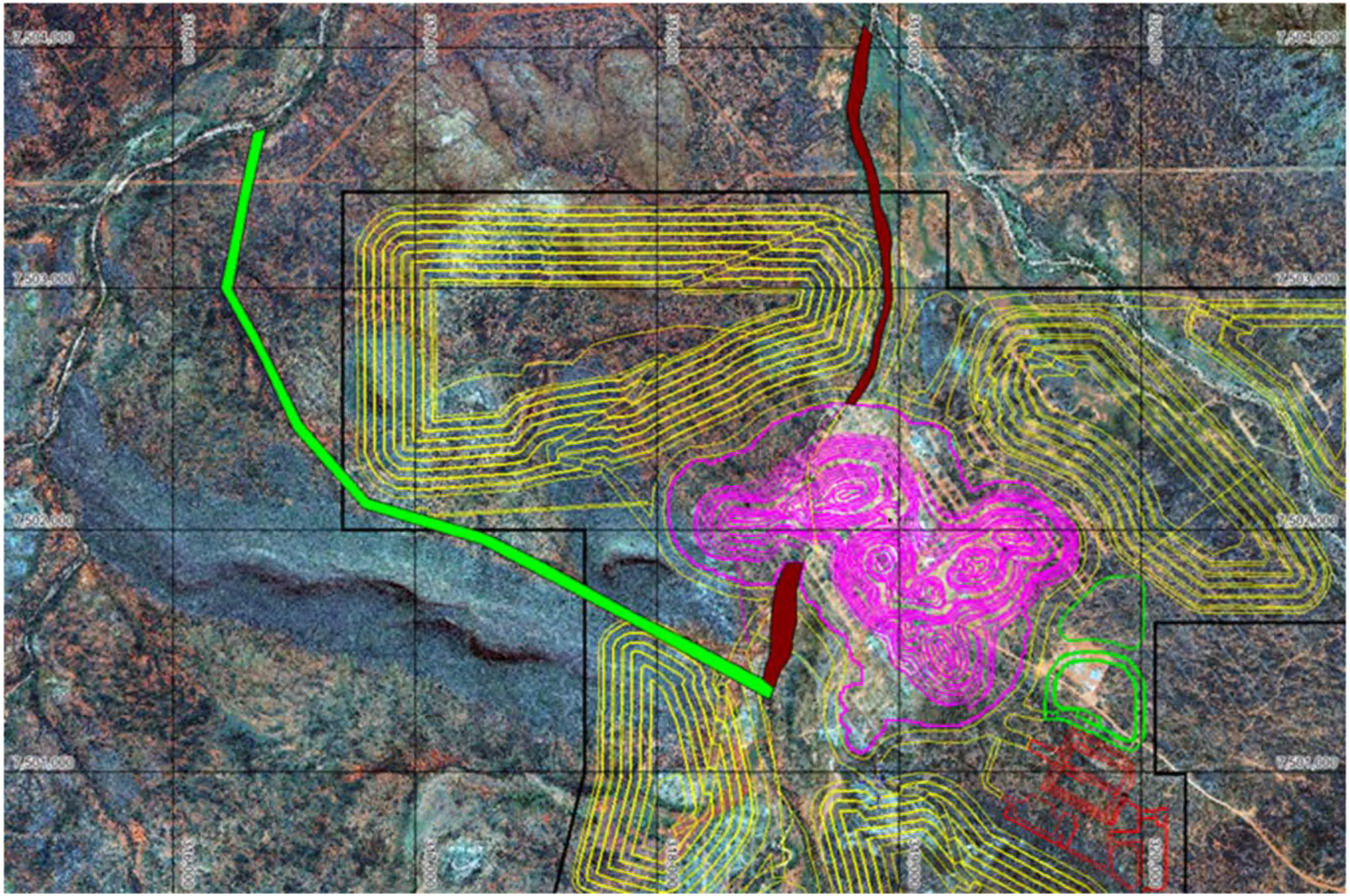


Figure 3-4 Riparian vegetation impact area

Department of Environment cont.

UID	Summary of submission	Response
283	a) Confirm whether an ILUA has been entered into for the portions of the site covered by native title claims. b) Confirm whether an additional ILUA has been entered into for the borefield. c) Discuss any measures outlined in the agreement (s) which may be of relevance to the EIS, e.g. protection of sites, compensation, access and ongoing use.	The proponent has long standing relationship with the CLC and the native title holders and claimants of land associated with the mine site, processing site and borefield area. Ongoing discussions with the CLC and the TO's regarding the project, and the basis of the ILUAs have been had; and will continue. The CLC does not wish to complete the ILUA negotiation process until the scheduled commencement date of the project has been confirmed, to avoid creating unrealistic expectations within the native title groups. The agreement will be completed prior to seeking an authorisation from the NT Department of Primary Industries and Resources. The agreement will be comprehensive and based on other established agreements negotiated by the CLC and industry. The basis of the agreements includes, at a minimum: • Ongoing engagement commitments • Protection and management of cultural sites and objects • Royalty payments • Environmental commitments • Employment and business development. The CLC is currently determining the extent of claims/determination and how they relate to the mine/processing site and borefield; so that the extent of the ILUA/agreement can be finalised. An ILUA/agreement will be entered into for each native title group or one collective group as determined.
284	Exclusion of the proposed Woodford quarry and haul road from the scope of the EIS a) Provide justification as to why the proposed Woodforde quarry and haul road have been excluded from the scope of the EIS.	The Woodforde Quarry is no longer required as a reagent material source for the project. This is because of the change in processing methodology from SAPL to PAPL – as detailed in the amendment notice issued. The PAPL processing circuit will use a quantity of hydrated lime for neutralisation purposes.. Local calcrete material that will be removed during construction of site, and some additional neutralisation reagents, will be imported to site. These off-site reagents are likely to be sourced in the NT from established suppliers.
285	Location of washdown bays a) Include discussion of where washdown bays for vehicles will be located and how will the contaminated water be dealt with.	Two wash down facilities are proposed with one located at the mine site and one at the processing site. These facilities will be standard high pressure wash facilities to remove road residue from vehicles. Maintenance equipment will also be washed at these facilities. Typically, these facilities consist of concrete pads with sumps that trap sediment and include oil/water separators to remove hydrocarbons. Water from these will be recycled within the

Department of Environment cont.

UID	Summary of submission	Response
		wash down facility. Water may also be discharged periodically to the TSF or RSF to be evaporated (if required). Sediment from the silt trap will be removed and disposed of into the TSF. Hydrocarbons will be removed and treated as per the requirements for chemical waste.
286	Severity level impact assessment for natural environment a) Provide justification for why impacts to the Natural Environment are considered minor, and why the ANCOLD rating is considered to be low given the potential impacts to the natural environment of a failure.	The sole objective of the study was to assess "Populations at Risk" and does not consider other impacts as part of the assessment methodology. The impact to the natural environment, as a result of TSF failure, was assessment as a minor consequence ranking. The consequence was considered minor as damage would be limited to areas of low conservation values (i.e. not threated) and that remediation of the environment would be possible. The assessment of risk to populations from a TSF failure, against all assessment criterion including the natural environment, concluded that the risk is low. It is noted that the dam failure study was completed by the proponent even though there was no specific requirement to do so under the ToRs for the EIS. The proponent independently sought to complete the study following the tailings dam disaster in Brazil, as the community (population) of Ti Tree lies directly downstream of the mine.
320	Frequency of use of roads within the borefield a) Describe the anticipated frequency with which roads will be utilised within the borefield and what types of vehicles will be required to utilise the roads.	The bore field may utilise diesel generators and as such will require access by a 20,000 L fuel truck approximately every few weeks. Maintenance checks on individual bores will be completed weekly using a light vehicle. Vehicle access will occur during daylight hours unless in an emergency situation.
360	Tailing characteristics a) Describe what the predicted characteristics of the tailings will be including concentrations of radionuclides.	Refer to Section 4.23 and 4.24.
405	Impacts of increased frequency of trains a) Clarify whether the impacts of increased frequency of trains has been assessed in terms of impacts to the public in areas adjacent to the train line e.g. increased noise. b) Confirm whether freight facilities in Alice Springs need to be upgraded to compensate for the additional load.	The traffic impact assessment was completed but did not include rail impacts to the public, given that rail traffic is considered to be within the existing capacity of the railway. It is proposed that train movements will be managed within the existing timetable, and most freight will utilise the lightly used return trip southward from Darwin. Discussions with the railway operator has confirmed there in enough residual capacity to handle all proposed inbound and outbound freight quantities associated with the project. There is currently significant redundant capacity available on the Adelaide Darwin line.

Department of Environment cont.		
UID	Summary of submission	Response
406	Construction traffic a) Provide details of expected traffic volumes associated with the construction of the project.	Studies completed as part of the EIS indicate that the Stuart Highway between Alice Springs and the Mine has significant redundant capacity (approximately 99% additional capacity available). The redundant capacity of key public roads, which would be utilised by during construction, indicates that construction traffic will not create an unacceptable impact. Arafura will complete a Traffic Management Plan for the construction and operational phases of the Mine. These Plans will require endorsement from DIPL.
453	Comments on WMP Nil Discharge in WMP (S 5.2.4) Contamination sources a) The site has been designed as a nil discharge site. However, s5.2.4 notes that during 'heavy' rainfall events there is potential for stormwater drains to discharge. Please clarify what is considered to be a 'heavy' rainfall event in this context. b) Haul roads should be considered a potential source of contamination for the project, please provide consideration of these risks.	<u>Part A</u> A heavy rainfall event is considered to be a rainfall event that exceeds the 100 year ARI design rainfall event. The mine site and processing site have been designed as far as practical to be zero discharge sites. Sediment ponds will be utilised as receiving bodies for stormwater drains. During heavy rainfall events (i.e. events exceeding the 100 year ARI design) there is the potential for stormwater ponds to discharge. Each sediment pond will be accompanied by dirty water catch drains to intercept sediment-laden runoff from disturbed areas and convey it to the sediment ponds. Sediment ponds and associated dirty water catch drains will be suitably located to minimise the risk of uncontrolled discharges of dirty contaminated water off site, and will be confirmed during detailed design. Runoff from haul roads will be managed by the water management system (i.e. drains and sediment ponds), to prevent uncontrolled discharges of water. Dust suppressant technology will be used to limit watering requirements for dust suppression on haul roads. During heavy rainfall events (i.e. rainfall event exceeds the 100 year ARI design rainfall event), discharges of potentially contaminated water from the haul roads may occur; however these discharges will be significantly diluted by runoff from the surrounding catchment. <u>Part B</u> RO water no longer being used for dust suppression. Runoff from haul roads will be managed by a water management system incorporating table drains and sediment ponds to prevent uncontrolled discharges of water. During heavy rainfall events (i.e. rainfall event exceeds the 100 year ARI design rainfall event), discharges of potentially contaminated water from the haul roads may occur; however these discharges will be significantly diluted by runoff from the surrounding catchment.

3.6 Department of Health

UID	Summary of submission	Response
196	Attached is the Environmental Health Factsheet for Mining and Construction Projects.	Noted. The application of the Fact Sheet will be considered in the detailed design phase of the project and development of operational procedures. This has been included as a commitment (refer to Chapter 5).
364	Radiation Protection Plan(RPP) must be submitted for approval by the Chief Health Officer prior to the commencement of the mining activity	A Radiation Protection Plan (RPP) will be submitted for approval by the Chief Health Officer prior to the commencement of the mining activity. This has been included as a commitment.
365	Baseline radiation data must be used to establish appropriate closure criteria and rehabilitation plan to ensure that the post mining environmental radioactivity is similar to the pre mining activity in the region.	The residual risk associated with radiation from post-closure sources affecting the health and safety of the public is considered 'low' (Appendix F of the EIS). Ongoing monitoring will be undertaken as detailed in the Radiation Management Plan (Appendix X_J) from the commencement of construction. This baseline radiation data will be used to establish appropriate closure criteria for incorporation into closure planning.
366	The EIS does not mention specific post closure tailing management to demonstrate that isolation of radioactive tailings from the surrounding environment is secure and likely to stay secure for virtually indefinitely (more than 10,000 years).	A Tailings Management Plan is provided in the appendix of Appendix 2. It should be noted that the radionuclide content of the tailings will be similar to the radionuclide concentrations in rocks and soils that already exist in the region. The tailings will potentially contain about 25% of the radionuclides present in the orebody following beneficiation. A radiological assessment of a number of potential future failure scenarios was conducted and showed that the estimated impacts, measured as radiation doses, were 'low' (see Chapter 12 of the EIS). The justification of this ranking was that the radionuclide concentrations in the tailings are identical to the radionuclide concentrations of the mined ore. Commitments regarding closure planning are discussed in in Sections 2.9.3 and 4.1.
367	Post closure criteria must be optimised to ensure that radiation dose to member of public accessing the site after closure is kept below the national standard at the time of the closure. Post closure criteria should include but not limited to gamma survey, survey of radon, thoron and its decay products, radionuclides in dust, radionuclide concentration in bush food and water.	Baseline radiation data will be used to establish appropriate closure criteria for incorporation into closure planning. It is noted that the residual risk associated with radiation from post-closure sources affecting the health and safety of the public is considered 'low' (Appendix F of the EIS).
368	EIS contains information on emergency response plan but it does not seem to provide information on emergency response plan for accidental release of radioactive material to the environment after a transport accident.	Arafura is not proposing to transport radioactive materials. The final product will not be classified as radioactive and therefore not subject to any additional transport requirements. Arafura is cognisant of the recommended Codes of Practice for transportation of radioactive material.

UID	Summary of submission	Response
369	The water quality test report was summarized in section 6.2.4 of Appendix P. Member of public would receive 1.9mSv per year by drinking untreated bore water at Aileron roadhouse and 2 mSv/yr by drinking untreated bore water of Nolan bore. Appropriate water treatment must be in place to ensure that the drinking water quality meets the requirements from Australian Drinking Water Guidelines(2011).	Arafura will provide water that meets the requirements of the Australian Drinking Water Guidelines (2011) to its employees, contractors and visitors to the project site. This has been included as a commitment.
370	Waste product from water treatment plant should be tested for radioactive contamination before disposal.	Arafura will no longer use wastewater from the water treatment plants for dust suppression. All brine reject water will be directed into the residue storage, tailing storage dams or evaporation ponds for disposal. Wastewater from the water treatment plant will be tested for radioactivity concentrations. This has been included as a commitment.
371	The operation should be considered similar to a uranium mining activity and should take all appropriate safety measures to ensure dose to workers and member of public is optimized in accordance with the International best practice and ARPANSA Codes of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (RPS 9).	All workers will operate in accordance with the ARPANSA Codes of Practice. This has been included as a commitment.
393	The project will require authorisation under the Radiation Protection Act of the Northern Territory	Noted.

3.7 Department of Infrastructure

UID	Summary of submission	Response
413	It is not clear what option is proposed for the intersection of the access road and Stuart Highway. An overpass/underpass was discussed, but it appears this option is no longer available. It is understood that DoT will provide a detailed response in relation to road impacts and preferred intersection design	The Notice of Intent submitted in 2008 detailed the potential use of a mining haul road and an overpass/underpass to facilitate traffic across the Stuart Highway. This mine haul road would have permitted access to a planned rail siding 55 km east of the Stuart Highway, on the Adelaide Darwin rail line, to export bulk ore. Ore in now proposed to be processed onsite and thus a mine haul road and overpass across the Highway is no longer required. An approved intersection with the Stuart Highway will be required for the mine access road that will be around 5km south of the Aileron Roadhouse southernmost access road. The design of this intersection will be in accordance with DIPL requirements and approved by NTG prior to construction.

3.8 Department of Land and Resource Management

UID	Summary of submission	Response
29	It is unlikely that the methods for monitoring Great Desert Skink could reliably detect a 20% change in numbers given the low incidence of detections during the surveys.	Agreed - it is unlikely that the methods for monitoring Great Desert Skink could reliably detect a 20% change in numbers given the low incidence of detections during the surveys (one active warren only). It is likely that with such a low incidence rate there is no suitable methodology available that would detect a reduction in numbers. The Biodiversity Management Plan outlines the monitoring for the persistence of the one known warren, and additional annual surveys to continue to search for additional warrens in the area. If any additional warrens were found, they would be added to the requirements for on-going monitoring for persistence and impact avoidance. Arafura will continue to consult with and follow the advice of the NT Department of Environment and Natural Resources (DENR) regarding detection and monitoring of the Great Desert Skink. This has been included as a commitment.
30	It is recommended that the bore field area is intensively surveyed for Great Desert Skink burrow systems and monitored annually.	Large components of habitat of the borefield pipeline proposal are comprised of recently burnt sandplain habitat (last burnt in 2011, Dr R. Paltridge pers. comm.). Extensive searches by teams of (a minimum) four people failed to yield additional active/disused Great Desert Skink burrows within the project area. The age class of the vegetation that occupies the sandplain across large areas is likely to be too young and lacks the diversity/cover to support

UID	Summary of submission	Response
		this species and as such, the habitat is considered to be currently of low quality. The active Great Desert Skink warren is located in the older spinifex to the far west of the borefield. Additional detection and monitoring activities for the Great Desert Skink have been presented in the Biodiversity Management Plan. Please refer to Table 4-6 'Threatened Species Monitoring – Sandplain Habitats', which specifies: • Motion-sensing camera surveys within known threatened species habitat for Brush-tailed Mulgara and Great Desert Skink including two cameras at known warrens. • Transect surveys searching for warrens within known threatened species habitat for Great Desert Skink. Camera surveys will comprise five 400 m camera transects, each comprising 5 cameras at 100 m intervals and be left in situ for 28 nights during Great Desert Skink active season. This monitoring will be completed on an annual basis. This has been included as a commitment.
31	Monitoring of the Black-footed Rock-wallaby should be limited to camera trapping as aerial surveying of the species is not recognised as a suitable sampling method	Refer Section 4.20.
97	Recommends the provision of a site plan map identifying infrastructure layout and the locations of all proposed Erosion and Sediment Controls and extent of earthworks	A site specific Erosion and Sedimentation Control Plan (ESCP) will be developed prior to commencing construction. The ESCP will be drafted by an ICEA certified professional and will be submitted to the DPIR as part of the Mining Management Plan. This has been included as a commitment.
123	A volumetric water balance (recharge, extraction, storage volume, etc.) is not provided for the aquifers that will be affected by the proposed mining activities	A summary water balance encompassed in the groundwater model is presented in Table 3-4, Table 3-5 and Table 3-6. A copy of the Water Resource Assessment is provided in Appendix 3.

Table 3-4 Water Balance for EIS Model (139)

m3/day	Time 0 Steady State	Mid-Mining	End of Mine (Rebound)	Closure plus 100 Year	Closure plus 1000 Years
Total Recharge	59561	59561	59561	59561	59561
Ti Tree Groundwater Inflow	359	359	359	359	359
Total Evapotranspiration	28513	28491	28334	27410	28260
Groundwater Outflow	24243	24237	24223	23970	24207
Groundwater Pumping	7176	18120	18098	7169	7169
Pit Pumping or Closure Groundwater Evaporation	0	2802	3417	946	698
Water Balance	-13				
ML/day	Time 0 Steady State	Mid-Mining	End of Mine (Rebound)	Closure plus 100 Year	Closure plus 1000 Years
Total Recharge	59.6	59.6	59.6	59.6	59.6
Ti Tree Groundwater Inflow	0.4	0.4	0.4	0.4	0.4
Total Evapotranspiration	28.5	28.5	28.3	27.4	28.3
Groundwater Outflow	24.2	24.2	24.2	24.0	24.2
Groundwater Pumping	7.2	18.1	18.1	7.2	7.2
Pit Pumping or Closure Groundwater Evaporation	0.0	2.8	3.4	0.9	0.7
Water Balance	0.0				
GL/year	Time 0 Steady State	Mid-Mining	End of Mine (Rebound)	Closure plus 100 Year	Closure plus 1000 Years
Total Recharge	21.8	21.8	21.8	21.8	21.8
Ti Tree Groundwater Inflow	0.1	0.1	0.1	0.1	0.1
Total Evapotranspiration	10.4	10.4	10.3	10.0	10.3
Groundwater Outflow	8.9	8.9	8.8	8.8	8.8
Total Groundwater Extraction	2.6	6.6	6.6	2.6	2.6
Arafura Pumping	0.0	4.0	4.0	0.0	0.0
Pit Pumping or Closure Groundwater Evaporation	0.0	1.0	1.2	0.3	0.3

Water Balance	0.0				
L/s	Time 0 Steady State	Mid-Mining	End of Mine (Rebound)	Closure plus 100 Year	Closure plus 1000 Years
Total Recharge	689	689	689	689	689
Ti Tree Groundwater Inflow	4	4	4	4	4
Total Evapotranspiration	330	330	328	317	327
Groundwater Outflow	281	281	280	277	280
Total Groundwater Extraction	83	210	209	83	83
Arafura Pumping	0	127	126	0	0
Pit Pumping or Closure Groundwater Evaporation	0	32	40	11	8
Water Balance	0				

Table 3-5 Water Balance for Model 301 (303)

m3/day	Time 0 Steady State	Mid-Mining	End of Mine (Rebound)	Closure plus 100 Year	Closure plus 1000 Years
Total Recharge	59561	59561	59561	59561	59561
Ti Tree Groundwater Inflow	359	359	359	359	359
Total Evapotranspiration	28514	28497	28399	27856	28288
Groundwater Outflow	24234	24233	24226	24082	24212
Groundwater Pumping	7173	13460	13447	7169	7169
Pit Pumping or Closure Groundwater Evaporation	0	2802	3417	946	698
Water Balance	0				
ML/day	Time 0 Steady State	Mid-Mining	End of Mine (Rebound)	Closure plus 100 Year	Closure plus 1000 Years
Total Recharge	59.6	59.6	59.6	59.6	59.6
Ti Tree Groundwater Inflow	0.4	0.4	0.4	0.4	0.4
Total Evapotranspiration	28.5	28.5	28.4	27.9	28.3

Groundwater Outflow	24.2	24.2	24.2	24.1	24.2
Groundwater Pumping	7.2	13.5	13.4	7.2	7.2
Pit Pumping or Closure Groundwater Evaporation	0.0	2.8	3.4	0.9	0.7
Water Balance	0.0				

GL/year	Time 0 Steady State	Mid-Mining	End of Mine (Rebound)	Closure plus 100 Year	Closure plus 1000 Years
Total Recharge	21.8	21.8	21.8	21.8	21.8
Ti Tree Groundwater Inflow	0.1	0.1	0.1	0.1	0.1
Total Evapotranspiration	10.4	10.4	10.4	10.2	10.3
Groundwater Outflow	8.9	8.9	8.8	8.8	8.8
Total Groundwater Extraction	2.6	4.9	4.9	2.6	2.6
Arafura Pumping	0.0	2.3	2.3	0.0	0.0
Pit Pumping or Closure Groundwater Evaporation	0.0	1.0	1.2	0.3	0.3
Water Balance	0.0				

L/s	Time 0 Steady State	Mid-Mining	End of Mine (Rebound)	Closure plus 100 Year	Closure plus 1000 Years
Total Recharge	689	689	689	689	689
Ti Tree Groundwater Inflow	4	4	4	4	4
Total Evapotranspiration	330	330	329	322	327
Groundwater Outflow	280	280	280	279	280
Total Groundwater Extraction	83	156	156	83	83
Arafura Pumping	0	73	73	0	0
Pit Pumping or Closure Groundwater Evaporation	0	32	40	11	8
Water Balance	0				

Table 3-6 Water Balance for Model 307

m3/day	Time 0 Steady State	Mid-Mining	Closure plus 100 Year	Closure plus 1000 Years
Total Recharge	41400	41400	41400	41400
Ti Tree Groundwater Inflow	232	232	232	232
Total Evapotranspiration	20400	20340	19880	20240
Groundwater Outflow	13990	13990	13850	13980
Groundwater Pumping	7173	13460	7169	7169
Pit Pumping or Closure Groundwater Evaporation	0	1350	75	152
Water Balance	69			
ML/day	Time 0 Steady State	Mid-Mining	Closure plus 100 Year	Closure plus 1000 Years
Total Recharge	41.4	41.4	41.4	41.4
Ti Tree Groundwater Inflow	0.2	0.2	0.2	0.2
Total Evapotranspiration	20.4	20.3	19.9	20.2
Groundwater Outflow	14.0	14.0	13.9	14.0
Groundwater Pumping	7.2	13.5	7.2	7.2
Pit Pumping or Closure Groundwater Evaporation	0.0	1.4	0.1	0.2
Water Balance	0.1			
GL/year	Time 0 Steady State	Mid-Mining	Closure plus 100 Year	Closure plus 1000 Years
Total Recharge	15.1	15.1	15.1	15.1
Ti Tree Groundwater Inflow	0.1	0.1	0.1	0.1
Total Evapotranspiration	7.5	7.4	7.3	7.4
Groundwater Outflow	5.1	5.1	5.1	5.1
Total Groundwater Extraction	2.6	4.9	2.6	2.6
Arafura Pumping	0.0	2.3	0.0	0.0
Pit Pumping or Closure Groundwater Evaporation	0.0	0.5	0.0	0.1
Water Balance	0.0			

L/s	Time 0 Steady State	Mid-Mining	Closure plus 100 Year	Closure plus 1000 Years
Total Recharge	479	479	479	479
Ti Tree Groundwater Inflow	3	3	3	3
Total Evapotranspiration	236	235	230	234
Groundwater Outflow	162	162	160	162
Total Groundwater Extraction	83	156	83	83
Arafura Pumping	0	73	0	0
Pit Pumping or Closure Groundwater Evaporation	0	16	1	2
Water Balance	1			

Department of Land and Resource Management cont.		
UID	Summary of submission	Response
124	More information on the groundwater model, particularly model input data, should be provided	Refer Section 4.22 and Appendix 8.
125	Access to source data used to describe water resource conditions and more detail on baseline monitoring should be provided to enable objective assessment of water resource conditions and monitoring	Refer Section 4.22 for further information on data inputs to the groundwater model. Refer to the Water Resource Assessment for a description of the Southern Basins as a water resource (Appendix 3).
126	Confirmation that proposed water extraction from the southern basins is required	Yes – water extraction will be required from the Southern Basins.
127	More quantitative information should be provided to confirm that ground water drawdown and subsequent impacts to other users carry only minor risk	Refer to Sections 4.4, 4.5 and 0.
128	More detailed information is required on the measures to mitigate impacts on other groundwater users should modelled predictions be exceeded	Should future data (through monitoring and validation of the groundwater model) indicate that unacceptable impacts will result from planned extraction from the bore fields in the Southern Basins is likely, management measures that would be introduced to minimise that impact may include:

Department of Land and Resource Management cont.

UID	Summary of submission	Response
		• Fully utilise water from the multiple bore fields to minimise the project potential impacts by separating production bores to an area of around 100km^2. It is proposed that 4 -5 of these borefield will be used to limit localised impacts (refer to Section 4.22.7). • Extract saline water from deep aquifers known to be present in the area. • Expand the bore fields south and possibly further west. There are known brackish water supplies to the west in the Whitcherry Basin. From Airborne Electro Magnetic surveys there are believed to be other paleo channels to the south. • Extract brackish water from the Ti Tree Basin either from deep paleo channels not currently utilised or a combination of use of these deep aquifers other brackish groundwater known from NTG investigations to exist in the southern sector of the NTG western Ti Tree Basin Water Management zone.
129	The groundwater assessment reporting is limited by the inadequacy of data presented to validate it.	A Water Resource Assessment is provided in Appendix 3.
130	No data to verify the viability of proposed water requirements from the five boreholes	A Water Resource Assessment is provided in Appendix 3.
236	No information is provided to demonstrate that the Kerosene Camp diversion will maintain equivalent ecological functionality with respect to riparian vegetation	Refer to Section 4.15.4.
454	An independent peer review of the Water Management Plan should be provided and accounted for in that plan	A copy of the updated independent peer reviewed, Water Management Plan is provided in Appendix 4.
455	Groundwater and surface water monitoring plans are not sufficiently detailed, particularly with regard to the number and location of monitoring sites.	A copy of the updated Water Management Plan, including proposed monitoring locations, is provided in Appendix 4.
456	A detailed plan of all proposed monitoring sites and associated sampling and analytical programs should be provided immediately, rather than after environmental approvals have been given.	A copy of the updated Water Management Plan, including proposed monitoring locations, is provided in Appendix 4.

Department of Land and Resource Management cont.

UID	Summary of submission	Response
457	Annual change in storage volume of the southern basins aquifer should be monitored for compliance with the N.T sustainable use policy	Refer to Appendix 3 and Appendix 4.
458	The assessment needs to propose a monitoring network as guided by the modelling outcomes, and what action would be undertaken should the data deviate from the modelled.	The groundwater monitoring network is presented in the updated Water Management Plan (Appendix 4). Refer to Section 4.22.7 for further information on use of groundwater monitoring for the purposes of adaptive groundwater management.

3.9 Department of Lands, Planning and the Environment – Heritage Branch

UID	Summary of submission	Response
209	The EIS (Ch. 16 – Section 16.4.1 Risk Assessment) concludes that sixty-seven Aboriginal archaeological sites will be subject to direct impact during site establishment for the Nolans Project; including several assessed to be of moderate-high archaeological significance and others identified as locally-regionally rare. However, it is not clear whether measures to avoid direct impact to these sites – particularly rare sites and those of moderate to high significance – have been adequately considered by the proponent, and no clear argument is made as to why such impact to these particular sites is unavoidable.	Overall, three sites of high cultural significance and another 23 sites of moderate to high scientific significance are likely to be directly impacted by the project. Twenty-one of the 23 sites of scientific significance that may be directly impacted are located within the development footprint of the mine site. The location of the mine is dictated by the target mineral deposit and the consequent spread of the mining site components (i.e. pit, dump, tailings storage) across the project area. It is not feasible to relocate the mine site to avoid these particular archaeological sites. One site of moderate scientific significance is likely be impacted by the upgrading and use of the existing access road to the bore-field. The preference is to minimise site disturbance by utilising the existing access road rather than constructing a new road through an undisturbed environment. One site of high scientific significance is likely to be directly impacted by construction of the processing site. Direct damage to the site is unavoidable as the processing site has been positioned so to exclude RWA 9, avoid damage to other archaeological sites of high scientific significance (i.e. NP-9, NP-11) and a potential historic place (i.e. Old Albs Bore and Yard). Natural terrain in this area is the limiting factor in developing alternate locations for the processing site and the arrangement of the processing site have been chosen to minimise direct impacts to sites of high significance.

UID	Summary of submission	Response
		The three sites of high cultural significance, which are all associated with the sacred site defined by RWA 8, are likely to be directly impacted by the access road between the mine site and processing site. The access road follows the alignment of an existing road and works will involve the upgrade of the road. The preference is to minimise site disturbance by utilising the existing access road rather than constructing a new road through an undisturbed environment. Alignment option for this area will be investigated during the detailed design phase.
210	The summary of archaeological management recommendations provided in Table 16-7 of the EIS does not match that provided in Table 3 of the CHMP in Appendix X-E, and several identified archaeological sites within the project area are missing from Table 16-7	Noted. Refer to the updated table (Table 3-7) below which outlines management recommendations for archaeological sites only. An updated CHMP is provided in Appendix 7.

Table 3-7 Summary of archaeological management recommendations

Management recommendation	Proposed infrastructure	Archaeological significance	Site name
Impact avoidance	Access road and service corridor between the processing site and the mine site	High	NP-1, NP-2, NP-3, NP-10, NP-11, NP-32
	Processing site	High	NP-6, NP-9
		Low	NP-4, NP-5, NP-7, NP-8
		NA	Old Albies Bore and Yard
	Mine site	High	Scar 1, Scar 2, NB-4, Site 2
		Moderate	
	Accommodation village	High	NP-15
		Moderate	NP-12, NP-13, NP-14
		Low	NP-ISO-13-1, NP-ISO-13-2,
		Moderate	NP-19

Management recommendation	Proposed infrastructure	Archaeological significance	Site name
	Borefield and raw water supply pipeline to the processing site and mine site	Low	NP-20
	Access road from the Stuart Highway	High	NP-23, NP-26, NP-27, NP-29, NP-31
		Moderate	NP-21, NP-28
		Low	NP-22, NP-24, NP-ISO-18-2, NP-ISO-22-1, NP-ISO-22-2, NP-ISO-22-3, NP-ISO-24
Work approval application and archaeological mitigation	Mine site	High	NB-3, Scar 3, SP-1, SP-2, Site 19, Site 10, Site 11, Site 15, Site 18, Site 1, Site 14, Site 5, Site 6, Site 7, Site 8, Site 12, Site 13, Site 16, Site 17, Site 3
		Moderate	NB-2
		Low	NB-1, NB-6, NB-9
	Processing site	Moderate	NB-4
		Low	NB-5, NB-7, NB-8,
	Accommodation village	Low	NP-16, NP-17, NP-18
	Access road from the Stuart Highway	High	NP-26
		Low	NP-25, NP-30, NP-20, NP-22, NP-24, NP-25
	Access road and service corridor between the processing site and the mine site	High	NP-32
Work approval application	Processing site	Low	NP-ISO-1-1, NP-ISO-1-2, NP-ISO-1-3, NP-ISO-2, NP-ISO-3, NP-ISO-4, NP-ISO-5-1, NP-ISO-5-2, NP-ISO-5-3, NP-ISO-6, NP-ISO-7-1, NP-ISO-7-2, NP-ISO-8, NP-ISO-9
	Mine site		ISO1, ISO2, ISO3, ISO4, ISO5, ISO8, 24 unnamed isolated artefacts in the vicinity of Kerosene Camp Creek
	Accommodation village (including access road)	Low	NP-ISO-10, NP-ISO-11-1, NP-ISO-11-2, NP-ISO-12-1, NP-ISO-12-2, NP-ISO-14, NP-ISO-15, NP-ISO-16-1, NP-ISO-16-2
	Access road from the Stuart Highway	Low	NP-ISO-17, NP-ISO-18-1, NP-ISO-19, NP-ISO-20, NP-ISO-21-1, NP-ISO-21-2, NP-ISO-23, NP-ISO-25, NP-ISO-26, NP-ISO-27, NP-

Management recommendation	Proposed infrastructure	Archaeological significance	Site name
			ISO-28-1, NP-ISO-28-2, NP-ISO-29-1, NP-ISO-29-2, NP-ISO-30-1, NP-ISO-30-2

Department of Lands, Planning and the Environment – Heritage Branch		
UID	Summary of submission	Response
211	The EIS states at several points (e.g. Ch. 16, Appendix F, Appendix X-E) that “permits will be sought from the regulatory authorities prior to site disturbance” and “permit will be sourced from NT Heritage prior to any removal or destruction.” The proponent should be advised that it should not be taken as a given that work applications under the Heritage Act regarding disturbance, removal and / or destruction of archaeological sites will be approved. Applications may be approved with specific conditions imposed, or may be refused altogether	Noted.
212	Appendix U and Appendix X-E / CHMP of the EIS both state, with regard to the procedure for submitting a Work Approval application under the Heritage Act, that a single application form with a schedule listing all heritage sites and objects that will be impacted can be submitted. This is not entirely correct and should be amended. A single application form covering a group of comparable archaeological objects – such as the identified isolated artefacts assessed to be of low significance – may be submitted; however, separate Work Approval applications should be prepared for all identified archaeological sites and places as each will be considered on a case by case basis.	Noted - the procedure for submitting a Work Approval has been updated in the CHMP (Appendix 7).
213	The EIS states (Ch. 16, Appendix U and Appendix X-E / CHMP) that heritage Work Approval applications should be / will be submitted to the Chief Executive Officer of the DLPE. This should be amended as	Noted – applications will be submitted to the Director of the Heritage Branch. This has been updated in the CHMP (Appendix 7).

Department of Lands, Planning and the Environment – Heritage Branch		
UID	Summary of submission	Response
	applications should, in practice, be submitted to the Director of the Heritage Branch, DLPE	
214	The EIS also states (Ch. 16, Appendix U and Appendix X-E / CHMP) that a copy of the heritage assessment and information regarding discovery of previously unidentified archaeological sites will be submitted to the Chief Executive Officer of the Heritage Council to fulfil notification requirements (i.e. Section 114) of the Heritage Act. This should be amended; under the Act, the "CEO" refers to the Chief Executive Officer of the DLPE (not Heritage Council), and in practice, all notifications should be submitted to the Director of the Heritage Branch, DLPE	Noted – a copy of the heritage assessment and information regarding discovery of previously unidentified archaeological sites was submitted to the Heritage Branch. The CHMP has been updated and addresses the comments. Refer Appendix 7 for a copy of the updated CHMP.
215	The heritage mitigation measures outlined in the CHMP (Appendix X-E of the EIS) include archaeological test excavation, possibly followed by archaeological salvage excavation, for three identified archaeological sites. It should be noted that Work Approvals under the Heritage Act are unlikely to be granted for archaeological test excavations. As such, it is advised that the proposed mitigation measures for these sites are amended to involve either impact avoidance or full recording and salvage	Noted - the use of archaeological test evacuations has been removed from the methodology detailed in the CHMP (Appendix 7).
216	The CHMP states that decisions regarding appropriate mitigation measures for some identified archaeological sites – such as whether or not artefacts shall be collected from sites assessed to be of low archaeological significance – will be determined "following consultation between the proponent, Traditional Owners and archaeologist." Whilst such consultation is necessary, it should be noted that the final decision regarding mitigation measures such as	Noted – the CHMP has been updated (Appendix 7) to detail that the Heritage Branch will determine the mitigation measures of archaeological sites that may be impacted as part of the Work Approval process.

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UID	Summary of submission	Response
	artefact collection is made by the Heritage Branch as part of the Work Approval process under the Heritage Act	
217	The CHMP states, with regard to identified isolated artefacts assessed to be of low archaeological significance, that “no further action” is required once “permission to destroy” is provided by the Heritage Branch. Again, it should be noted that conditions may be imposed on Work Approvals, including a requirement to record each isolated find (description and photos), and may include artefact collection. This comment also applies to the Artefact Collection general approach outlined in Appendix 3 of the CHMP	Noted.
218	The CHMP recommends archival photographic recording of potential historic site(s) in accordance with ICOMOS principles, but also New South Wales Heritage Office guidelines (in Appendix 3 of CHMP). It should be noted that the specific requirements contained within the NSW guidelines are not applicable to Northern Territory cultural heritage management	Noted – reference to the NSW guidelines has been removed from the CHMP. The CHMP will be appended to the Mining Management Plan for approval by the DPIR as part of the Authorisation to carry out mining activities under the Mining Management Act. Once final project design and infrastructure layout is confirmed, Arafura will be able to assess which, if any, of the identified archaeological sites will be impacted. Arafura acknowledges that in the event that a Work Approval is submitted to the Director of the Heritage Branch to disturb or destroy an archaeological site, that the application may be approved, approved with conditions or refused.
219	The CHMP states, under “Management of Archaeological Material” (Appendix 3) that during the project, all Aboriginal archaeological material would be stored with the heritage consultant for analysis and documentation; after which, the artefacts would be returned to the proponent for disposition in accordance with agreements following negotiations between the proponent and Traditional Owners. It should be noted that all recovered Aboriginal artefacts must remain	Noted – the following text has been included in Appendix 7 (the CHMP): “The material will remain in Northern Territory unless prior approval is granted under the Heritage Act (section 89)”.

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	within the Northern Territory unless prior approval is granted under the Heritage Act (Section 89); which also necessitates consent provided by the relevant Traditional Owners. It should also be noted, as above, that final management of recovered artefacts will be determined by the Heritage Branch as part of the Work Approval process.	
220	Appendix 6 of the CHMP “Unexpected Finds Procedure – Suspected Human Remains” states that if suspected human skeletal remains are encountered and there are reasonable grounds to suspect the remains are Aboriginal, the discovery must be reported to the Aboriginal Areas Protection Authority. As Aboriginal skeletal remains are protected under the Heritage Act, such a discovery should actually be reported to the Heritage Branch, rather than the AAPA. The Heritage Branch will subsequently work with AAPA in such cases, however, notification of discovery should always to be made directly to the Heritage Branch.	Noted – suspected remains will be reported to the Heritage Branch. This has been updated in the CHMP (Appendix 7).

3.10 Department of Mines and Energy

UID	Summary of submission	Response
3	Provide details on whether dust deposition gauge (DDG) equipment and monitoring was conducted according to Australian Standards AS/NZS 3580.10.1. The data presented in Figure 13-2 shows DDG's were not sampled monthly and baseline monthly seasonal variation year to year has not been provided. Fourteen monthly events were recorded off site above the assessment trigger which indicates dust impact will require management from mining activities. Provide details on other sources of dust generation other than the WRDS which may include the topsoil stockpiles, ROM, roads and traffic, processing plant and TSF/residues (if they do not have wet cover).	<u>Part A</u> Dust deposition gauge (DDG) equipment and monitoring was completed according to AS3580 specifically including AS3580.10.1, AS3580.10.2 and AS3580.14. DDGs were sampled over the two different periods of continuous monitoring: • October 2010 to August 2011 and • August 2012 to June 2015. AS3580.10.1 has a period of exposure for routine monitoring of typically 30 ± 2 days (Clause 7.3). However, due to practical considerations, the sampling period (t) in the number of days is a variable in equation 9.1 of the Australian Standard. Site issues associated with collecting monthly in a remote area were catered for by extending beyond 32 days. As long as the bottle does not overflow with rain, (soluble matter determination is invalid) and bottles are ‘sun-shielded’ to protect for algal growth, the deposition determination over a longer period than 32 days can be legitimately normalised to a monthly value. However, routine monitoring when the mine is operational is recommended on the first day of the month, so as to meet the typical exposure period of 30 ± 2 days. Figure 13-2 in the EIS outlines the baseline monthly variation (based on normalised monthly values) for a period of three years between August 2012 and June 2015 (plus 2010/2011). Baseline seasonal variation (based on normalised monthly values) for the period of monitoring is presented in Figure 3-5.

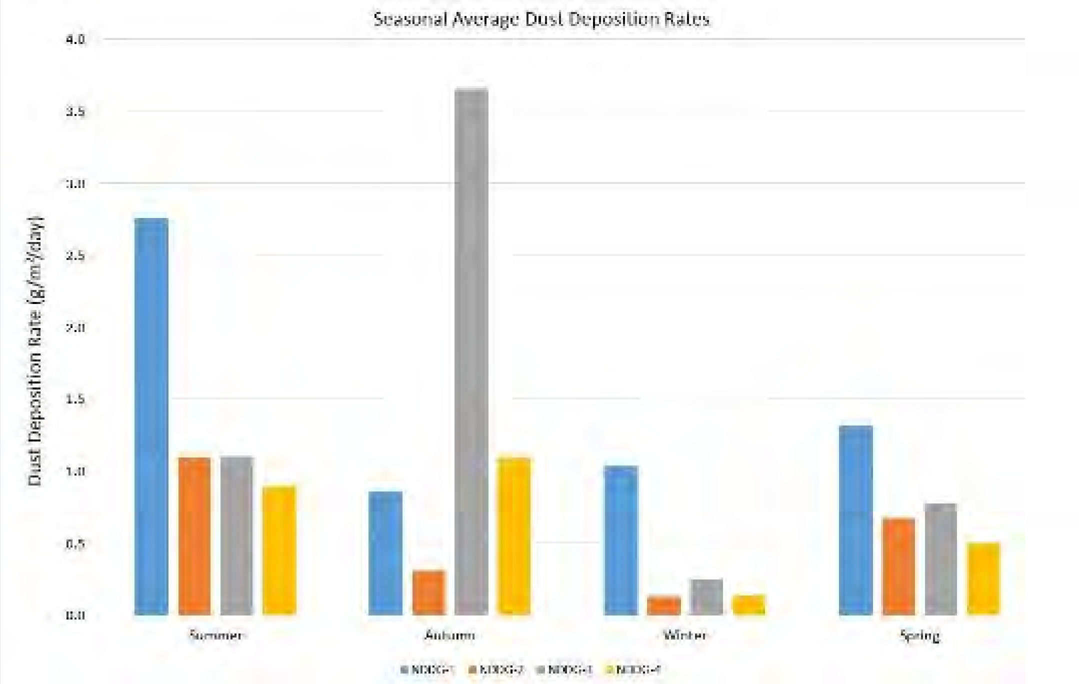

Figure 3-5 Baseline dust deposition seasonal variation (based on normalised monthly values)

Part B

Whilst 14 monthly determinations were above 2.0 g/m2/day, four months were above the total dust increment of 4.0 g/m2/month. Individual months can go above the criterion, however the rolling 12-month average is critical as the indicator for dust impacts.

Exceedances in the context of the 12-month rolling criteria are explained below:

October 2010 to August 2011 was not a complete year, but one month at NDDG-2 had an anomalous peak of 7.9 g/m2/month in July 2011. However, the rolling 12-month average for measurements in a 12-month period was approximately 1.2 g/m2/month.

August 2012 to July 2015 recorded one month of 5.1 g/m2/month at NDDG-1 above the rolling annual total dust deposition criterion. However, the 12-month period from August 2012 to July 2013 had an average total dust deposition determination of 2.3 (no gap filling) to 2.8 g/m2/month (the latter with gap filling – for example, 5.1 applied to all months December

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		2012 to March 2013 inclusive). (Note: ‘gap filling’ considers the recorded value as the same for all the individual months in the exposure period). Dust as a result of mining activities will be managed with the objective to meet the rolling 12-month average criterion. Part C The emission inventory process is to identify all mining activities that have potential to create dust. Once the exposure, bulk movement or stockpiling of ore or topsoil occurs, it is accounted for in the inventory. However, when processes become wet, i.e. during entry into the processing plant and then through to slurry deliver to a tailings facility, it is considered to be a wet process with none to insignificant potential to emit dust. The dust inventory includes the mining activities within the pit (i.e. blasting and use of machinery), truck hauling, ROM pad, stockpiles (either ore, waste rock, topsoil) and the concentrate plant. Exposed surfaces including exposed areas of the pit and areas of disturbed soil are also included as a wind erosion sources. The tailings areas have considered to be continually wet, as slurry is delivered, until final closure when completed areas are capped and rehabilitated (thereby returning to be an ambient/background dust load to the atmosphere). They have not been included in the dust inventory. Natural erosion from unexposed areas is also not included, as that is considered part of the ‘background’ dust load. Further detail regarding the dust inventory is located in Chapter 3 of Appendix Q of the EIS.
4	Only unquantifiable operational controls can be applied to waste rock dumping. These operational controls include gentle dumping of overburden on the WRDs Clarify the technique for gentle dumping of overburden (and waste rock) and provide additional controls to manage offsite dust impacts.	The National Pollutant Inventory (NPI) Emission Estimation Technique Manual for Mining (Version 3.1, January 2012) gives a generic/default emission factor for dumping of overburden or waste rock. This default emission factor was used (See Appendix A 1.1.6 of NPI Mining Manual) as it is independent of source characteristics and has been increased from the value used by USEPA (AP-42 documentation, Chapter 11.9 Western Surface Coal Mining). Table 4 (NPI Mining Manual) gives an unquantified control factor for Draglines achieved by ‘minimising drop height’. Minimising drop height is not possible with fixed heights to the backend of haul trucks, however, the same principle can be applied through the implementation of a slower dumping rate (longer time to raise truck tray). This technique was referred to as ‘gentle dumping’ in the Air Report (Appendix Q). Table 4 of the NPI Mining Manual provides ‘estimated control factors for various mining operations’. There are no controls for loading trucks and the only control available for

UID	Summary of submission	Response
		unloading trucks is 70% for water sprays. The use of water sprays is generally considered to be impracticable in operations where waste rock and other dumping will occur over a wide area. The use of water sprays as a control measure would only be applied as a last resort, after first applying mitigation measures to larger emission source contributors, and only if required when off-site dust monitoring indicates an impact larger than predicted. The operational controls for waste rock dumping are discussed in the Air and Dust Management Plan (Appendix X-C) including: Offloading of waste and ore undertaken from minimum heights; and Use of water sprays at high frequency dump locations (i.e. start of crushing circuit). Arafura will implement additional controls if dust emissions exceed the dust criteria. This has been included as a commitment.
5	Figure 11 provides the data for the three different periods of continuous monitoring: 26 September 2010 to 26 October 2010 28 October 2010 to 6 December 2010 3 February 2011 to 9 March 2011 The seasonal increase was attributed to heavy vehicle traffic associated with dry, hot summer conditions. Winter is also a period that may be dry with windy conditions Provide more details on baseline dust concentrations during the dry season to facilitate modelling.	Near the tropics, in a desert, a traditional wet/dry season is rarely experienced. A desert has less than 400 mm of rain per year and this is often sporadic. The best indicators of seasonal potential for dust emissions are wind run and evaporation; the latter being a function of temperature, humidity and, a lesser degree, wind. The Territory Grape Farm climatic site of the BoM (Site Id; 015643) shows a pattern of a stronger wind regime during the austral summer than the winter (refer Figure 3-6). Since the Territory Grape Farm does not record evaporation, the north and south relative sites of Alice Springs (Site Id: 015598) and Barrow Creek (Site Id: 015525) provide the required data. A clear seasonal trend is evident with highest evaporation October to February and lowest May to August (refer Figure 3-7). It is noted that it can be dry and windy in winter, but not as much as in summer, and therefore modelling has been undertaken using worst-case climatic conditions.

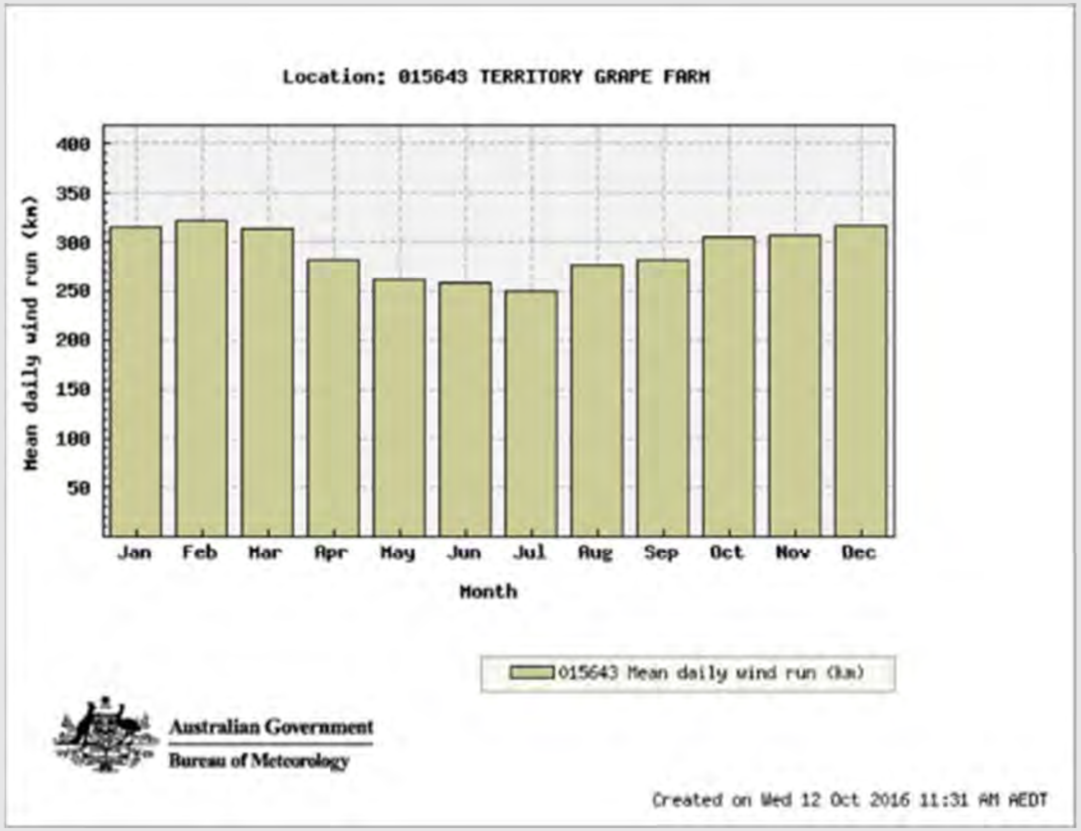


Figure 3-6 Territory Grape Farm BoM site – mean daily wind

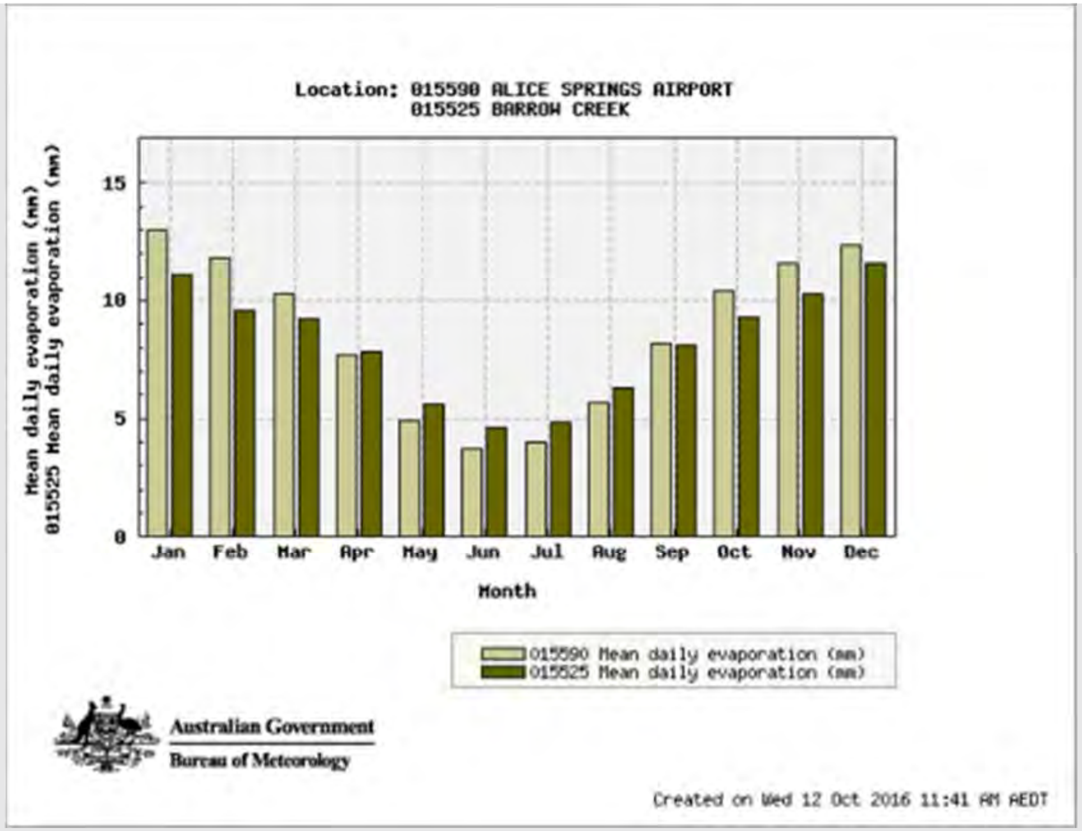
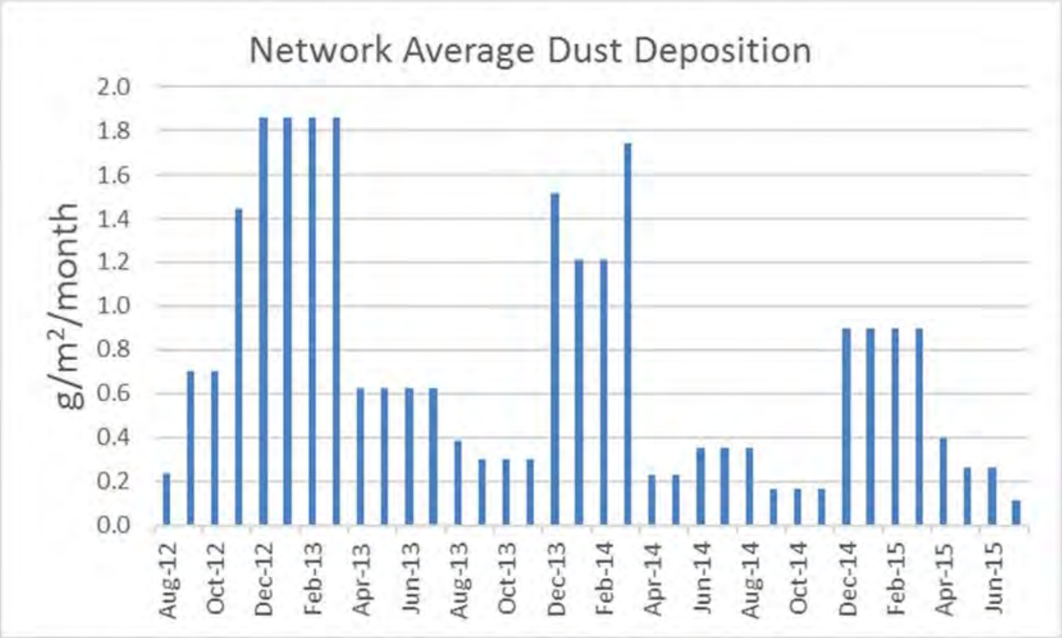


Figure 3-7 Alice Springs and Barrow Creek BoM sites – mean daily evaporation

Some further data analysis was performed on the dust deposition data to see if there is an annual cycle. The most complete set of data is from August 2012 to July 2015. Some of the data spanned up to four months with calculated values of g/m2 per 30 days. A ‘Gap Filling’ technique has been used that considers the recorded value as the same for all the individual months in the exposure period. A 36-month data set at four sites can therefore be created. Two data values were removed from the dataset where excessive monthly values well above the ‘rest-of-network’ average indicated a localised source (or even sabotage). These were April 2015 at DDG-4 and June 2015 at DDG-3. A network average across the four sites was applied and these are plotted as a time series below (refer Figure 3-8).

UID	Summary of submission	Response
		A clear trend is evident with a greater dust load December to March, this correlates well with the evaporation seasonal trend from above. This preference will also manifest in greater dust-in-air concentrations during the hottest portion of the year, so the assumed 'worst-case' PM10 during September to March is reasonable (and the measured background levels have been kept constant across the colder drier 'winter' months).  Figure 3-8 Network average dust deposition
6	Clarify whether there are site specific differences in particle size distribution compared to the default US EPA references used in the model.	Appendix B.1 of the US EPA AP-42 documentation provides 'particle size distribution data and sized emission factors for selected sources'. None of the processes at this mining operation are included. Appendix B.2 of US EPA AP-42 provides 'Generalized Particle Size Distributions' and is described as: "Because particle size information for many processes of local impact and concern are unavailable, this appendix provides "generic" particle size distributions applicable to these processes. The concept of the "generic" particle size distribution is based on categorizing measured particle size data from similar processes generating emissions from similar

UID	Summary of submission	Response
		materials. These generic distributions have been developed from sampled size distributions from about 200 sources. Generic particle size distributions are approximations. They should be used only in the absence of source-specific particle size distributions for area-wide emission inventories”. As there is no site–specific measurements of Particle Size Distributions (PSDs), only generic PSD’s could be used in the modelling, as best matched between the described processes and the 43 categories in the AP-42 documentation, distilled into nine ‘generalised’ categories. Mechanical generated fugitive dusts from unprocessed and processed ores provide the best match and the PSDs are provided in Table 8 in Appendix Q of the EIS, along with a PSD for wind erosion due to “wind-generated particulate emissions from mixtures of erodible and nonerodible surface material subject to disturbance” at industrial sites. After accounting for scatter in the original data, the US EPA AP-42 generalised PSDs are the best approximations to real variations in source characteristics and/or measurement/reporting errors. Site-specific data, if available, would lower the error bars but no large variation is expected.
7	Provide a map of local sensitive receptors (e.g. less than 20km from mine site) in the modelled impact contour plots. From these plots it appears there may be off site exceedances for PM10 dust deposition, TSP etc. Annual and rolling averages have been provided rather than month by month which may show seasonal variations. The proponent has concluded that air quality impacts are mostly low risk however as noted in the EIS a properly equipped and resourced dust monitoring network, combined with more accurate mine operations data would provide an opportunity to evaluate emissions estimates and dispersion model predictions and confirm this conclusion. Clarify the audit measures available to confirm that mining operations have minimal and acceptable impacts on the environment.	Figure 13-3 of the EIS illustrates the location of sensitive receptors. For all identified pollutant assessment criteria, every sensitive receptor location such as the Accommodation Village, Aileron/ Alyuen and Anna’s Reservoir are outside the respective assessment criterion contours – and therefore not impacted. The sensitive receptors have not been included on the contour plots to maintain a scale that provides detailed contour information in a mapping format (i.e. the detail would be lost if the extent of the mapping was increased to include sensitive receptors within 20 km). In lieu of NT specific guidelines or standards the criteria within the NSW EPA’s Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 2016 (Table 7.1) have been adopted. These criteria are based on a 12 month rolling average. The ‘audit measures’ are detailed in the Air Quality and Dust Management Plan (Appendix X-C of the EIS). Monthly monitoring will be undertaken (across five sites) and the results will then be used to confirm the predicted particle concentrations (refer Table 2-4) modelled in the Air Report (Appendix Q of the EIS). The Air Quality and Dust Management Plan outlines the mitigation measures that are to be implemented to minimise dust impacts and provides a Trigger, Action and Response Plan (TARP) the trigger values for the implementation of additional controls.

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8	Upon closure, stock piles, waste dumps and residue storage facilities that contain radioactive material will be capped with benign waste rock to a thickness of 2m to ensure underlying waste and tailings will not be exposed or eroded in the long term. Provide evidence the 2m of waste rock will be sufficient to support this above statement.	Refer to Section 4.1.3.
36	The proponent has conducted a thorough fauna survey as per the guidelines. Of the threatened fauna found, it appears they have detected a large population of the threatened Brush-tailed Mulgara. Overall this significant finding has not been adequately discussed against other studies. The proponent must discuss the importance of the Brush-tailed Mulgara population as its own entity and provide specific mitigation measures to protect the population from mining activities.	Brush-tailed Mulgara (*D. blythi*) is not listed under the EPBC Act and is likely that other unsurveyed habitats within the broader area within sandplain habitats would support this species. The only approach to confirm this with any certainty though is to conduct surveys, however based on the similar habitat to where the active mulgara burrows and fauna camera records occurred, it is likely they are found over a much larger area. During targeted surveys, a total of 45 active Mulgara burrows were recorded along the 37.4 km of proposed alignments, or within 20 m of the centreline. A total cumulative loss of 122.25 ha of known foraging/breeding/dispersal habitat. This equates to broadly 0.29% of the approximately 41,568 ha of potential habitat within the sandplain habitats of Napperby and Aileron Stations that encompass the Nolans Project. Specific mitigation has been provided for the Mulgara within the Biodiversity Management Plan (Appendix D of the EMP) provided in Appendix X-A B of the EIS. Table 4-6 covers mitigation for all threatened species on the sandplain habitat (i.e. borefield) and includes: Pre-clearing fauna surveys prior clearing and a qualified ecologist will be present during clearing of the Borefield where Mulgara burrows have been mapped, to capture/translocate animals unable to escape (FF10). Monitoring including motion sensing cameras to monitor burrows with accompanying predator control, fire management and traffic management. Pest monitoring and management will also be carried out for feral cat, foxes (refer Tables 4-2, 4-3, 4-4) which are a well-documented threat to small/medium native mammals.
37	Specific mitigation measures may need to be implemented for species with very small known populations such as the Great Desert Skink in the south- west of the study area (See Chapter 10) (P. 9-55). Provide mitigation measures for all protected fauna that may be affected by mining activities.	Mitigation, management and monitoring for fauna species is presented in the Biodiversity Management Plan (Appendix D of the EMP). These controls are encompassing of all threatened fauna species that may be affected by mining activities.

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38	The active warren is not currently part of the proposed development and this would need to remain through protection of this location (P. 9-55). Provide details on how the proponent will protect this location, and ensure this protection is monitored for effectiveness.	The primary mitigation strategy for the Great Desert Skink is the complete avoidance of the known active warren. A 200 m buffer maintained around the warren and exclude all borefield activities. The location of the buffer will be detailed in the site induction. This has been included as a commitment. The effectiveness of the strategy will be measured through annual monitoring including: Motion-sensing camera surveys within known habitat including two cameras at known warrens. Transect surveys searching for warrens within known. Camera surveys will comprise five 400 m camera transects and be left in situ for 28 nights during Great Desert Skink active season (i.e. warmer months).
39	Populations of Black- footed Rock wallaby which occur within 2km of the mine site could be subjected to low levels of dust (Chapter 10). Mitigation measures as discussed in Section 9.7.8 would be implemented to keep dust levels to a minimum. The residual risk of impact associated with dust is low (P. 9-56) A dust risk assessment is required for each known and likely threatened species that may be subjected to dust generated by mining activities	Two threatened species risk assessments were completed: Table 27 assessed impacts to species associated with habitats located within the borefield (i.e. woodlands and grasslands) Table 28 assessed impacts to species present within the mine site and within the vicinity (i.e. rocky areas). These risk assessments encompass the potential habitat areas of all threatened fauna likely to occur within the project site. Dust has been captured as a source of impact in both risk assessments.
40	There would be an extremely low chance that passing Princess Parrots or other threatened species would stop for a d rink at a TSF/RSF (P. 9-59) Explain if TSF/RSF water poses a risk to fauna/avian visitation and how the proponent intends to prevent the access by threatened species.	Refer to Section 4.19.
41	Most mining activity is scheduled to occur in daylight hours and only the concentrator at the mine site will operate 24 hours a day. This will substantially reduce vehicle movements between the mine site and processing site and therefore reduce the risk of this occurring. Mitigation discussed in Section 9.7.12 would likely involve the implementation of speed limits and possibly the reduction in vehicle travel at night (P. 9-60). Provide clarification if the proponent commits to driving	Ore mining will occur during daylight hours while waste mining will occur 24 hours a day. Waste mining will require vehicle movements within and between the mine site and processing site during both daylight and night hours. Speed limits will be implemented through sensitive areas to minimise fauna strike (refer UID 488 (NT EPA)). The residual risk associated with night-time vehicle movement is low.

UID	Summary of submission	Response
	in daylight hours between the mine site and processing site only given there is the possibility of nocturnal fauna strike.	
42	In particular, the Project will aim to avoid where possible, sensitive vegetation types such as riparian vegetation and or sites where listed threatened species are known to occur (P. 9-60). Provide clarification on how Brush-tailed Mulgara habitats will be identified and avoided	It is considered highly unlikely that the Mine will avoid Brush-tailed Mulgara habitat in its entirety. The location of the borefield is positioned in context of the Southern Basins aquifer and, as such, the relocation to avoid such habitats is not possible. Impacts from the clearing would likely be minimal, and not amenable to detection at the population level. Clearing impacts equates to broadly 0.29% of the approximately 41,568 ha of potential habitat within the sandplain habitats of Napperby and Aileron Stations that encompass the Nolans Project. Qualified ecologist will be present during clearing of the Borefield where Mulgara burrows have been mapped, to capture/translocate animals unable to escape.
43	Consideration of a cool, well managed fuel reduction burns of all habitats to be cleared to allow fauna to have the chance to escape prior to clearing of vegetation, or pre-clearing fauna surveys would be conducted prior to construction of the mine with qualified ecologists on site to capture and translocate animals that are found during the clearing process (P. 9-61) Provide evidence of how fuel reduction burns are a proven fauna mitigation method when conducting clearing activities.	Implementing a fuel reduction burn in cooler weather can be used to encourage fauna to leave their habitats, however, Arafura has determined that burning will not be utilised as a method to clear vegetation. Reference to the use of burning for vegetation management will be removed from the EMP.
44	The reduction of impacts of TSF/ RS Fs on wildlife by following best practice guidelines currently recommended for the Northern Territory where practicable (P. 9-64). Provide reference to the specific management of impacts referred to in the best practice guidelines and what the operator commits to implementing from these guidelines.	Refer to Section 4.19.

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45	To determine if an action will have a significant impact, criteria have been developed for each of the abovementioned categories. The significant impact criteria are listed in the Significant Impact Guidelines 1.1 - Matters of National Environmental Significance, developed by the former Department of Environment (2013), and include: (P. 10-2). The criteria for endangered and criticality endangered EPBC listed species are stated. Provide the significant impact criteria for vulnerable EPBC listed species.	A precautionary approach has been applied for the risk assessment, therefore the Significant Impact Criteria for Critically Endangered and Endangered species was used rather than criteria for vulnerable species only. The Significant Impact Criteria for vulnerable species has not been used in the risk assessment.
46	Surveys for Greater Bilby burrows were completed during the 37.4 km of walking transects of the proposed alignments, and from the air by helicopter when flying over areas of sand plain during rock-wallaby surveys (P. 10-13). Clarify the confidence of spotting Greater Bilby burrows from helicopter surveys.	Greater Bilby burrows are quite extensive (up to 2 m deep) and with a distinct large 'spoil' heap. Searches for Greater Bilby burrows from a helicopter were conducted as a complementary activity (enroute to Black-footed Rock-wallaby habitat) along with more conventional searches for burrows, scat, tracks conducted along the 37.4 km of the proposed borefield pipeline. Dr John Read who was involved in the Rock-wallaby surveys indicated that Greater Bilby burrows would be visible from the air in the sparsely vegetated habitats of the sandplain.
47	This species was not recorded during the 2010 or 2015 surveys, and no records exist for the stud y area (P. 10-14). Though no records were recorded within the small study area, there is one record about 40 km to the West of the project. Provide a likelihood assessment that includes this species.	The likelihood of occurrence has been assessed in Appendix D of the Fauna and Threatened Species Report (Appendix N of the EIS). It is still possible that the Greater Bilby could occasionally be present within the borefield component of the study area due to its capacity to expand rapidly in distribution and abundance under favourable conditions (Woinarski et. al. 2007).
48	Habitats within the study area are unlikely to be considered 'important habitat', and the birds that occur there are unlikely to be an 'ecologically significant population' (in accordance with the EPBC Act). The Project is not expected to impact on any listed migratory species (10-14). Provide studies that support this statement and the assessment against migratory species as per the significant impact guidelines.	The majority of migratory species predicted by the Federal Department of the Environment and Energy's Protected Matters Search Tool (PMST) are unlikely to occur on-site, see Section 4.7 and Table 21 of the Fauna and Threatened Species Report (Appendix N in the EIS). Seven species listed as migratory are known from the Burt Plain Bioregion, however, five of these species are wetland species. There is no wetland habitat within the Project site, however, it is possible that these species may utilise temporary habitats across the project area (e.g. ponded water) following heavy rainfall. Any utilisation would be transient in nature with the presence of migratory species being opportunistic only. Two of the Migratory species (Fork-tailed Swift and Rainbow Bee-eater) are likely to occur within the study area.

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		Based on the site-specific findings of the Flora and Vegetation Report (Appendix M) and the Fauna and Threatened Species Report (Appendix N) the Project site unlikely to be considered 'important habitat', and the bird s that occur there are unlikely to be an 'ecologically significant population' (in accordance with the EPBC Act).
49	Targeted survey for Mulgara in July 2015 in the sand plain areas (i.e. bore field area and southern extent of proposed water supply pipelines) was carried out to determine the size and distribution of the population in areas proposed for impacts (P. 71). What is the predicted population of Brush-tailed Mulgara's in the area proposed for clearing?	Forty-five active Brush-tailed Mulgara burrows were encountered during the targeted surveys conducted in July 2015, however, no individuals were seen. This was a dedicated survey with a consistent effort and method to identify signs of mulgara. It is impossible to indicate with certainty how many animals were actually occupying the burrows as there could be single or multiple animals (female with young) in each of the burrows or single animals occupying multiple burrows (i.e. several burrows used within a home range). The other information reported on Brush-tailed Mulgara presence (36 observations) comes from the results obtained using motion-sensing cameras at one burrow during and after the baseline surveys. One active warren found during the baseline surveys was monitored for Great Desert Skink using motion-sensing cameras, and subsequently detected at least one mulgara individual. Brush-tailed Mulgara were ‘seen’ on camera, but it is not known whether there was one individual (observed 36 times) or multiple individuals.
50	During targeted surveys a total of 45 active Mulgara burrows (indicated by fresh tracks, digging and/ or scat) were recorded along the 37.4 km of proposed alignments, or within 20 m of the centreline (Figure 11). These results suggest that mulgara are present in quite high numbers and widespread in areas of suitable sand plain habitat across the southern borefield area (P. 71) According to Appendix F - Found Species recorded within the study area during the 2010 and 2015 found surveys there are 36 records of Brushtailed Mulgara, clarify exactly how many Brush-tailed Mulgara were seen along with active burrows	Refer to UID 49 above. Brush-tailed Mulgara were ‘seen’ on camera, but it is not known whether there was one individual (observed 36 times) or multiple individuals. It is acknowledged that the result of ‘36 observations’ should have been accompanied by a qualifying note to explain this.
51	Each of the species to be assessed can be regarded as having a population in the Nolans Bore area. The assessment is risk averse in that two of the species were not recorded during the stud y (P. 110).	Each of the threatened species recorded during the surveys within the study area could be considered a ‘population’. It could be argued that by virtue of their definition as a ‘population’ by EPBC Significant Impact Criteria that these populations are important to the conservation of each of these two species (Black-footed Rock-wallaby, Great Desert Skink and Brush-tailed Mulgara).

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	Of these populations, how important are they to the conservation of the species.	
52	A total cumulative loss (all vegetation communities) of 122.25 ha (conservatively veg communities 2a, 3b and 12) of known foraging/breeding/dispersal habitat. This equates to broadly 0.29% of the approximately 41,568 ha of potential habitat within the sand plain habitats of Napperby and Aileron Stations that encompass the Nolans Project (bore field area assessed for the project, see Figure 26). There is certainly far more extensive potential habitat in the Burt Plain Bioregion in addition to this area (P. 111) Given that this is the first time the Brush-tailed Mulgara have been recorded from the Burt Plain Bioregion, what is the certainty that all of this habitat is suitable for this species.	As discussed in Section 1.5.1 of the Fauna and Threatened Species Report (Appendix N of the EIS), there has been a great deal of confusion in the Australian scientific community over the identification of the mulgara species, and therefore, the Dasycercus species that occurs on the mine site. This information is repeated here for clarity: Up to December 2013, two species of mulgara were listed as threatened under the EPBC Act: the Brush-tailed Mulgara (*Dasycercus cristicauda*) and the Ampurta (*D. hillieri*). The distribution identified for *D. cristicauda* covered a large part of central and northern arid Australia, from western Qld, through northern SA and southern NT, across to the Pilbara region in WA. The distribution identified for *D. hillieri* covered a small area of central arid Australia, centred on the area where Qld, SA and NT meet. The distribution identified for D. hillieri did not include the study area, while the distribution identified for *D. cristicauda* did. Because its distribution included the study area, the ‘Brush-tailed Mulgara’ (*D. cristicauda* or *D. blythi*) was included as a focal threatened species during the site assessments. In December 2013, the EPBC species listings for mulgaras were revised to align with taxonomic work on the mulgara species by Woolley (2005). Woolley concluded that there were indeed two species of mulgara, but that those species did not align with the existing species identification. Woolley concluded that *D. hillieri* is a synonym *of D. cristicauda* (i.e., that they are one and the same), and that species is now classified as the Crest-tailed Mulgara (*D. cristicauda*). The Crest-tailed Mulgara (*D. cristicauda*) is listed as Vulnerable under the EPBC Act and Vulnerable under the TPWC Act. The Crest-tailed Mulgara (*D. cristicauda*) is now reported to occupy an area of central arid Australia, centred on and extending west from the area where Qld, SA and NT meet. It occurs in sand dunes that have a sparse cover of Sandhill Canegrass (*Zygochloa paradoxa*). This habitat does not occur within the mine site. The Crest-tailed Mulgara (*D. cristicauda*) was not identified by the PMST search for the study area, and is considered unlikely to occur within the mine site. Woolley concluded also that the mulgara species originally (i.e., pre-2013) referred to as Brush-tailed Mulgara (*D. cristicauda*) is really the Brush-tailed Mulgara (*D. blythi*). This species is not currently listed as threatened under the EPBC Act, but it is listed as Vulnerable under the TPWC Act. This species is reported to occupy sandplain habitats across a large part of central and northern arid Australia, from western Qld, through northern SA and southern NT, across to the Pilbara region in WA. This species occurs within the Study area.

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		The name *D. hillieri* has been removed from the EPBC Act threatened species list (December 2013). The name Ampurta was used by Aboriginal people (Woolley 2005), and Woolley notes that it is impossible to tell which species was known as Ampurta. In Appendix E of the Report it is noted that Crest-tailed Mulgara has previously been recorded from the Burt Plain Bioregion, it is likely with the confusion over these species that these records are in fact Brush-tailed Mulgara as the Burt Plain is outside the currently accepted distribution of the Crest-tailed Mulgara which occupies dunes crests with Cane Grass more typical of the Simpson Desert in the NT.
53	A risk table needs to be conducted for each threatened species, especially as the Brush-tailed Mulgaras that are present may represent an important population of this species.	Two threatened species risk assessments were completed: Table 27 assessed impacts to species associated with habitats located within the borefield (i.e. woodlands and grasslands) Table 28 assessed impacts to species present within the mine site and within the vicinity (i.e. rocky areas). These risk assessments encompass the potential habitat areas of all threatened fauna likely to occur within the project site.
54	Include Brush-tailed Mulgara in this list as they are listed threatened fauna under the Territory Parks and Wildlife Act	Section 7.1.2 of the Biodiversity Report (Appendix N of the EIS) details threatened fauna listed under the EPBC Act. Table 18 and Section 4.5.3 of the EIS detail the listing of the Brush-tailed Mulgara under the TPWC Act.
55	Monopterus sp. 3 Is this an undescribed species, and if so what is the potential impact of the project on this species?	The genus Mormopterus is currently undergoing a revision, with Mormopterus sp. 3 previously referred to as both *Mormopterus planiceps* (small penis form) and *Mormopterus species 3* in Adams et al. 1988. This species is likely to be formally described by the work of Terry Reardon (Churchill 2008). This species is widespread throughout inland Australia south of the Tropic of Capricorn. It occurs in inland southwest WA to coast at Eyre Peninsula, SA and into western NSW and southwest Qld. Restricted to arid and semi-arid habitats. Churchill 2008 notes that they are common in more arid parts of Australia and are often caught along water courses lined with River Red Gums in arid areas. This species is not considered to be of threatened status under Commonwealth or NT legislation and is well represented across southern inland Australia.

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90	The NT DME requires that a post mining land use is discussed with all stakeholders and agreed to by the Department, and that this process should be recorded in the earliest planning documentation for the site. To date, no commitments have been made by Arafura to third parties in relation to the closure of the Nolans Project The proponent must demonstrate that at closure and for the closure period (1000 years) the mine is: physically safe to humans and animals; geotechnically stable; geochemically non contaminating (e. g. acid, metalliferous or saline drainage); and capable of sustaining an agreed post-mining land use. It must be demonstrated that the tailings and waste rock can be managed and contained on the surface for a period of greater than 1,000 Years without unacceptable impact to the environment or posing an unacceptable safety risk. The proponent has not provided the hydrogeology and long term water quality of the pit that is proposed to be left open.	Part A The requirement to consult with stakeholders regarding post-mining land use is detailed in both the Closure Plan (Appendix W of the EIS) and the Social Impact Management sub-plan (Appendix X of the EIS). Consultation with effected stakeholders has been detailed in the Community Consultation Report (Appendix H of the EIS). Arafura continues to work closely with the landholders and Traditional Owners regarding future land use and is currently proposed to be rehabilitated back to cattle grazing. Part B Refer to Sections 2.10.1 and 2.10.2 for information on WRDs and infiltration, quantities of material required for rehab, management of material required for closure. Refer to Sections 4.1.3 and 4.1.4 for further information on capping for the WRDs, TSF and RSF. Refer to Appendix 16 for further detail on the characteristics of waste rock. Part C Refer to Section 4.1.5.
91	It is understood that not all necessary details for rehabilitation be provided in the EIS but there must be enough detail provided to provide confidence that all relevant issues have been identified and will be managed during operation and post closure. Before the proposed mine closure of Nolans can be assessed the following should be provided: • Proposed post mining land use. • Material characteristics of the tailings, residue and waste rock dumps to enable a workable closure plan.	Refer to the Environmental Risk Register (Appendix F of the EIS) and the Closure Plan (Appendix W of the EIS) for information on the identification, assessment and risk of post closure issues. A Closure Plan will be submitted to the DPIR as part of the mining authorisation phase and approval of the Plan will be required prior to the commencement of operations. Further to the following sections for further information: • Proposed post mining land use – Closure Plan details a cattle grazing land use (Appendix W of the EIS) • Material characteristics of the tailings, residue and WRD – Appendix 2 and 16 • Final pit void water quality – Section 4.1.5 • Potential erosion of landforms - Section 4.1.4

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	- Final void water quality - surrounding groundwater level and expected level of water held in the void. - Potential surface water quality impacts due to erosion from landforms. - Potential seepage impacts from WRD, TSF, RSF. - Details of the source, qualities and quantities of material required for rehabilitation. - Management of material required for closure (e. g. topsoil, clean inert waste rock). - Long term stability of post closure landforms and drainage to ensure management of runoff and seepage from the site. - Provide a comparison of the long term or residual environmental risk for potential AMD between the current plan of open void and WRDs on surface versus backfill of the final void with the mined waste material.	- Potential seepage impacts from WRD, TSF, RSF – Section 4.27 and Appendix 2 - Details of material required for rehabilitation – Section 4.1.4 - Management of material required for closure – refer to updated project description (Section 2) - Long term stability of post closure landforms – Closure Plan details that landscape modelling will be undertaken and updated as the mine develops (Appendix W of the EIS) Provide a comparison of the long term or residual environmental risk for potential AMD between the current plan of open void and WRDs on surface versus backfill of the final void with the mined waste material – Section 4.1.1 for an assessment of alternative closure strategies and Section 4.27 for AMD risk.
92	Prior to closure, review and update the AMD management plan to incorporate specific control measures for closure and rehabilitation Information is required on AMD management and effective operational methods must be completed prior to disturbance. Post closure landforms and drainage will be designed to ensure runoff and seepage directed to the pit is low enough to ensure evaporation of surface water. Inflow to the pit lake will be managed to keep the lake below the surrounding groundwater level, preventing outward	Part A Refer to Section 4.27 for more information on AMD. The AMD Management Plan will be updated to incorporate specific control measures for closure and will be appended to the MMP. This has been included as a commitment. The MMP will require approval from DPIR during the mining authorisation phase and prior to the commencement of mining. Part B Pit closure will be completed as per the WA Guidelines (i.e. Safety Bund Walls, Pit Abandonment). Surface water runoff will not be directed into the pit and the pit will act as a sink post-closure. Refer to Section 4.1.5 and the Water Management Plan (Appendix 4) for further detail.

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	flow of groundwater or surface discharge Provide details on how this inflow will be managed to ensure there is no outflow of groundwater water or surface discharge	
93	Waste rock dumps will remain on the surface rather than be backfilled into the pit and will be progressively rehabilitated. Progressive rehabilitation of WRDs to minimise exposed material and dust generation No firm commitment or timeframes have been provided supporting the progressive rehabilitation of WRDs. Explain the concept and accepted methodology for WRD progressive rehabilitation.	The rehabilitation schedule will be determined once detailed mining schedules are available. The schedule will be detailed in the MMP. The WRD outer skin will be constructed first near the pit so dumping can be progressed from this skin. The outer batters can then be shaped and the topsoil placed and spread on these. These batters will then be contour ripped. The dump footprint will then be expanded to the north away from the pit. This will ensure the outer skin begins the process of stabilising and vegetation begins to establish. By using this methodology the dump skin will provide a barrier to the mine and beneficiation plant.
109	A summary table listing the commitments made in the EIS, including clear timelines for key commitments and performance indicators, with cross- references to the text of the EIS. Indicate whether recommendations included in the EIS will be endorsed and adopted by the proponent Provide a summary table of all commitments as required by the Terms of Reference	Refer to Section 5.
113	a) Once mining ceases, groundwater near the pit will begin the process of rebounding. A pit lake will form and the pit will slowly, partially fill until the water level reaches equilibration where the net evaporation is equal to natural groundwater inflow. This will then result in a process where water quality will slowly deteriorate and over time results in a hypersaline pit lake. Flow will be radially towards the pit lake and thus contribute to the concept of a zero discharge site. The likely chemistry of this pit lake has not been modelled; however, it is highly likely to be of no beneficial use. It is understood that poor quality water would accumulate in the final void. The hydrogeology and long-term water quality of the void must be fully	<u>Part A</u> The EIS in Section 6.3 Appendix K details that the pit level drawdown rebounds to a level where groundwater flow equates to evaporation (refer Figure 36). Once at this steady state, all inflow is evaporated and therefore inflow equals how much water will be lost from groundwater due to evaporation. This is approximately 700 m3/day (8L/s) or approximately 250 ML/year (Figure 36). Refer to Section 4.1.5 for further information on pit lake water quality. <u>Part B</u> Refer to Section 2.10.1 for the framework in further developing the WRD surface water management considerations. Pit closure will be completed as per the WA Guidelines (i.e. Safety Bund Walls, Pit Abandonment). Surface water runoff will not be directed into the pit and the pit will act as a sink post-closure. Refer to Section 4.1.5 and commitments regarding closure planning (Section 5) for further detail.

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	understood and demonstrated that this water will not over time cause unacceptable impacts to surface or groundwater, before approval to retain an open final void post closure is provided. Provide details on how much water in the pit will be lost from the aquifer due to evaporation annually. b)The mine closure design should ensure that all surface water runoff is diverted around and away from the pit so that the pit remains a groundwater sink Provide details on how these surface water diversion structures will be maintained post closure to ensure water does not flow into the pit.	The Kerosene Camp Creek is the main source of surface water in the vicinity of the pit and with the proposed diversion of this creek the likelihood of surface water ingress to the pit is limited.
173	The proponent must provide specific, realisable plans that are supported with comprehensive evidence including: • A hydrogeological conceptual model with more detail on aquifer boundaries and depths including the unique isolated aquifer under the pit	Refer to the Water Resource Assessment (Appendix 3). The Water Resource Assessment currently under review by DLRM. A digital appendix to the groundwater model is also provided in Appendix 9.
174	The proponent must provide specific, realisable plans that are supported with comprehensive evidence including: Modelling on groundwater drawdown on all aquifers that may be impacted by mining and processing activities including the assumptions and estimations that were used in modelling;	The Groundwater Report (Appendix K of the EIS) outlines the drawdown on all aquifers that will be impacted by mining (i.e. Southern Basins and the isolated pit aquifer). Refer to Section 4.22 for further information on data and assumptions used in the groundwater modelling.
175	The proponent must provide specific, realisable plans that are supported with comprehensive evidence including: Provide assumptions and estimations used for the groundwater model;	Refer to Section 4.22 for further information on data and assumptions used in the groundwater modelling.

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176	The proponent must provide specific, realisable plans that are supported with comprehensive evidence including: Identification of groundwater dependent ecosystems and the impacts from the drawdown of groundwater - e.g. Lake Lewis and water users in the area such as pastoralists or agriculturalists - Territory Grape;	Refer to Section 4.5 for further information on ground water dependant vegetation/ecosystems. Refer to Section 4.3 for further discussion on potential impacts to Lake Lewis. Refer to Section 4.6 for information on other groundwater users in the region.
177	The proponent must provide specific, realisable plans that are supported with comprehensive evidence including: Provide quality, depth and location of existing groundwater under the mine site, processing site and the bore field area.	Refer to UID 117 (ARPANSA). Further detail is provided in the Water Resource Assessment (Appendix 3).
178	Show an understanding of subsurface drainage, depths and location of shallow palaeochannels	Refer to Section 4.17.
179	The actual number of bore fields developed will depend on the results of future bore field groundwater investigations to be completed during the mine development phase. The level of uncertainty associated with using a Class I groundwater is insufficient given the potential for impacts on the receiving environment. Due to the close proximity of the borefield to communities and groundwater dependent ecosystems, the groundwater knowledge gaps need to be addressed. The proponent needs to undertake the following to validate the proposed model prior to commencing any operations in the region, a. Undertake stress testing of the borefield aquifer to accurately determine the potential impacts of the borefield b. Investigate reasonable alternative options for the location of the borefield which will not impact groundwater dependent ecosystems or the water supply of local communities.	Part A Stress testing the Southern Basins, in order to provide meaningful data, would require the pumping of 25-30 GL of water over an extended timeframe (e.g. 2-3 years). This is considered to be an inefficient use of the water resource and Arafura preference is to implement a groundwater monitoring program to further validate the groundwater model. Refer to Section 4.22.6 for further information. Part B The Ti Tree Basin was initially investigated as a source of water for the Project. Further groundwater investigations identified the Southern Basins as an alternative (and preferred) water source. The impacts associated with the use of Southern Basins have been assessed in both the Water Resource Assessment (Appendix 3), groundwater model (Appendix K of the EIS) and the GDE risk assessment (Appendix 12). The borefield has been positioned so to minimise impacts. Refer to Section 4.22.7 for discussion on the adaptive management of the borefield.

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180	The predicted drawdowns are negligible in the Lake Lewis area and not likely to be measureable ....Despite this, the groundwater available for evapotranspiration, like in the Reaphook Palaeochannel area to the north, is likely to be impacted in the Lake Lewis area. The modelled groundwater drawdown at the bore field is very large in terms of extent and could be referred to as 'groundwater mining' as the flow rates should not be considered 'sustainable in the long term (i.e. indefinitely). Despite being unsustainable in the long term, the bore field is considered an appropriate use of the aquifer provided the bore field is ceased at the end of mining and the aquifer allowed to recover. The minor current and potential future uses should not be impacted in a material manner, although it is recognised that minor drawdowns at stock (Napperby Station and Aileron Station south of Yalyirimbi Range within the vicinity of the bore field) and drinking water sources (Aluyen [and Aileron Station Homestead and Aileron Road house] and Laramba [and Napperby Homestead]) are likely to occur. Beyond this, stock bores on Pine Hill Station and Aileron Station may experience minor drawdowns in the long term but no existing bores are likely to be materially affected by mine drawdown by during their anticipated operational life Modelling indicates a drawdown of 0.5 to 1m is expected near this area. The proponent appears to contradict themselves in saying that draw down impacts are both unsustainable and negligible. These statements need to be further clarified. The modelled drawdown of 0.5 to I, m has not been shown to have negligible impacts on all groundwater. The proponent must provide evidence that the drawdown does not impact any potential groundwater	The use of groundwater in the Southern Basins is not considered ‘sustainable’ in the long term (i.e. indefinitely) as it is not likely replaced by recharge at the same rate as the proposed discharge rate. The modelled drawdowns, associated with this groundwater use, are ‘negligible’ in the Lake Lewis area over the period of proposed extraction (i.e. 43 years LOM) for further information on the potential (negligible) impacts to Lake Lewis. The predicted drawdown will impact on current users with peak predicted drawdown impacts at the current Aileron and Alyuen supply and the Laramba and Napperby supply locations are approximately 0.6 m and 1.3 m respectively. The material impact of these drawdowns will also depend on the current and future availability for drawdown and contingency (or redundancy) within the existing and future bores at these locations. This has been identified as a possible moderate impact in the risk register (Appendix K of the EIS). Ongoing monitoring of groundwater is detailed in the Water Management Plan (Appendix 4). Alternative water supplies to supplement demand for directly impacted users, or change to borefield management if water table drawdown is demonstrated to be unacceptable. This has been included as a commitment. Refer to Section 4.5 for further discussion on potential impacts to groundwater dependant vegetation and Section 4.6 for further information on other groundwater users.

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	users, or the intrinsic value of groundwater dependent environments.	
181	Baseline shallow groundwater quality data is currently inadequate and is required to assist in determining impacts to ground water from seepage/runoff from mine infrastructure such as WRDs and TSF/RSF. The Nolans project region (including the bore field) contains ecosystems and communities that are dependent on groundwater. Further validation of the current groundwater model, which includes further field assessment, must be undertaken prior to proceeding with any other project activities.	The Water Management Plan details that surface, groundwater and sediment monitoring that will be undertaken (Appendix 4). The baseline monitoring will commence 24 months prior to the commencement of operations. Refer to Section 4.22.6 for commitments regarding the validation of the groundwater model.
182	Anecdotal evidence suggests that subsurface flow occurs within the alluvium of creeks and this could presumably provide a path for the dispersion of contaminants. What is the consequence of this pathway for WRDs and the TSF/RSFs being built on top of creek lines? (Fig 3-1).	Refer to Section 4.17 and Appendix 16 for information on subsurface flow. Since submission of the EIS, a new concept mine layout has been developed for a LOM 55. WRD 5 is no longer proposed. Refer to the updated flood modelling provided in Section 4.14.1.
183	Groundwater sampling and analyses dataset has been provided by Ride (2016). The sample set consists of 158 samples from a total of 71 bores. Samples were obtained using numerous opportunistic methods including but not limited to, during airlifts, through the use of existing infrastructure (submersibles, outlets and taps) as well as specific sampling from depth. Current results do not provide any indication of annual or seasonal variances or the basis for any statistical mean or variance required for calculation of site specific values. a) Further details of the sampling methodology are required to assess if the samples collected are representative of the groundwater within the aquifers	<u>Part A</u> Sampling methodology is as follows: 1. Standing water levels have been periodically measured in 71 bores in the NE Southern Basins, the Nolans Arunta Basement Ti Tree Basin catchment area and in the southern Ti Tree Basin. Baseline water quality monitoring is not being completed in all the 71 NE Southern Basins Bores. 2. The baseline groundwater quality consisted of two programs: a. Sampling from key bores in selected areas for standard ADWQ chemical water quality laboratory analysis (including trace metals) b. Opportunistic sampling of other bores when access is available. These include pastoral bores, Central Desert Shire Regional Council management bores, NTG bores (e.g. public road maintenance bores) 3. To date baseline water quality sampling has focused on samples from the following bores:

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	tested, No information has been provided on the dates of sampling, screen depths, bore logs etc. Provide a map of the location of these 71 bores and details of the groundwater monitoring data collected. b) It is recommended that the operator undertakes systematic groundwater monitoring in order to satisfy baseline requirements.	a. NE Southern Basins: RC4 (K2- RN 18872); RC 85 (Alyuen 1 production – 18976) b. Nolan' Bore Area: RC 63 (New Nolans Pastoral Bore – RN 18761) or the adjacent New Nolans observation bore RC 64 – RN 18762); RC 75 (Nolans Dewatering Bore) or adjacent 50 mm PVC cased Dewatering Monitoring Bores # 1 & 7 RC 67 & RC 72 c. Aileron Roadhouse Bore RC 83 (Greg's Hope Bore RN 15971) 4. Southern Ti Tree Basin Dann's Hidden Valley paleochannel, Aileron Station, *Arafura Resources* Monitoring Bore DHV1; RC 92 5. As identified in the draft EIS the NE Southern Basins Program is to be expanded to include periodic sampling each year of *Arafura Resources* production bores and key water investigation bores. Several investigation bores were completed with 100 mm PVC casing to facilitate future quality water sampling. This baseline water sampling program to include: a. NE Southern Basins Arafura Resources production bores: RC 21, 22, 25, 28 & 27 b. Arafura Resource NE Southern Basins Monitoring Bores: RC 12, 13, 23 & 26 The standing water data record is being provided to the DENR Alice Springs, is detailed in the Water Resource Assessment (Appendix 3) and will be included in future annual mining reports to DPIR. Part B Baseline monitoring undertaken to date is provided in the Water Resource Assessment (Appendix 3). A baseline groundwater dataset will be collated as outlined in the updated Water Management Plan (Appendix 4). Monitoring, as per the WMP, will commence a minimum of 24 months prior to the extraction of water from the Southern Basins. This has been included as a commitment.
184	a) No background monitoring of bores have been established (shallow groundwater monitoring - section 7-6-2). b)EC should not be used as the only indicator of water	Part A Groundwater monitoring is currently ongoing, albeit, at a periodic interval. Arafura monitors RC 23 and RC 25 (refer Groundwater Report Appendix K of the EIS), SWL in DLRM investigation monitoring bores at Paddy Well, adjacent to two of the Laramba Production bores, abandoned stock bores in the area and Arafura PB 4 on the banks of Day Creek.

UID	Summary of submission	Response
	quality and clarify whether these were taken at depth or from the alternative methods listed above.	Arafura has installed 31 rising stage samplers in creeks in and around the project. 6 were washed away during 2016-17 wet season and will be re-established. Once more certainty is known about project timing, the frequency and intensity of data collection will be increased to a point that the groundwater monitoring detailed in the Water Management Plan is fully implemented 24 months prior to the commencement of operations. Part B Water quality associated with each of the monitoring points is presented in Appendix B of Appendix K of the EIS. All major ions, nutrients, metals have been recorded for each sample. Refer to the Water Resource Assessment (Appendix 3).
185	The model is calibrated to ground water level information and not ground water flow information. The model relies on boundary conditions and material hydraulic conductivity information based on assumptions and estimations from previous investigations and those made during the field program. Provide assumptions and estimations used for the groundwater model.	Refer Section 4.22.
186	At this point the groundwater model predicts a drawdown of two metres during mining but approaches 20 m in the long-term closure model Clarify why drawdown approaches 20 m in long term closure - how much water loss is going to occur post closure from that aquifer?	The EIS in Section 6.3 of the Groundwater Report (Appendix K) details that the pit level drawdown rebounds to a level where groundwater flow equates to evaporation (refer Figure 36). Once at this steady state, all inflow is evaporated and therefore inflow equals how much water will be lost from groundwater due to evaporation. This is approximately 700 m^3/day (8L/s) or approximately 250 ML/year (Figure 36). The depth of drawdown, based on the loss of groundwater from evaporation, is illustrated in Figure 8-10 of the Groundwater Report.
187	The relevant study area water users should be added to these figures to allow context of the modelled drawdown impacts. Proposed bore field monitoring bores (Table 8-1) should be added to these figures.	Water users in the study area are presented in Figure 10 of the Groundwater Report (Appendix K of the EIS). The proposed bore monitoring locations are presented in the Water Management Plan (Appendix 4).

UID	Summary of submission	Response
188	In the unlikely situation where the pit is filled and overflows either to the surface water bodies or ground water system (i.e. the pit lake rises above adjacent ground water levels to the point where it is no longer behaving as a sink), this contaminated water could discharge. Provide information on adjacent groundwater levels and modelling that demonstrate the pit lake would not exceed this level.	The modelling presented for the aquifer associated with the Nolans deposit in the EIS is conservative. This model predicts the pit might fill to within 70m of surface. The standing natural water level in and around the pit area and nearby bores is between 15-20 metres below surface giving a buffer of at least 50-55 metres. With all surface runoff diverted away from the pit, and the shallow palaeochannel fed by Kerosene Creek also diverted as part of the creek diversion, the only possible inputs into the pit will be from groundwater infiltration from minor rock fractures and rainfall on the pit itself. Given this, and the extremely high evaporation rates at site of approximately 3 m annually, it is not conceivable that the pit would ever fill to a point where it would overflow.
189	Raw data provided in Appendix B should have associated SWL and dates.	Refer to UID 117 (ARPANSA).
190	The modelled solution represents a non-unique solution. A different combination of parameters could be applied resulting in an equally valid prediction which could result in impacts with differing magnitudes Specify the combination of parameters and assumptions used for the modelling.	Refer Section 4.22.
191	Ground water is extracted from the Ti-Tree Basin for irrigation, stock and domestic purposes. An additional groundwater extraction of 4.5 GL/ year over 43 period is proposed for the Nolans Project Clarify whether the 4.5GL is extracted from the Ti-Tree Basin, unique isolated aquifer under the pit or the southern borefields	The project will use 2.7 GL/year from the Southern Basins.
192	On what basis has it been demonstrated that the aquifer for Nolans is low-value?	The basement aquifer at the mine site and the Southern Basins aquifer at the borefield location have been considered low-value based on their current uses, potential beneficial uses (Table 5 in Appendix K of the EIS) and the scale of the aquifer and location. Table 5 includes information relating to exceedances in stock watering guidelines, exceedances in irrigation guidelines and AWDG 2014 exceedances.

UID	Summary of submission	Response
193	Day Creek If vegetation is currently dependent on the groundwater at these locations, based on water table level observations (of approximately 28 m below top of collar) in the adjacent SB0026 (RC00026 RN19038), tree roots must be capable of extracting water from greater than 20 m deep, even accounting for the river bank and collar heights. If vegetation is capable of extending its root systems to such depths it is hypothesised that itis reasonable to expect that it could gradually extend its root system a further 1.5 m over the predicted drawdown period during mining. This is a hypothesis that will need to be proven prior to drawdown commencement, The proponent should provide evidence to support this statement and commit to further study of the hypothesis	Refer Section 4.5.
194	Groundwater level datasets - provide a map of monitoring bores. It appears only one set of SWL taken in December 2015 and 12 bores taken in December 2014 and 24 bores in June 2014.	Refer to UID 117 (ARPANSA).
195	Given groundwater radionuclide concentrations are elevated and variable across the region -include in future groundwater analyses.	Radionuclides (U-238, U-234, Th-230, Ra-226, Rn-222, Pb-210, Po-210, Th-232, Ra-228, Th-228) will be tested annually at representative bores only. Refer to the updated Water Management Plan (Appendix 4).
249	The permanent diversion of Kerosene Camp Creek requires a more detailed and rigorous assessment	Refer to Section 4.15.
250	This option also requires permanent diversion of the creek but keeps the creek diversion further away from mining activities and substantial ground disturbance, thereby reducing the risk of offsite contamination Provide an investigation into the spatial extent that the additional flow from the diverted catchment may have on the riparian zone downstream.	Refer to Section 4.15.4.

UID	Summary of submission	Response
251	While recognised there has been limited opportunity to conduct surface water monitoring due to limited stream flow - the surface water baseline assessment of existing water bodies (e. g. Kerosene Camp Creek, Nolans Creek) is inadequate. Given the relatively few water monitoring results, the proponent should identify the appropriate guidelines with which they will aim to comply.	Arafura will implement the surface water monitoring program 24 months prior to the commencement of operations (refer Water Management Plan – Appendix 4). This has been included as a commitment. The monitoring program will be completed with the intention to develop a suitable baseline dataset. Due to the ephemeral nature of surface water across the Mine and the existing environment (i.e. naturally-occurring stressors) there are no existing guidelines that can be appropriately applied in lieu of site-specific criteria. Site-specific criteria will be developed prior to the commencement of operations and updated as additional data points are collected. The site-specific criteria will be finalised after 24 data points have been assessed.
252	Anecdotal evidence suggests that surface runoff infiltrates the alluvium of creek channels where after, it will form shallow groundwater flow moving down gradient along the creek channel The proponent should undertake a more thorough assessment to further understand surface water and groundwater interactions	Surface and groundwater interactions are discussed in Section 7.3.6 and 8.3.7 of the EIS. Groundwater is approximately 15 metres below the ground surface at the mine site location. The ephemeral nature of creeks indicates no sustained support of surface flow from groundwater. In addition, the large disparity between evaporation and rainfall throughout the year suggests that recharge of aquifers is limited to periods of intense rainfall which are infrequent (once or twice a year) and relatively short lived. It is understood that the local watercourses include some subsurface (alluvial) groundwater flows following periods of rainfall. These alluvial flows will be intercepted and conveyed around the site by the proposed creek diversion.
253	Provide catchment outlines for the various drainages which will be affected by the mining infrastructure as shown in Figure 7-2 Provide maps of the southern area for topographic contours and drainages in the vicinity of the processing plant and residue storage facilities. Provide flood modelling results for the processing area similar to Figures 7-6 and 7-7.	The proposed mine site lies at the head of the Kerosene Camp Creek on the north facing slopes of an east – west trending ridge of the Reynolds Range, whilst the processing site is situated on the southern slopes of the same ridge. Refer to Section 4.14 for further information on the catchment, preferential flow paths as assessed by flood modelling.
254	Figures 7-6 and 7-7 show that pre-mining flood depth and velocity modelling for Nolans Creek over lie the planned outlines for the TSF and WRD's 2 and 6. Provide information on extent, depth and velocity of flooding for existing site conditions for the processing site and associated infrastructure (RSFs, evaporation ponds)	Refer to Section 4.14.

<table>
<tr><th>UID</th><th>Summary of submission</th><th>Response</th></tr>
<tr><td>255</td><td>These records are limited to just a few individual samples taken in February and March 2011. The available records include salinity, pH, dissolved oxygen temperature and turbidity.
No data has been provided and it appears no chemical analyses conducted of the couple of samples that were taken in 2011. Provide data and chemical analyses and details of a sampling program.</td><td>The surface water quality records referenced in the EIS are available from the DLRM water data portal. This data is limited to just two locations in the vicinity of the Mine site, namely Arden Soak Bore (G0280010) which is on the Woodforde River 26 kilometres downstream of the mine site, and Allungra Waterhole (G0280004) which is on a different river system 42 kilometres to the east of the mine site (refer to Table 3-8).

Table 3-8 Summary of surface water quality data
<table>
<tr><th>Analyte</th><th>Units</th><th>Observed Range</th><th>ANZECC</th></tr>
<tr><td>EC</td><td>S/cm</td><td>56 to 79</td><td>83 (a)</td></tr>
<tr><td>Turbidity</td><td>NTU</td><td>88 to 631</td><td>5 (b)</td></tr>
<tr><td>Temperature</td><td>°C</td><td>25.24 to 29.66</td><td>-</td></tr>
<tr><td>pH</td><td>-</td><td>6.36 to 6.90</td><td>-</td></tr>
<tr><td>DO</td><td>mg/L</td><td>4.66 to 8.05</td><td>5 (c)</td></tr>
<tr><td colspan="4">(a) Based on a reference level of 50 mg/L
(b) Aesthetic considerations
(c) Aquatic life stress level</td></tr>
</table>

Further data from surface water monitoring is detailed in the Water Resource Assessment (Appendix 3).
The Water Management Plan (Appendix 4) details the surface water monitoring program. The monitoring program will commence 24 months prior to the commencement of operations. This has been included as a commitment.</td></tr>
<tr><td>256</td><td>Receptors include:
• Third party infrastructure
• Water supplies
• Locations with environmental or heritage value
• Nolans site infrastructure</td><td>Section 7.5.1 of the EIS identifies ‘locations with environmental or heritage value’ as receptors. Environmental value includes flora and fauna values.</td></tr>
</table>

UID	Summary of submission	Response
	The proponent has not included flora or fauna in the receptors; these should also be acknowledged and the associated risks assessed.	
257	Clarify what the coloured areas defined in Figure 7-9 indicate. Provide outlines of the planned mine infrastructure similar to what was provided in Figures 7-6 to 7-7 to orient the reader with the location of infrastructure relative to the drainage lines.	The coloured areas are sub-catchments areas. Refer to Figure 2-1 for detail of the updated layout (LOM 55) in relation to drainage lines.
258	In Figure 7.6, it appears that WRD1 , proposed in the NW of the site, falls into the catchment area of the western tributary of Kerosene Creek. Provide an updated map for the surface water drainage catchment areas after implementation of the proposed Kerosene Creek diversion and construction of the various infrastructures. On the map indicate by arrows, the flow direction of surface water flow off the various infrastructures and the catchments/creek drainage into which the water will flow. It is indicated that the catchment area for the tributary accepting the diversion flow will increase by 30% and that flow will increase by a similar amount and that the additional flow will not have a significant impact on the receiving channel. Provide studies which demonstrate that an increase of 30% flow in the Kerosene Creek tributary will have no downstream impacts.	Part A Refer to Figure 2-1 for detail of the updated layout (LOM 55) in relation to drainage lines. Refer to the Water Management Plan for further information on the management of surface water flows across the site (Appendix 4). Part B Refer to Section 4.15.
259	It is indicated that the catchment area for the tributary accepting the diversion flow will increase by 30% and that flow will increase by a similar amount and that the	Refer to Section 4.15.4 further discussion on potential impacts associated with the diversion.

UID	Summary of submission	Response
	additional flow will not have a significant impact on the receiving channel.	
260	The separation of clean and mine affected water, and the diversion of clean water runoff around the Nolans site, will be achieved by means of flood protection bunds and shallow drainage ditches. A proposed diversion of Kerosene Camp Creek will change the direction of flow within a tributary of Kerosene Camp Creek away from the open pit and towards the major western tributary of Kerosene Camp Creek. The channel design commences inside the mine (near WRD 5). This creates the potential for mine-affected water to run off site. Provide detail on water catchments and how mine affected water will be segregated from clean water.	Refer to Section 4.10 and the Water Management Plan (Appendix 4).
261	The controls to provide rock protection where flood velocities of 0.5m/s can be expected will not prevent water ingress and egress which may permit release of poor quality water from the TSF and waste rock dumps. The proponent must include detail on how this will be managed and how mine affected water will be retained within the mine site.	The base and the inside batter of the tailings storage facilities will be lined with low permeability materials to reduce seepage vertically and laterally. Toe drains (see Figure 5-12) will be installed to remove excess water near the base, which will reduce the hydrostatic head in these locations. Seepage water could contain dissolved elements, which will be monitored in shallow seepage detection bores and piezometers installed within and near the toe of embankments.
262	WRD5 is shown in Figures 7-6 and 7-7 as straddling the drainage channel for Kerosene Camp Creek. Figure 7-2 shows that the drainage channels pass to either side of the WRD. It is then stated on p7-20 that Kerosene Camp Creek enters the mine site adjacent to the proposed WRD 5, and proposed top soil stores in this area... Clarify the location of Kerosene Camp Creek and the drainage lines relative to WRD 5.	Since submission of the EIS, a new concept mine layout has been developed for a LOM 55. WRD 5 is no longer proposed. Refer to Appendix 13 for the diversion alignment drawings.

UID	Summary of submission	Response
263	Proposed infrastructure appears to have little regard to the drainage pattern with WRDs, top soil dumps and the tailings/residue storage facilities placed on top or across drainage channels. Explain the likelihood of subsurface water flow continuing via the alluvial palaeochannels (tracing the old drainage lines) under the infrastructures. Has any modelling been completed which demonstrates that pit inflow will not be affected by the alluvial inflows via the existing drainage palaeochannels.	Since submission of the EIS, a new concept mine layout has been developed for a LOM 55. WRD 5 is no longer proposed. Refer to Section 4.17 for further discussion on palaeochannels. These palaeochannels will be cut off from their respective water sources so recharge to the pit from these will diminish accordingly.
264	In addition to the low risk of pit overflow, the low sulfur content, generally low metal toxicant content and low metal and salt leachability of the mined material, further limits the risk of acid mine drainage at the mine site (refer Appendix L of this EIS). The proponent should identify the basis on which metal toxicant content was classified as low.	Refer to Section 2.26.1.
265	Detail of the likely water retention capacity of dumps is not available, however given the height and potential void space of stored material, the water retention is likely to be comparable with extreme 1 in 100 year ARI) storm rainfall events - depth of 295mm. Therefore the in majority of incident rainfall over WRDs will infiltrate and result in negligible surface runoff or return of seepage to the ground surface. Clarify whether the above statement refers to WRDs at full capacity (50m height) and how runoff or seepage will be managed during their construction. Provide details of water retention capacity given the dumps will be designed as water-retaining structures that will increase seepage and infiltration into the dump,	Details of water retention capacity will be determined as part of refining the WRD concept discussed in Section 2.10.1.

UID	Summary of submission	Response
266	Depending on the properties of material used in the base of the WRDs infiltrating water within the dumps will eventually seep into the underlying ground where it will follow prevailing hydraulic gradients Describe the resultant chemistry and physical properties of WRD runoff and seepage as a result of rainfall infiltration e.g. electrical conductivity, salinity, nitrates etc.	Refer to Sections 4.26, 4.27, 4.28 and Appendix 16.
267	Sediment ponds will be used to capture surface runoff from all mine affected areas to promote evaporation and seepage to ground. The proponent has not included details of where the sediment dams are located and what magnitude of rain event the sediment dams be sized to manage. This information should be provided both in text and included in a graphical format for easy interpretation. All sediment darns should be designed and built to comply with the appropriate Australian Standards.	The exact location of sediment ponds will be determined as detailed design is completed. These structures will be sized to hold a 1:100, 72-hour rainfall event. The sediment ponds will be designed and built to comply with the appropriate Australian Standards and IECA guidelines. This has been included as a commitment.
268	Appropriate consideration of surface water flow in design, placement of infrastructure and construction (P 7-23) The approximate locations of RSFs provided in Figure 7-2 (P 7-5) indicate that significant portions of RSFSl. and RSFS2 will be located within a visible drainage channel. These structures must be repositioned to prevent storm surges or seepages that may impede material containment and infrastructure integrity in both the operational period and for long term storage.	Catchments upstream of the processing plant are typically less than 1 km^2 in extent (Figure 4-10 and Figure 4-11 of the EIS). Due to their small catchment area, channels within the processing site tend to be ill-defined with runoff likely to be dispersed across the south facing hillslope before combining into distinct creeks or local drainage lines towards a sandy-floodplain area. A photo of the drainage channel identified in Figure 7-2 is shown below (co-ordinates: 53K 315228E 7493896N) to provide further context of the extent of the drainage line.

UID	Summary of submission	Response
		 Refer to Section 4.14.2 for flood modelling completed for the processing site. It is noted that the layout of the processing site has since been updated but the pre-mining flood modelling provides further context to the extent of flooding through the site. Modelling of flood velocities has not been undertaken as they are considered too low to warrant control. The design of the RSFs requires a geomembrane liner, low permeable material and rock fill used to form buttress zones to minimise seepage (refer Section 2.9). Based on the design of the RSF and calculated flood modelling of the catchment, it is considered unlikely that the drainage lines will result in impede material containment and infrastructure integrity.
269	Flood maps have been provided for the TSF, provide similar maps for the RSFs located in a different catchment area.	Refer to Section 4.14.2 for further information on flood modelling for the RSF.

UID	Summary of submission	Response
270	Appendix A - Kerosene Camp Creek Diversion - Concept 3. Concept Design and Evaluation p80 Designed banks are 3V:1H batters and are between 4 and 14 m high. Explain how these slopes are to be stabilised as stable slopes for closure is expected to be 1V:4H (14°). Slopes greater than this will require abandonment bunding.	Refer to the diversion alignment drawings (Appendix 13) and diversion management plan (Appendix 14).
271	the initial 200 metres to 400 metres of the diversion be steepened to improve flow conveyance and sediment transport at the start of the diversion… it is also recommended that the flood protection bund be designed to provide flood protection for design storm events well in excess of the 100-year ARI flood event modelling. This will reduce the risk of future creek capture by the pit from progressive sediment accumulation at the start of the diversion and /or from design event exceedance. Closure planning is to be for +1000 years. Design for flood protection must consider that erosion/sedimentation caused by extreme weather events i.e.1:100 ARI may occur 10 times (as an average) and that a 1:1000 ARI event may occur at least once during the period of planned closure. Clarify that plans which consider 1:100 ARI events are sufficient to maintain safe, stable and non-polluting landforms during the post-closure period.	Pit flood modelling is discussed in Section 4.14.1. The flood levee would be designed to 100-year ARI flood event during the operational phase. The flood levee would be upgraded to accommodate greater than a 1,000-year ARI flood event for post closure. This has been included as a commitment. A Closure Plan will be finalised on completion of the detailed mine design. The rehabilitation objective are detailed in Appendix W of the EIS. The Plan will be updated to include the use of landform modelling to aid the design of the rehabilitated landscape. It will then be submitted to DPIR as part of the mining authorisation phase. The Plan will require approval from DPIR prior to the commencement of operations.

UID	Summary of submission	Response
276	A flotation TSF adjacent to the concentrator at the mine site. Separate water Leach, neutralisation and phosphate RSFs and evaporation ponds adjacent to the processing plant. From Tables 3-8 - 3-1.0: The floatation TSF will be a 25.1m embankment covering 1.00 ha containing 45Mt tailings storage. The RSF at the processing plant will be 20 -25 in embankment height, 324 ha (total - 60,150 and 114 ha each), *LOO*Mt residue. The evaporation and sodium sulfate ponds will be total 70 ha, 2.5m embankment height and HDPE lined (Water storage capacity 17501VIL in total) The proponent will need to demonstrate the above structures can be managed and contained on the surface for a period of greater than 1000 years, without causing unacceptable impacts to the receiving environment or posing unacceptable safety risk. The footprint for the TSF/RSF does not match what is described in Appendix I (combined footprint 650 hectare) - this needs to be clarified in the Supplement.	Part A The facilities were assessed as having an ANCOLD High C consequence category classification for the EIS. Since then this has been reviewed. When detailed design is completed a full assessment will be done and the appropriate rating will be applied which will be used to inform the design. This has been included as a commitment. The ANCOLD consequence category classification dictate the storage facilities designs (e.g. a High C requires freeboard storage for 1 in 100,000 ARI or PMF 72-hour). Refer to Section 2.9.3 for further information on the closure of the RSF. A Closure Plan will be finalised on completion of the detailed mine design. It will then be submitted to DPIR as part of the mining authorisation phase. The Plan will require approval from DPIR prior to the commencement of operations. Part B Since submission of the EIS further work has been completed and the footprints of the TSF and RSF have been refined. Refer to Section 2.9 and Appendix 2 for more detail. The LOM 55 footprint of the TSF is 195 ha and the LOM 55 footprint of the RSF is ≈345 ha (combined footprint of ≈500 ha).

UID	Summary of submission	Response
277	The TSF and RSF will collect leachate and minimise seepage, whilst also maximising tailings and residue densities. The TSF will have a low permeability soil liner and the embankments will be constructed from suitable mine waste material The current RSF design incorporates a HDPE/low permeability soil liner system, combined with basin drumage and a leakage collection and recovery system. Further detail is required on the low permeability soil liner and embankment material including thickness and material specifications, identified sources of material and quantities. Explain the longevity of the low permeability liners, including the HDPE liners to prevent seepage, and how these liners and the collection systems will be maintained post closure. Greater detail is required on seepage interception. Detailed chemical characterisation of these process residues is in progress. Following receipt of this work on alternate design for the RSFs may be contemplated which removes the HDPE liner Details of the tailings and residue chemistry are required for the Supplement to assess the potential impacts of long-term disposal of these wastes.	Part A Refer to Appendix 2 for further information on low permeability liners and their use in the RSF and TSF. Natural materials are favoured over HDPE liners because of longevity. Natural liners have no defined life and if placed in accordance with geotechnical engineering specification can last indefinitely in normal neutral conditions. HDPE on the other hand has a life of between 20-200 years depending on its application, the quality of its installation and the properties of the material stored on the liner. All testing to date on the tailings and residues indicate that they will remain neutral. Part B The residue testing to date has been completed on residues collected using the SAPL flowsheet. The piloting test program for PAPL will be completed in 2018. It is anticipated that the new, as yet untested residues will have similar properties to the SAPL residues (no phosphate) and will present no greater risk to the environment. All residues from the extraction process are completely neutralised before deposition. Appendix 2 details the design framework that will be applied to design the TSF and RSF. During operations, it is also intended that periodic sampling will be done of waste streams to ensure the predicted geochemical characteristics of these does not alter.
278	It is proposed thot the TSF and RSFs will be progressively covered with a layer of benign stable rock during operations if practicable to limit the area of exposed residues More details are required on progressive nature of this capping of TSF and RSFs. At closure the TSF and RSFs will have a layer of	Part A The RSF facilities will consist of multiple cells to enable operational cycling across the cells periodically. Deposited process residue will settle and consolidate. Once cells are filled to capacity, they will be covered progressively once filled. As a cell of the RSF reaches maximum storage capacity, this cell can start closure/rehabilitation works. The cycle time for deposition will be determined once representative residue material is available from the current pilot test programs to be completed by mid 2018. The testing will characterise the physical properties of the residues.

UID	Summary of submission	Response
	around two metres of benign waste rock placed over them to limit natural erosion and ensure long term security of the contained tailings and residues. Provide additional information to indicate that two metres of waste rock is adequate for long term disposal of wastes and define the minimum time for containment.	Additionally, the closure design plan can be refined for the next cell based upon the performance of the rehabilitated cell. This approach can demonstrate to the regulator that the closure methodology is reasonable and sustainable. The schedule for progressive rehabilitation will be detailed in the RSF/TSF Operating Manual (refer to Tailings Management Plan (Appendix A) of the Tailings and Residue Storage Aspects – Appendix 2) There will likely be multiple cells for process solids residues (mainly gypsum) which will also contain uranium and thorium and there will be a liquid storage cells for the evaporation of reject brine liquors from the process. These liquid holding cells will be smaller in size and also multiple so solutions can be cycled through the cells. This will allow the evaporated solids to be removed periodically for disposal in to the process solids RSF. The TSF will consist of two cells. Progressive closure will not be possible until later in mine life. Cell 1 will store tailings generated in approximately the first 20 years of operation. Once cell 1 is raised (around year 10) and filled (around year 20), and after consolidation, covering the cell can commence. Cell 2 will be in use from about year 20 to LOM 55. Following consolidation, covering the cell can occur (which won't be until after mine closure). <u>Part B</u> Refer to Section 4.1.3.
279	The WRDs will be constructed to a height of about 50 m above the land surface built in ten metre lifts interspersed with 5 in wide berms. These WRDs will also be designed as water-retaining structures i.e. to encourage water infiltration and assist vegetation establishment on tops of the dumps More information is required on how the design of the WRD will reduce water velocity from the slopes and withstand extreme weather events.	A framework to develop the WRD concept design has been developed (refer to Section 2.10.1 above in Project Description). The concept includes: • Undertake designs to develop water management and drainage design and • To refine WRD seepage models' accuracy to optimise drainage and storage designs to provide a bases for WRD infiltration and storage cover design requirements. • Transient water /dump seepage modelling will be undertaken in addition to Erosion and closure modelling. Modelling has also been undertaken to determine flood depth and velocity around WRDs in 1 in 1000 year flood.
280	A total storage area of 95 ha has also been set aside for topsoil storage (Figure 3-I). Top soil storage will progressively be increased as WRD footprints increase during mining. To ensure that topsoil remains viable,	Further work has been undertaken since the development of the EIS. Appendix 2 indicates a topsoil storage area of 113.8 ha is set aside for a LOM 55. The topsoil will still be progressively stripped and stockpiled and progressively used in rehabilitation.

UID	Summary of submission	Response
	storage will be kept to a minimum and topsoil will also be used progressively as WRDs are rehabilitated and closed Provide a timeframe for when each WRD will be closed and rehabilitated to ensure viability of topsoil.	Arafura will only pre-strip areas that are required for immediate use to restrict the time soil is stockpiled. Wherever possible soil will be recycled as quickly as possible to ensure it remains viable. As dumps develop and progress, top soil will be stripped ahead of the advancing footprint and returned to completed batters. The scheduling of waste dump completion and use of topsoil in rehabilitation will be determined following development of final mining schedules during the definitive feasibility phase of the project. The MMP and Closure and Rehabilitation Plan would be updated accordingly during operations. For information regarding the viability of stockpiled topsoil refer to UID 301.
281	During operations, some waste rock will be mined that has a radionuclide concentration exceeding I Bg/g. Details of the amount and location of final storage of this material is required and how it will be segregated into its respective waste category (radioactive or benign) - the discriminator is also used for determining what goes to ROM and waste.	A description of the identification and management of materials containing radionuclide concentrations greater than 1 Bq/g is provided in Section 3.5.5 of the EIS. It is conservatively estimated that the project will produce up to 173.5 Mt of waste rock that may fit within the category of 'low level' radioactive waste because it exceeds the 1 Bq/g definition. It should be noted that this material will range between 1-3 Bq/g, which is similar to a number of natural outcrops in the area. An initial indication of the material will be provided by the grade control management system and this will be confirmed via two radiometric analysers. The gamma radiation from each truck will be measured and will be used to direct the truck driver to the correct area for delivery of the load. Each truck load of material will then be directed to either the ROM pad, the stockpile or a WRD. All material that exceeds the 1 Bq/g limit will be placed within a WRD and covered with benign waste rock. It is estimated that 129 Mt of benign waste rock is available for construction and covering purposes.
295	Provide waste rock dump designs - engineering drawings, water balances, material types and specifications	Preliminary WRD information is available in Section 2.10.1 and Figure 2-1. A framework to refine WRD concepts and detailed design is provided, which will include generation of detailed design drawings, water balance, material balance and specifications.
296	Provide pit design including details on geology, base of weathering, fault structure, mineralisation and ore zone outlines	Concept pit design details (footprint and other parameters associated with the pit) were provided and assessed in the EIS. The pit shell has been updated to reflect the 55 year LOM (refer Section 2.5). Pit shells, as defined by Whittle 4X software, have been created to DFS level. Previous studies on the orebody have shown that the Whittle pit shells and the slope assumptions used in generating them (i.e. allowance for haul roads) have shown close approximation to subsequent detailed design of pits. Geotechnical and geo-mechanical investigations and

UID	Summary of submission	Response
		analyses have also been carried out to a Feasibility Study level of accuracy and are available in Appendix 16. Detailed designs of the pit are not yet available. The economics for the commodities may alter, therefore affecting the recovery of resources and the final pit design. Detailed pit designs will be completed during the final design phase of the project. The final design of the pit will be provided in the Mining Management Plan, which will be submitted to the Regulator for approval prior to mining authorisation being granted.
297	While recognising that the proposed Woodforde quarry and haul road are not included in the scope of this EIS, if this resource is not available or suitable, the proponent needs to indicate alternative sources of material that will be used for acid neutralisation capacity for use in the processing plant. It is intended that the bulk of the row materials, which includes rock, grovel, sand, topsoil and carbonate material, will be sourced either from within or near the Nolans site. (P 4-7) Clarify the locations on a map and the details required.	The Woodforde Quarry is no longer required as a reagent material source for the project. This is because of the change in processing methodology from SAPL to PAPL – as detailed in the amendment notice issued. The processing circuit has neutralisation circuit. Local calcrete material that will be removed during construction of site which may be used in the process of fro construction. Additional neutralisation reagents will be imported to site as required. These off-site reagents are likely to be sourced in the NT from established suppliers.
298	Gas supply offtake pipeline (to connect to the existing Amadeus Basin to Darwin, high pressure gas pipeline). Mark on figures provided where the gas supply offtake will occur and distance of pipeline to processing site.	The location of the gas pipeline will be determined by the gas pipeline owner; however, it will be requested that the offtake be located in close proximity to the power station (Figure 3-2 of the EIS). This would result in an expected distance of approximately 300m between the gas pipeline and the power station.
299	Slurry transfer pipeline (HDPE pipeline earth bunded along the pipeline corridor). Show location of this transfer pipeline from mine site to processing plant.	Figure 3-1 of the EIS shows an indicative path line of the slurry pipeline; however the legend has omitted the slurry pipeline in the key. The slurry pipeline is included in the services corridor that also contains water supply pipeline, portable water pipeline and power lines.
300	Overburden and waste material will be deposited in purpose constructed waste rock dumps (WRDs) with a stand-off distance from the pit of 50m Provide information on whether 50m is sufficient distance to allow for safe placement of a final pit abandonment bund and potential pit wall slippage post closure.	The fifty metre standoff distance for waste dumps (and flood levee) from the pit perimeter was determined following a geotechnical investigation by our mining consultants. Several specific geotechnical holes were drilled into the footwall and hanging wall rock sequence and were subjected to a range of geotechnical tests.

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301	Topsoil will be stockpiled for later re-use in rehabilitation or landscaping The topsoil will be stored at a height of three metres coving 95ha for an unknown storage time. Provide details on the depth of removal for topsoil from the WRD footprint area and the long term viability of this topsoil storage. Provide more details on the properties of the topsoil and subsoil, the management of the resource during storage and how it will be used on the WRD rehabilitation.	The topsoil across the project site is on average 10 mm deep with the deeper areas associated with either aeolian or alluvium sources. The soil substrate thickness also varies across the site from a few centimetres to a maximum of 5 m in limited zones (i.e. in a paleo-channel that runs through the pit). The average depth of soil to be stockpiled is estimated to around 0.5 metre across the project site. It is intended that this thin layer of topsoil will be recovered with the underlying soil substrates for use as a growth media in rehabilitation activities. It will be removed just immediately before waste dump footprint advance before being placed into designated dump areas. The subsequent reapplication of the topsoil, allows for planting conditions that are closer to the pre-disturbance condition than planting on the subsoil layers that remain. Seed longevity is promoted under dry arid conditions; however, the viability of seed with the stockpile after a 55 year period is not known (Golos, et al. 2014). The objectives of mine site rehabilitation, including the revegetation, are provided in the Closure Report (Appendix W of the EIS).
302	It is indicated in the Section 8.5.5 that samples for AMD testing were taken of pegmatite, mineralisation, gneiss and schist. Provide geology maps of the deposit showing the surface distribution of the geology in context to the proposed pit outline. Provide geological cross-sections of the deposit, showing the outline of the proposed pit and zones of mineralisation.	Refer to Appendix 16 for further detail on the geology and Section 4.27 for additional information on AMD.
303	Table 3-3 Mineral Resource Provide the resource values for uranium and thorium as ppm or percent	A stated in the EIS, the deposit contains uranium concentrations of 190 ppm U3O8 and thorium concentrations of 2,900 ppm ThO2.
304	The distribution of the mineral resource categories has been described and illustrated. Provide details of the main categories, material types and distribution of the waste rock material.	Refer to Appendix 16.
305	Calcsilicate mineralisation - the mineralisation has elevated concentrations of calcium, phosphorous, thorium, uranium, strontium and fluorine. What are elevated concentrations in the different waste rock types?	<u>Part A</u> The U and Th contents and averages of the waste rock types are shown in Table 7 in Hussey (ARU-15/008) in Appendix P. It should be noted that the highest values for the different waste rock categories may not be accurate. The high assay results presented here are high due to

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	Provide cross-sections of the resource model which shows the distribution of the two broad styles of RE bearing mineralisation i.e. apatite and calcsilicate mineralisation.	the RC sampling method mixing different lithologies with mineralisation and examples of mislabelled mineralisation that are distal to the resource and therefore waste. Part B The requested information on the distribution of the two broad styles of mineralisation are shown in Figure 3-7 in Chapter 3 in the EIS.
306	Provide open pit designs for the various stages of the proposed operation.	Refer to Appendix 16. The final design of the pit will be provided in the MMP and will be submitted to the DPIR for approval prior to mining authorisation being granted.
307	There is a lack of detail regarding the water usage within the processing facility. Without an accurate assessment of the required volumes of water for each section of the processing plant it is unlikely that the required extraction rate from the bore field has been accurately determined. Provide more details on expected water use within the processing facility to more accurately determine required extraction rates.	An updated water balance is provided in Section 2.11.1. The updated water balance details water usage for each section of the processing facility. Total demand for the processing facility is 2,242Mlpa. The demand for the processing facility, as presented in the EIS, for SAPL was 2,990Mlpa.
308	Option 2 considers site-based and nearby supplies of suitable carbonate material. The preferred strategy is to initially mine known calcrete occurrences at the mine site. These areas will eventually be buried by WRDs More information is required if this is the preferred option – how deep will excavation go and what are the implications for the base of WRD, surface hydrology, groundwater, flooding ingress etc.	Calcrete is no longer required as a reagent as the process has changed from a SAPL to PAPL process. Only calcrete associated with the orebody maybe mined and stored.
309	The information contained within the waste rock classification section of the EIS indicates that NMD Leachate is likely to be produced by waste rock on site. The production of mine-affected water resulting from infiltration and incident runoff of within and on the waste rock dumps indicates that the WRD design is insufficient. The WRD design should ensure the following: 1. All runoff from WRDs is directed to appropriate	WRD leachate is discussed in Section 4.28. The WRD concept design is discussed in Section 2.10.1.

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	water holding facilities; 2. All infiltration of water into WRDs is contained onsite and does not enter groundwater; and 3. Inundation of the base of WRDs will not occur during the LOM or post mine closure.	
310	The proponent has not made it clear if the zero discharge facilities include all waste rock dumps (WRDs) and the final pit void. This should be addressed as inundation of the base of waste rock dumps is shown to occur under a 1 in 1000-Year flood event. The current waste rock design does not demonstrate that mine affected water will not be transported offsite Provide: A detailed design of all WRDs, including preferential water flow paths and water holding capacities. Details regarding the final pit design. A detailed plan for surface water management and associated controls and diversions. Details of all water holding facilities, including areas, storage capacity and inputs/outputs. Current calculations of size and volume are incorrect for some water storage facilities. Details of the specifications and the QA/QC program designed to ensure that the low permeability base of water holding facilities is appropriate. Evidence that the current WRD design will contain incident rainfall or evidence that runoff and seepage from incident rainfall will not affect the surrounding environment.	Part A The WRD concept design is discussed in Section 2.10.1. A framework for the WRD concepts is provided to demonstrate the approach to the detailed design of water flow paths around WRDs, water infiltration, geochemical testing and the like. The final design will be detailed in the MMP and will be submitted to DPIR for approval. Part B Refer to Sections 2.5.2 and 2.5.3 regarding the development of the pit design and commitment for the final pit design. A flood levee designed to a 1000 year ARI will surround the pit post-closure, as illustrated in the Water Management Plan (Appendix 4), to prevent the inflow of surface water. Part C The concept of the water management system is discussed in Section 4.10. The proposed water management system was modelled and the results reported in Section 7.4 of Chapter 7 of the EIS. Further detail on the water management is provided in the Water Management Plan (Appendix 4). Part D The facilities were assessed as having an ANCOLD High C consequence category classification for the EIS. Since then this has been reviewed. When detailed design is completed a full assessment will be done and the appropriate rating will be applied which will be used to inform the design. This has been included as a commitment. The ANCOLD consequence category classification dictate the storage facilities designs (e.g. a High C requires freeboard storage for 1 in 100,000 ARI or PMF 72-hour). Refer to Sections 2.9.1 and 2.9.2 that provide embankment heights, number of cells, footprints, water storage capacity and tailings residue storage volumes for the TSF and RSF. The sections also provide embankment height, number of cells, footprint and water storage capacity of evaporation ponds and sodium sulfate ponds. Appendix 2 provides further detail.

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		Part E Refer to Section 2.9.2 for discussion regarding the approach to determine the liner system and liner. Once all test work is completed and detailed engineering commences, the test work will be used to inform the liner design for these facilities. Low permeability materials will be tested as outlined in Appendix 2. Part F The final WRD design may not contain incident rainfall under all event conditions. Refer to Section 2.10.1 for discussion regarding incident rainfall. AMD and leachates assessments have been completed and further information (in addition to the EIS) is provided in Sections 4.27 and 4.26/4.28, respectively.
311	As all storage facilities are designed as zero discharge facilities (i.e. evaporation controlled), they will be designed or managed such that they do not breach or decant either to the surface water bodies or seep into groundwater systems. Commitment is required that these storage facilities will be designed and operated in accordance with ANCOLD 2012 Guidelines which includes review and surveillance of monitoring data collected as part of routine monitoring of the TSF/RSFs and annual inspections be undertaken by geotechnical and engineering specialists.	These storage facilities will be designed and operated in accordance with ANCOLD 2012 Guidelines which includes review and surveillance of monitoring data collected as part of routine monitoring of the TSF/RSFs and annual inspections be undertaken by geotechnical and engineering specialists. Refer to the Tailings Management Plan attached to Appendix 3.
312	The tailings and residue storage facilities have been recently resized to allow for an increased LOM from 20 years to 43 years. Because a revised design is not currently available, the number of cells in the original design has been increased on a pro-rata basis which increases the foot print as that from the 2012 Ore Reserve design (and that contained in the 2010 Draft B FS) 2. The combined foot print of the revised tailings and residue storage facilities is approximately 650 hectares. An accurate updated design is required for tailings and	Appendix 2 outlines the design framework for the TSF and RSF. Detailed design will be completed once the tailings and residues for the PAPL process have been completed in 2018. The final design will be included in the MMP and submitted the DPIR for approval during the mining authorisation phase. Since the submission of the EIS the LOM has increased to 55 years. The updated detail on the location and extent of the TSF and RSF is provided in Section 2.9.

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	residue storage facilities and location shown on an updated map.	
315	The change in processing methods has far reaching impacts through the entire operation e. g. scheduled mining rates, ore classifications, energy requirements, freight transport, radioactive material, water balance, tailings and residue storage facilities. As such, management of the environmental impact for the change in process may require updating. Sections of the EIS related to this change in product that may require updating include Appendices E, F, I, J, K, L, 0, P, Q, R, V, W and X.	The change from a SAPL to PAPL process primarily has the effect of reducing inputs to the project described in the EIS. For example, there is a significant reduction in inputs such as: • 43% less ROM feed • 62% less reagents • 57% less water demand • 25% less power demand • 50% less waste produced The updated description of the project is provided in Section 3. The environmental risk register will be updated once the PAPL test work has been completed in 2018. An updated register will be appended to the MMP.

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316	Project Scope Modification for Phosphoric Acid Product Clarify over what time frame the annualised comparisons extend (e. g. first 4 years of production, over a 1.0 Year period, Life of Mine etc.). a) Mining and Processing The amount of ROM feed and waste rock generated per annum has reduced by 43% and 26% respectively. Clarify if: - the geological resource ore and waste classifications and volumes have changed; - parts of the waste rock been reclassified as ore based on the phosphoric content; and - The Life of Mine has changed based on the reduced ROM feed Provide a summary of the resource ore and waste class volumes. b) Tailings The amount of storage required for tailings and residues has been reduced in the phosphoric acid proposal. Provide updated engineering designs for the tailings and residue storage facilities and evaporation ponds. An updated tailings and residue leachate study is required for this change in process method. c) Phosphoric Acid Plant Detail where this plant will be located. Explain if additional infrastructure and reagents (e. g. for 'purification and evaporation processes') will be required for this plant and where this additional infrastructure will be located. Provide an assessment of the environmental risks associated with the additional infrastructure and changes to the processing system, Explain how the addition of this plant will affect the process circuit and the tailings residue chemistry. Describe if the change of chemical and reagent usage	The change from SAPL to PAPL methodology requires the addition of a phosphoric acid circuit to purify the phosphoric acid into a saleable merchant grade product. It will also include storage facilities and a laydown area for the acid and other out bound products. This additional infrastructure will be accommodated within the area already designated for the processing site and as such, the overall plant footprint requirements will not increase. The phosphoric acid will be transported from site on a regular basis to the market so storage requirements will be limited. No sodium carbonate will be utilised as part of the PAPL process. Hydrated lime will be used in the neutralisation process. Local calcrete material that may be removed during the construction of site will be stockpiled for use in the project. The project description has been updated to reflect the change from SAPL to PAPL. Refer to Section 2 for further information on the follow-on changes to mining, processing, tailing/residues and water demand. The updated project description replaces that presented in the EIS.

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	and the change in processing method will affect the possible amount of naturally occurring radioactive materials (NORM) leaving site with product. d) Water Provide an updated water balance model which recalculates the water requirements throughout the site. Explain if there will be an excess of water from pit dewatering now that water requirements are lower. If so, explain how this excess water will be managed.	

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317	Project Scope Modification for Phosphoric Acid Product "... changes deliver a coarser concentrate feed..." "This has the added benefit of reducing the volume of waste residue material reporting to RSFs, thus having a positive impact on the environmental footprint of the Nolans operation. " Clarify the average particle sizes of ore concentrate, tailings and residue material as compared to previous process methods (sulphuric acid plant process). Explain if the increased grain size will impact on the expected profile of deposited tailing residues, the compaction and consolidation of the settled tailings and residue. Clarify whether the reduction in water reporting to the TSF and RSF will affect the deposited profile of the tailings and residues due to the coarser particle sizes and further if there will be sufficient water coverage of the tailings to prevent generation of dust of the radioactive residues and tailings. Detail how the change in resource processing will affect rehabilitation and final closure.	Part A The particle size of (beneficiated) ore will comprise a coarser concentrate feed to around 150µm. This is an increase from what was proposed in the EIS which will assist in the tailings consolidation. Test work on the PAPL process is currently being completed and will be finalised in mid-2018. Appendix 2 discusses the tailing and residue storage aspects and includes a Tailings Management Plan. A Residue and Tailings Management Plan will be developed once the test work has been complete and will be appended the MMP. Part B There will be no change to the proposed rehabilitation and final closure.
318	The proposed phosphoric acid plant and processing circuit poses a potential risk to surface and ground water contamination which will affect the groundwater sourced locally for livestock drinking water. Site trigger values for phosphate in groundwater, surface waters and stream sediments must be set for background concentrations to monitor for potential contamination.	The residual risk associated with an uncontrolled release, spill or discharge of reagents is considered to be low as demonstrated in the risk register (Appendix F of the EIS). The processing plant will be built to Australian Standards and operated in accordance with good chemical industry practice. The process plant will be constructed in the plant site precinct and managed along with the rest of that facility. The processing plant site was selected because it sits on shallow underlying basement and has no stock bores down gradient. There is very limited surface drainage because it is very

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	Water and stream sediment quality data must include monitoring for phosphate.	high in the catchment of the Southern Basins. There is also low potential for the presence of paleo-channels based on our assessment of the detailed AEM. The ground water monitoring program and sediment monitoring program will be updated to include phosphate. This has been included as a commitment.
319	Project Scope Modification for Phosphoric Acid Product Explain what will be used to neutralise acids for tailings as carbonate and other chemicals (NaOH) have been removed/reduced in the reagent list. As SEG-HRE carbonate is listed as an output product, carbonate may still be used in the processing circuit. Provide an updated diagram of the processing circuit system with the changes in reagent inputs and quantity. Explain why grinding balls will no longer be required. Describe how ore will be treated without crushing. Provide an update on the ore grinding requirements for processing. Detail the changes in daily annual traffic with the changed reagent amounts, decreased outgoing rare earth product and increased phosphoric acid product. Describe what the additional environmental risks are for transporting this amount of acid per annum given that the highest risk is a road collision according to the EIS risk assessment.	The project description has been updated to reflect the change from SAPL to PAPL. Refer to Section 2 for further information on the follow-on changes to mining, processing, tailing/residues and water demand. The updated project description replaces that presented in the EIS.

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380	A two stage impurity removal process to produce a residue containing thorium and a phosphate residue that contains most of the uranium present in the Nolans ore. These residues will be stored and managed onsite in dedicated RSF's. Provide an average chemistry of the intermediate RE products which will be transported from site for export. Provide the specific activity (Bq) of the intermediate RE material for export and explain if there are any special conditions for transport.	Arafura is currently undertaking piloting test programs that are due to finish in mid-2018. The piloting test programs will produce a typical RE concentrate that will be exported from the Mine. This concentrate will be subjected to full analysis including chemistry and radioactivity. The PAPL flowsheet will recover the phosphate component of the ore. This means the bulk of the uranium in the orebody be removed with this product. To produce a saleable merchant-grade phosphoric acid the uranium level must meet product specifications. This phase of the piloting program has been completed and the phosphoric acid produced meets the required standards for a merchant-grade product. Based on laboratory scale test work to date the current PAPL flowsheet effectively removes the uranium and thorium from our products. The final concentrate to shipped from site will contain very minor amounts of U and Th below 1 Bq/g. The test work has identified that a small amount of Actinium 227 is present in the concentrate because of its chemical affinity with lanthanum. As a consequence the activity of this concentrate is estimated at about 2.3Bq/g. This activity will be confirmed following completion of the piloting program. This activity level allows the product to be readily transported using the ARPANSA transportation guidelines.
381	The results shown in Table 12-4 radionuclide analysis indicate that background results are 2 to 3 times greater than those samples collected upstream and downstream of the mine site. Explain how these samples are representative of each area given that gamma results for the areas would indicate a different expected result.	The data presented in Table 12-4 provides a summary of baseline monitoring undertaken to date in the Nolan Bore region. Refer to Section 4.11.4 for further detail on the baseline monitoring undertaken.
382	Explain the difference for the two separate data rows for Tree leaves (on deposit) and Tree leaves (off deposit) with different sampling densities. Explain the vegetation sampling which shows lower values for U and Th away from the deposit as compared to Table 12-6 which shows vegetation radionuclide analyses indicates background results are higher than those samples nearer the deposit.	Anomalies between Table 12.6 and Table 12.7 in Chapter 12 of the EIS have been noted. Table 12.6 provides results in Bq/kg, reflecting the origin of the results, which specifically was radionuclide analysis (by ANSTO). The results in Table 12.7 are in units of ppm and were obtained as part of a resource exploration program. It is also noted that there appears to be repetition in Table 12.7 of Chapter 12. Table 12.7 was obtained from Table 10 of Hussey ARU-15/008, Environmental Radiation and Geochemical Studies Associated with the Nolans Project EIS, Discussion and Analysis of Some Results (provided as an attachment in Appendix P of the EIS) and some detail has been inadvertently omitted. Table 12.7 from the EIS has been reproduced below with figures converted to Bq/kg (from ppm) and an explanation of the repetition.

<table>
<tr><th>UID</th><th>Summary of submission</th><th>Response</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th></th><th>Number of Assays</th><th>Uranium (average and range in Bq/kg)</th><th>Thorium (average an range in Bq/kg)</th></tr>
<tr><td>Grass (on deposit)</td><td>9</td><td>0.27 (<0.12 - 0.74)</td><td>0.88 (0.40 – 1.56)</td></tr>
<tr><td>Grass (off deposit)</td><td>17</td><td>0.18 (<0.12 - 1.48)</td><td>0.56 (0.08 – 5.48)</td></tr>
<tr><td>Tree leaves (on deposit) [*1]</td><td>10</td><td>0.57 (<0.12 - 0.74)</td><td>0.60 (0.12 – 2.36)</td></tr>
<tr><td>Tree leaves (off deposit) [*1]</td><td>17</td><td>0.12 (<0.12 - 0.99)</td><td>0.08 (0.04 – 0.16)</td></tr>
<tr><td>Tree leaves (on deposit) [*2]</td><td>75</td><td>0.95 (<0.12 - 0.59)</td><td>2.15 (0.04 – 21.4)</td></tr>
<tr><td>Tree leaves (off deposit) [*2]</td><td>1127</td><td>0.20 (<0.12 - 8.73)</td><td>0.08 (0.04 – 1.36)</td></tr>
</table>
Note 1: Samples taken during exploration activities for regular environmental analysis (elemental only)
Note 2: Samples take opportunistically during exploration activities
For clarity, the results presented in Table 12.6 are from an early survey conducted by ANSTO in 2006 (see Section 6.2 of Appendix P). The results in Table 12.7 are from opportunistic sampling undertaken over a number of years during resource exploration activities by Arafura Resources. The sampling densities reflect the actual location of the exploration program rather than a specific program for radionuclide analysis of leaves, and the results have been provided for information purposes.
There is a difference between the conclusions that can be drawn from the results in the two tables. The main conclusion that should be drawn is that the uranium and thorium concentrations and radionuclide concentrations in vegetation are variable across the region.
</td></tr>
<tr><td>383</td><td>The results show that groundwater radionuclide concentrations are elevated and highly variable across the region.
The table of results provided is inadequate to make an assessment of radionuclides in groundwater as baseline values.   Provide further details on the dates</td><td>Baseline radionuclide concentration in groundwater sampling will be undertaken as per the Water Management Plan (Appendix 4). The results of sampling that has been completed since 2015 is detailed in the Water Resource Assessment (Appendix 3).</td></tr>
</table>

UID	Summary of submission	Response
	of samples and individual results to assess any seasonal variances.	
384	The results in this table for dust deposition monitoring do not provide information on the timeframes and variability throughout the year based on weather conditions. It is noted that average PM10 dust concentrations were calculated from a time period between September 2010 and March 2011.	Additional information on the radiological aspects of dust deposition monitoring is provided in the Radiation Reports (Appendix P of the EIS). Further information on the baseline dust deposition monitoring is provided in the Air Report (Appendix Q of the EIS) in Section 2.4. This information includes the timeframes and variability throughout the year.
385	Clarify how the total dose rate for the listed species is calculated and what the dose rate means. Explain the total dose rate and whether this relates to a potential dose rate per hour based on dust dispersion and the likely life expectation for the species.	A full description of the method for assessing potential radiological impacts to flora and fauna is provided in the Radiation Reports (Appendix P of the EIS) in Section 4 of the Environmental and Public Radiation Technical Report. In summary, the assessment is based on the ARPANSA recognised ERICA assessment method which calculates a relative radiological risk factor for a reference set of flora and fauna species. The ERICA assessment method is widely used for radiological risk assessments
386	Total occupational dose from gamma and dust for one year is estimated to be 3.2 mSv/y (for TSF drilling) and 4.1 mSv/y (for RSF drilling) Explain why dose rates are higher than public allowable levels post closure. Clarify why there is a difference in dose rates between the RSF and TSF facilities if suitable cover has been placed over the storage facilities for closure.	In the radiation chapter in the EIS, Section 12.4.4 refers to potential post closure exposure scenarios as a result of a features, events and process (FEP) assessment that was conducted. The FEP assessment is aimed at identifying potential failure scenarios and then assessing the potential exposures that may result. Where there is an exposure, control measured are identified and proposed. The text refers to Appendix J, where the FEP assessment is discussed in more detail. The particular exposure scenario identified that may result in exposures above 1m Sv/y is work that involves exploration drilling on the rehabilitated residue facilities. For the purposes of calculating a worst-case exposure assessment, the following assumptions were made: • no institutional controls are in place (therefore the drillers are unaware of the presence of uranium and thorium) • the facilities are covered with 1 m of inert material containing 500 ppm of thorium and 80 ppm of uranium (note that the final cover is expected to be greater than this) • drilling would be undertaken for a full year (2,000 hours exposure) • inhalation of 1mg/m^3 for a full year of the residue materials The likelihood of this exposure situation occurring is very low and the proposed control as outlined in Table 12-18 is that exploratory drilling is likely to know about the residue or would have sufficient capability to understand the various minerals (and their properties) present.

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		This is supported by the fact that the region is known to contain elevated levels of thorium and uranium.
387	Explain whether the sample sites included in Table 7.2 Area 1, Area 2 and Background are spatially comparable with the sites from Table 7.1. If the sample sites are different, than the comparison of results is meaningless. It would be expected that representative samples for radionuclide analysis would be comparable (high to high relationship) to the gamma radiation averages presented in Table 7.1 for on deposit, off deposit and background sites. Explain why those sites with higher gamma radiation do not have high radionuclide concentration results	The samples sites, Area 1, Area 2 and Background, reported in Table 7.2 of the Radiation Report (Appendix P of the EIS), are different from the sites reported in Table 7.1. As noted in the text in Section 6.2, a general radiation survey was conducted in the region by ANSTO in 2006. The radiation survey included a number of parameters and a gamma survey was conducted across the mine site area with 52 samples being taken. These results are summarised in Table 7.1 of Appendix P. A smaller number of soil samples were taken for radiometric analysis. The results of the soil sample analysis are shown in Table 7.2. The soil samples were not intended to provide a definitive assessment of the regional soil radionuclide characteristics. Rather, the limited number of samples provides an indication of the equilibrium status of radionuclides in soils in the general region. No comparison is made between the results presented in Tables 7.1 and 7.2. A further review of the original ANSTO report shows that gamma radiation levels monitored at the three soil sampling locations (the Aileron Hotel and at both the southern and northern ends of the Creek bisecting the ore deposit area) were consistently between 0.15 and 0.18 uSv/h. As noted in the text in Section 6.2.2, the radionuclide content of the soils at each of the locations is consistent with the average levels found elsewhere in Australia. A more definitive assessment of the relationship between gamma radiation levels and soil uranium and thorium content was undertaken by Arafura and reported in Section 6.3 of Appendix P and further elaborated on in the attachment to Appendix P, ARU-15/008 Environmental Radiation and Geochemical Studies Associated with the Nolans Project EIS, Discussion and Analysis of Some Results.
388	Provide a description and source of the background image used in Figure 7.1.	The background image used in Figure 7.1 is a high-resolution satellite SPOT5 image obtained by Arafura from GeoImage in Brisbane in 2012. The image is a panchromatic enhanced 2.5m pixel resolution image covering the Nolans site and the general area.
389	Clarify if there is a difference in dose rate from meat ingestion if the source of the meat was from native wildlife e.g. kangaroo, bushes turkey etc. rather than cattle.	Table 13 of the Arafura Resources Nolans Rare Earths Project: Environmental and Public Radiation Technical Report (JHRC Enterprises, 2016) outlines the concentration ratios for both kangaroo and large mammals. This Report is located in the Radiation Reports (Appendix P of the EIS).

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390	All unplanned in-plant spillage possibilities will be taken into account in planning, by providing for bunding to hold the contents of a tank which has lost integrity (such as for example the Ranger leach tank collapse), or of a tank which may require emergency or planned draining. Clarify whether the bunding is planned to contain the contents of all storage vessels within the processing area in the event of catastrophic failure and rupture of all storage vessels.	It is proposed that the processing plant will be designed and constructed in accordance with Australian Standards. These standards require that bunding is capable of containing 110% of the largest tank within that storage bund. If there are multiple tanks within the bund then it is only designed for a single tank catastrophic failure of the largest tank or vessel within it.
395	Risk workshops facilitated independently of the project team were conducted over five days and attended by a cross-section of internal stakeholders and technical specialists For those risks rated as having medium or high level certainty (Table 5-5), details should be provided for the qualitative analyses made to give that level rating e.g. list the relevant investigations, data, modelling that provides that level of certainty.	The approach to assessing risk certainty was described per the Table 5-5 in Chapter 5 in the EIS. The risk register is a 'live' document and is updated as new information becomes available, additional mitigations are developed or a change in activity occurs. Of the 153 impact pathways, 80 were assessed by specialists as having High or Medium Level confidence in the risk rating as per Table 3-9. Table 3-9 Level of certainty (see table below) The potential risk associated with each aspect and the level of certainty connected with that risk is detailed in each of the technical studies (refer Appendix H to W of the EIS).

Table 3-9 Level of certainty

	High Level	Medium Level
Air quality		6
Socio-economic		-
Fauna		17
Flora		15
Groundwater	1	4
Historic and cultural heritage		3
Human health and safety		1
Mine closure		6
Radiation		11
Surface water		13
Transport		3

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396	While recognised a risk assessment has a certain level of subjective ness when determining consequences and likelihood, it appears many potential events have been given insignificant/minor consequences without a quantitative basis or given ratings of rare or unlikely likelihood of occurrence. For example: 81. Failure of post closure TSF cover and batters, leading to erosion, contaminated seepage, loss of material to the environment. This has been given a rating of rare occurrence when it is known to have occurred in mines located in similar environments in the NT. Supply some detail as to how the risk assessment was conducted and details of the technical specialists involved	Chapter 5 in the EIS provides a detailed description of the methodology undertaken in completing the risk assessment, and lists the name and qualifications of each of the participants. A failure of the TSF batters and covers is considered a rare likelihood in that it would occur in only exceptional circumstances due to the following: • The Mine is located in a dry climate with annual average rainfall of 317 mm (refer Appendix L of the EIS). • The material will be tested to obtain geotechnical parameters and permeability to assess if the materials are suitable for use. • The TSF will be covered with a cover system that will be tested in pre-closure trials and investigations. • Monitor cover performance and adjust design parameters as required. • Modelling of the proposed cover system will be completed to assess the net percolation rate and the cover system adjusted to limit the development of a ‘bath tub’ effect. No historical data is available for tailings dam batters and covers failing in similar environments in the NT or the NT generally. Few mines exist in southern portion of central NT, or even the greater NT, which could serve as benchmark or provide a suitable risk profile.
403	A stakeholder engagement register should include details such as date of consultation, description of type of engagement, stakeholders consulted, stakeholder comments or issues raised, operator response to each of the issues raised and stakeholder response or outcomes from the meeting/consultation (acceptable, N/A. etc.). For example, issue 4 in the table does not have any details of the stakeholders who raised the issue and stakeholder acceptance of the proponent's response. This is particularly important for reaching an agreed post mining land use for mine closure.	Information regarding the date of consultation, description of type of engagement, stakeholders consulted, stakeholder comments or issues raised is recorded in the stakeholder engagement register. Arafura will continue to maintain a stakeholder engagement register for the life of the Project. All issues identified (in some instances addressing multiple comments) during the consultation process have been presented in the Table 4-3 and are attributed to a specific stakeholder group. Comments or issues have been presented in this manner so to maintain a degree of anonymity. The proponent believes that it is important to provide assurances of anonymity to the stakeholders and individuals making the comments, so that discussions are open, honest and unreserved. Some interviewees have explicitly requested that their comments be made anonymously. During consultation with the traditional owners, detailed maps and images were used to ensure a proper and complete understanding of the project. People were provided with handouts, site tours and on-country meetings to ensure the issues relating to the project and

UID	Summary of submission	Response
	The mine footprint has been communicated by diagrams provided in the EIS but 2D diagrams do not provide a clear indication of the scale of the project and the impact it will have on the visual amenity of the post mining landscape (e.g., 50m waste rock dumps, permanent void, TSF etc.). It is not clear whether community concerns raised about the implications of diverting Kerosene Camp Creek were accepted by the stakeholders who raised the concerns.	the context of landscape were understood. In addition, the CLC completed their own detailed consultation with the respective traditional owners during the exhibition period to gather community feedback. The CLC has not raised any issues regarding the inadequacy of diagrams and potential impacts to traditional owners understanding of the project, its impacts and its opportunities.
414	4 Breach Geometry (p22) Provide details on the location of the breach. Explain whether modelling shows differences with a breach on the western wall versus eastern wall. Provide details on why the RSFs were not assessed. Explain if modelling has been completed with proposed infrastructure in place i.e. WRDs, open pit, creek diversion etc. Describe and display the breach modelling at various scenarios at the site and in context with the proposed infrastructure in place.	Dam breach geometry is explained in Flotation TSF Failure Impact Assessment (Appendix J of the EIS) and is based on the TSF geometry provided in the Tailings Storage Facilities Engineering Cost Study (Appendix 2). The northern embankment was selected as there is a population to the north of the project some 60 km away. The breach was conservatively assumed to occur as a result of either piping or local failure, as the facility is designed to the PMF overtopping is considered unlikely. Failure to the west is considered to result in lower flood levels, considering the additional flow distance, obstructions and potential to enter the pit. The results of the modelling of both sunny-day and flood scenarios are presented in Section 4.12 and the TSF Failure Impact Assessment (Appendix 2).
415	It is recognised that a failure impact assessment study was undertaken for the TSF to establish the potential risk to downstream residents from a hypothetical dam break scenario. The environmental impacts assessment should be undertaken by considering the potential failure modes of the facility and the resulting economic, social and environmental consequences. Explain the environmental risks and consequences of breach of the TSF/RSF wall and provide flood inundation maps based on potential breach locations. The proponent has not provided the details of the assessment for the Severity of Damage and Loss.	It must be noted that the dam failure study was not a ToR EIS requirement and was completed by Arafura to confirm the perceived low flood failure risks. This study was completed as Arafura believed it was important to complete the work following the recent tailings dam disaster in Brazil and Canada. The focus of this study was to assess the potential downstream Populations at Risk and not the environmental impacts associated with a failure. Flotation TSF Failure Impact Assessment (Appendix J of the EIS) assessed the potential risk to downstream residents from hypothetical dam-break scenarios of the TSF. The RSF were assessed using first principles but later discounted due to: • No population immediately down gradient of the plant site with the nearest populations at the Tilmouth Well Roadhouse some 66 km west southwest, and Laramba some 50 kms to the west and up gradient.

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	The ATC Williams report included as attachment J refers to the Tailings Storage Facilities Engineering Cost Study (Knight Piesold, February 2014, Rev 0) which concluded a worst impact of medium. The Department requires the report in order to understand the justification for the worst impact case of medium. The Department considers that the following aspects may be greater than a medium rating: Importance to the business Effect on services provided by the owner Dislocation of businesses Area and duration of impact Ecosystems and rare and endangered species.	• No defined down gradient drainage to concentrate dam breach flows, and would locally spread out over landscape. • Presence of natural barriers in between the ponds and Tilmouth Well and Napperby Road, such as sand dunes, Haan Range and Reaphook Hills. A dam break run-out study has been completed for the RSF and is provided in Appendix 2. The environment impacts associated with a TSF and RSF failure are captured in the Environmental Risk Register (low risk ranking, medium risk ranking - respectively). Refer to Sections 4.12 and 4.13 for further information. The Tailings Storage Facilities Engineering Cost Study is commercial in confidence and has not been provided.
420	Provide an improved waste classification involving the collection of more data for waste rock, tailings and residue characterisation to better determine the risk from AMD, including risk of generating saline and metalliferous leachate	Refer to Appendix 2 and 17 for further information on waste classification. Further discussion on AMD and leachate is provided in Sections 4.27 and 4.28/4.26, respectively.
421	What test work has been completed to determine the constituents that may cause potential concern in leachates. Constituents in leachate may include metals and salinity. 200 samples were analysed for stage one and 25 for stage 2 acid metalliferous drainage tests. Provide details on the samples, e.g. location, depth, lithology, alteration minerals, ore or waste classification, chemistry etc.	Refer to UID 420 above.
422	The material to be stored has broadly been classified into four waste rock types, mineralisation, pegmatite, schist and gneiss. Provide details on the mineralisation waste rock type, given that 1.2% of waste rock (1.7 million in') is	Mineralisation includes low grade ore.

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	mineralisation material. Clarify whether this is mineralised or low grade ore.	
423	It is recognised that the Arunta Region also contains multiple units other than granites and gneiss (i.e. schist, quartzite etc) which may contain higher fracture permeability, but all Arunta Region rocks are collectively grouped as the hydrogeological unit 'basement' for the purposes of this assessment. On what basis are all the rocks of Arunta Region grouped as a basement? It has been described there are numerous rock types, and as such different rocks should have differing hydrogeological properties. In general Section 2.3 is vague and does not systematically describe the key geological units as a function of depth and therefore it is difficult to corroborate how or on what basis has the geological units been grouped as hydrogeological units. Furthermore, this section does not describe what the primary host rock to the ore is and whether there any dominant structures that may affect the hydrogeological system . Provide characterisation of all rock types and lithologies.	Refer to the Groundwater Report (Appendix K of the EIS) for further description of groundwater characteristics associated with the Mine site.

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424	There are significant inconsistencies in the presentation of the historical geochemical dataset: The number of elements is stated as both 38 and 42; Sulfur results were not presented; Analytical techniques are not clear; The summary table in section 4.2.2 appears to combine historical data and data from stage 1 and 2 EIS investigations. It is not clear which samples were subject to field XRF, benchtop XRF or Inductively Coupled Plasma (ICP) analysis. More information is required and must include: • Source of the samples (exploration chips, core etc.); Suitability for analysis (i.e. any oxidation prior to analysis); Lithological description; Total sample numbers of each major lithological unit; Parameters analysed; and Parameters calculated along with assumptions. Figures must be included showing the sample locations and where appropriate, cross-sections showing the vertical distribution of the sample locations with respect to the dominant rock types and proposed footprint of the open pit.	Refer to Appendix 16, Sections 4.27 and 4.28/4.26, respectively.

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425	The historical assay-based data have been used to estimate NAPP, although it is unclear how this was achieved, given that for some data (Section 4.2.1) sulfur measurements were not taken. An assumption was made on using Ca and Mg as indicators for carbonates, and ANC, without appropriate validation (e.g. petrographic or XRD) that carbonates are the dominant acid neutralising minerals at Nolans. Provide more data for waste rock characterisation to better determine the risk from AMD, including risk of generating saline and metalliferous leachate In Section 4.5.2, dipping ABCC profiles of selected samples from Stage 1 and Stage 2 testing led the proponent to conclude that non¬ carbonate minerals (micas, clays, silicates) were the source of acid neutralisation. Furthermore, results of Stage 1 testing (NAPP) clearly show significant dissimilarity between measured ANC (maximum value of 229 kg/t H2S04) and ANC values calculated from using Ca and Mg as an indicator for carbonates using the historical assay data (maximum value approximately 700 kg/t H2S04). Given such a finding, the results of the historical assay are considered unreliable and should not be used for AMD assessment. Consequently, a large number of samples in the historical database, now considered unreliable for AMD assessment, were used to give a misrepresentation of an appropriate level of statistical confidence. Given this significant shortcoming, at present, only the results of the Stage 1 and 2 testing can be considered appropriate, and given the significant volumes of waste to be generated, the current number of samples (154) is considered inadequate.	Refer to Appendix 16 for further information on waste classification. Further discussion on AMD and leachate is provided in Sections 4.27 and 4.28/4.26, respectively.

UID	Summary of submission	Response
	Provide more data for waste rock characterisation to better determine the risk from AMD, including risk of generating saline and metalliferous leachate	
426	Provide definitions for acronyms and abbreviations used in the report. These include: NREC (Figure 6); CLCR, CS, Cy, GRT (Figure 7); CBT (Figure 8); METM, MG, MYL (Figure 9).	NREC – no recovery CLCR- calcrete Cy – Clay CBT – carbonate MG – mafic gneiss GRT – Granite CS – Calc-silicate MYL – mylonite

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427	Based on the results from Stage 1 NAG testing and Stage 2 Kinetic NAG (KNAG) testing, the Department does not support the statement static NAG test is broadly suitable for classifying material. If there was a strong correlation between NAG pH and KNAG then the results should be roughly plotting linearly with a gradient of 1 in Figure 13. While some samples do, overall a linear trend is difficult to accept. Thus NAG pH and KNAG pH does not show strong correlation. Furthermore Figure 13 shows conflicting data where for some samples KNAG Final pH values are acidic, but NAG pH values alkaline. This suggests that KNAG tests were ended pre-maturely (i.e. not undertaken to completion) and highlights that early on during PAF oxidation acidic effluent will result and the available ANC will not be sufficient to neutralise it. KNAG profiles for some samples showed buffering of acidity generated from peroxide oxidation for up to 340 minutes, but a downward trend towards acidic pH at close to 360 minutes demonstrates that the tests needed to be extend longer that what was actually undertaken. The dissimilarity in NAG pH and KNAG tests also demonstrate that not all of the measured ANC is available to neutralise the acidity generated and further corroborated by the ABCC test results. ABCC tests profiles provided show that for some samples (EB1532081-002; EB1532081-004; EB1532081-006; EB1532081- 007; EB1532081-008; EB1532081-009; EB1532081-010; EB1532081-011; EB1532081-011 check) that the pH started to drop (i.e. became acid), prior complete exhaustion of the total acid neutralising capacity. The MEND handbook (2009) states that silicates, as	Only one of the KNAG results (2133727) showed a final pH of less than 4.5 that would indicate sulfide acidity. It is an anomalous sample, in that the single addition NAG had a pH of 11, suggesting significant inhomogeneity in the sample. It also had a relatively low (4.8 kg/t H2SO4) MPA. The remaining samples with final KNAG pH of less than 7 had pH above 4.5, indicating it is due to metal oxidisation, unlikely to develop under atmospheric conditions. Tests where final KNAG pHs are alkaline but have a single addition NAG pH above pH 4.5, indicate that in some cases NAG overestimates acid risk. Even in the case of the one sample with a final pH below 4.5, the decline in pH is very slow and unlikely to generate acid at a significant rate, given the very low MPA and a time to drop to pH 4.5 of 330 minutes. Based on the above aspects and the overall AMD results, the combination of total sulfur and NAG testing is an adequately conservative indicator of AMD risk. Additional testing however, including sequential leach and barrel leach tests will be carried out prior to commencement of mining operations to confirm the long-term leachate generation behaviour.

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	acid neutralising agents, do not show comparable kinetics as carbonate minerals (i.e. silicate minerals are much slower in neutralising acid than carbonates). ABCC profiles presented in Appendix B confirm that neutralisation availability is reduced for some samples. Conduct further kinetic tests to fully understand the lag times for neutralisation reactions to take place to determine timeframes and implications associated with stockpiling of suspect materials and WRD construction.	
428	Groundwater samples were obtained from Nolan Replacement Bore (RN1876) and dewatering bore (RN37197) the results of which have been reported in GHD 2012. Provide the results of this groundwater analysis as well as any prior and subsequent groundwater monitoring data and highlight those samples that exceed fresh water aquatic guidelines. Provide the reasoning for why deionised water leaching is considered aggressive and reason for subsequent adjustment of leachate testing (ASLP) results by a factor of 10 and 100 (Section 4.5.3). The proponent has not indicated what the actual adjustment was for each individual sample and results must be provided without adjustment prior to assessment of the results of NMD and SMD.	Refer to Section 4.27.5.
429	Describe what representative sized sample intervals will be used for the acquisition of additional geochemical data if the samples are taken from the blast holes. Explain whether these samples are able to be correlated with the current resource drilling samples. If sample analysis is completed with the portable XRF, explain if samples can be correlated and compared	Refer to Appendix 16.

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	with those analysed by Lab XRF. Clarify if the portable XRF has the detection capacity to analyse for the required resolution of sulphur.	
430	Section 6.3.2 of the report provides information regarding geochemical monitoring. Specific comments related to this section include: • If portable XRF will be used as a screening tool, will the proposed instrument have the required sensitivity to measure the low levels of sulphur potentially associated with this site • An on-site NATA accredited laboratory is stated to be setup for analysis of blast hole samples and AMD assessment. Is this confirmed to proceed or will field laboratory testing be undertaken (i.e. not NATA-accredited); • Will the identical samples analysed by field XRF be further laboratory analysed for NAG, NAPP and ASLP; and • Free draining column leach tests, in accordance with AMIRA (2002) are proposed as further kinetic tests, however given the potential kinetics of this deposit and waste material, drum/barrel tests should also be considered, which will be more representative of field conditions, rather than column testing alone.	Broadly, the concentrations of sulfur and other potentially significant elements will be measured in both ore and waste rock, in a manner consistent with that routinely used for confirming ore grade during mining. Portable XRF will be used as a screening tool and the instrument will have a Limit of Reporting (LoR) of 0.02% sulfur, which is adequate. It will also be calibrated against the key elements noted to be elevated at the site, in accordance with the manufacturer's guidelines. An on-site laboratory will be setup and will analyse a subset of the field tested samples for quality control, as is normally carried out for ore grade control. No decision has been made on whether this lab will be a certified laboratory as yet. Appropriate samples analysed by XRF will be further analysed in the laboratory. Barrel tests have commenced but these will be run over a long period of time to determine the likelihood of NMD for each combination of lithology and oxidation/weathering state. Additional ASLP, column leach and sequential leach tests will be carried out prior to mining and throughout the life of mine and will enable site-specific comparison of the various leach results.
431	Given the small number of samples (four) the current results should only be used to assess requirements of further analysis and not used to infer the potential environmental impacts of tailings and residue samples. Basing conclusions on a limited number of samples (n=4) provides no statistical significance and there is a	Refer to Appendix 16 for further information on waste rock. Further discussion on test work is provided in Sections 4.27 and 4.28/4.26.

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	high possibility that the results may not be representative of the entire TSF and RSF material	
432	The table included in 2.1. I lists five samples. Clarify the number of, the sample identity and the type of samples that have been analysed and included in this report. Explain what part of the processing stream the samples have been taken from Acid Neutralising Capacity (ANC) Clarify the lithologies and weathering state of the processed sample material. Explain if this material would be consistent with ore feed during life of mine operations.	Refer to Appendix 16 for further information on waste rock. Further discussion on test work is provided in Sections 4.27 and 4.28/4.26.
433	"Acid Neutralising Capacity (ANC) is determined by treating the sample with acid then back titrating with an alkaline solution to determine its net ability to neutralise acid. " As part of the processing, carbonate (or other alkali) is added to the product to neutralise the addition of sulphuric acid. Explain if the net acid producing material values may be controlled by the manipulation of neutralising alkali amounts added to the product during the processing process.	Due to the digestion of the residue with a strongly acidic solution, while residues will initially have high “actual acidity” the lack of remaining sulfide minerals means there will be no latent acidity. The residues will be washed to recover acid for further processing and will be neutralised prior to discharge to the RSF. This will effectively aim for a net acidity of zero, although if calcium carbonate is used as the neutralising agent, a moderate negative net acidity can be achieved while maintaining pH in the desired upper limit of 8.5, which is the optimum pH for solubility of the key metals at the site.
434	Explain why the A16422 Arafura Tails Blend was not included in the AMD analysis. Additionally clarify why the A16422 CST Reserve and A16422 Non-Mag Subs were not leach tested.	Leachates were not carried out on samples with separate liquor, as the single additional ASLP as the liquor is considered to be in geochemical equilibrium with the solids and provides a better indication of likely initial leachate concentrations.

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435	Both tailings samples, A46422 CST and A16422 Non-mags reported results of -24.5 and -69.4 kg/t H2S04 suggesting that they can be classified as non-acid forming (NAF). Process samples 040488BH BNS and 40488BH BNS Water Leach reported results of -346.9 and -111.2 kg H2S04/t indicating that they may be acid consuming material. A review of the laboratory report (EB1538805) indicates a NAPP value of 225 kg H2S04/t for sample 0488BH Barren Neutralised Slurry that is in contrast to the GHD calculated value of -346.9 kg H2S04/t. Clarify the discrepancy of the NAPP values	
436	The U content of the analyses indicates that samples were taken from waste material. Provide results of analyses of processed ore material. Provide the initial analysis of the material which has been used for the testwork and further provide the analyses of samples from each step in the process. Demonstrate that the presented results are consistent with what will be produced during life of mine. Describe any differences that are observed between different mineralised ore types.	The comment relating to U content is unclear. The ore and waste have been tested and the analyses have been discussed in the Radiation Report (Appendix P of the EIS). Processed ore will be exported from site.

UID	Summary of submission	Response
437	The leachate analysis confirms that elevated metal concentrations will occur in tailings residue, tailings leachate and the waste rock on site. Given the elevated metal concentration observed in the leach testing results the tailings storage facility (TSF) and residue storage facility (RSF) will require appropriate design, construction and management, to ensure protection of the receiving environment (including groundwater). It is recommended that an Independent Certifying Engineer be engaged to guarantee appropriate measures are taken to ensure measurable performance criteria are achieved.	An Independent Certifying Engineer will be engaged to certify the design and construction of the TSF and RSF. This has been included as a commitment.
438	This section provides a factual summary of the leachate results however it does riot interpret the results to a level required for management purposes. The pH of the tails leachate is slightly above the acceptable pH for FAE95% but the two residue leachates are significantly alkaline pH, indicating over-neutralisation of the acid leach residue. Will the alkaline pH lead to the deterioration of the liner proposed to be used for the TSFs and RSF? Sodium, calcium, alkalinity and sulfate in the residue are higher than in the waste rock, consistent with a sulfuric acid leach neutralised by lime or aglime. Subsequently, total dissolved solids (TDS) is higher than the waste rock leachate but is consistent with groundwater. Is the residue material showing high alkalinity potentially suitable for use in AMD management within the WRDs? Review the results and provide a re-interpretation so that management decisions for the materials can be made.	Part A The imperfect neutralisation (some acidic and some alkaline) has been discussed and modifications of the process recommended – as outlined in the EIS. The RSF liner will be chosen and the liner system designed to resist likely leachate chemistry, including imperfectly neutralised material. This has been discussed further in Appendix 2. Part B Given the risk of elevated salinity and metal content in the residue leachate, GHD would not recommend its use in neutralising acidic leachate unless tested to confirm it contains acceptable metal and metalloid concentrations, especially alkaline soluble metals such as Al, As and Mo. Part C Refer to Appendix 2 for further information on the management of tailings and residues.

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439	"Aluminium is consistent with waste rock leachate and is elevated above ambient groundwater, FAE99% and LTV, but is consistent with most ASLP results for natural soils and rock. " LTV has not been defined in the report, but is assumed to represent Irrigation Trigger Value. Since discussion of other analytes does not include this Environmental Value (EV), explain if it is applicable to the site? The concentration of dissolved Aluminium (Al) does not correlate with the measured pH, as it is generally accepted that Al dissolution is enhanced away from neutral pH. Thus, it is expected that sample "A16422 Arafura Tails Blend" which reported a pH of 8.67 showed the highest dissolved Al concentration (0.61 mg/L) of the three samples analysed. Could the results be affected by presence of Al sesquioxides, present as very fine particulates? "Arsenic is elevated in the tailings leachate but is consistent with ambient groundwater. " Only one sample (A16422 Arafura Tails Blend, 0.004 mg/L) reported As concentration above the detection limits. This measured result is not consistent with ambient groundwater. Appendix K indicates an average and median As concentration of 0.00078 mg/L and 0.0005 mg/L, respectively with a maximum of 0.0037 mg/L. Thus, the leachate result is an order of magnitude higher than the groundwater. Update and correct the inconsistencies noted above.	Part A LTV, or long term irrigation values, were discussed to enable consideration of on-site re-use. Re-use is not applicable and therefore no applicable to the site. Part B It is likely that the elevated aluminium is from colloidal aluminium, which can pass through the 0.45 um filters conventionally used to filter leachate samples, and does not represent dissolved, bioavailable aluminium. Part C Only one sample had arsenic above limits of reporting. The concentration is very close to the maximum groundwater concentration. Furthermore, the average leachate arsenic concentration is effectively identical to the average of the groundwater if <LOR taken as 0 mg/L and is still within an order of magnitude if half the LOR is used in the calculation. Consequently, it is an accurate statement to say that arsenic concentrations are consistent with groundwater.

UID	Summary of submission	Response
440	"Chromium is elevated in the residue leachate with respect to FAE99% and ambient groundwater. The FAE and drinking water guidelines are based on all chromium being in the hexavalent form. Given the high pH of the neutralised residue, there may be some hexavalent chromium present in oxidised/aerobic material" For hexavalent chromium to be present, an oxidant is needed. Describe if an oxidant is used in the ore extraction/processing. "The thorium in the tailings sample was the highest recorded value out of the other leachate and groundwater samples, but within the equivalent gross alpha and beta limit for drinking water. " This statement is incorrect. The attached laboratory reports clearly indicate that radioactive concentrations of Th and U were not measured, only chemical concentration. Provide the radioactivity concentrations (in Bq/L) of the three samples.	Part A Irrelevant given new process and assessment of new residue will include Cr and As speciation. New residue should have gross alpha and beta as well as other radio isotopes. U and Th based on average isotope concentrations more detail could be provided to cover old samples but not applicable anymore. Part B Refer to Section 2.10.2 for further detail on NORM.
441	If new processing techniques are implemented an updated leach test will be required to assess if the new processing techniques will pose a higher or reduced risk to the receiving environment.	Noted. Although the chemistry is pH-controlled, additional total and leachable contaminant analyses will be done along with ABA analysis, once process test samples are available. This has been included as a commitment.
442	ASLP testing indicate that some metals and ions, including fluoride, are elevated in the leachate but are consistent with waste rock leachate. Where analytes (fluoride and sulfate) exceed human health guidelines, they are less than 10 times the guideline and hence do not represent a significant risk to human health through incidental exposure, other than pH. " Evidence supporting the claim that an exceedance of >10 times human health guidelines do not represent a	Unless the leachate makes up more than 10% of daily water intake, the risk is low. Furthermore, the exceedance factors discussed are consistent with Northern Territory and other landfill guidelines. More detail is provided in response to Sections 4.28/4.26.

UID	Summary of submission	Response
	significant risk to human health must be included. If not, it must be assumed that there is a threat to human health.	
443	It is appears that acid metalliferous drainage is unlikely to be an issue however the results clearly indicate that neutral metalliferous drainage and saline mine drainage may be issues. Appendix K of the EIS suggests that the TSF and RSF designs were such to completely prevent infiltration; however this is extremely difficult to achieve on a larger scale. In this context, an assessment of the TSF and RSF liners used to prevent infiltration is required to determine if they can prevent alkaline pH infiltration in the long term.	Appendix K of the EIS suggests that the TSF and RSF designs 'should' completely prevent infiltration, however, it is agreed that this would be extremely difficult. Low permeability liner will be utilised to line the TSF and RSF and the design assumes some leakage. Refer to Appendix 2 for further information on the specifications of the low permeability liners. Further assessment to determine if the low permeability liners can prevent alkaline pH infiltration in the long term will be undertaken once the testing results have been completed. Should it be determined that the characteristics of leachates or leakage rates likely risk to the environment then the TSF and RSF liner design will be reviewed. This has been included as a commitment.
465	Site water balance indicates a potential surplus of water due to pit dewatering during the first four stages of mine development and a potential deficit in the supply of water demands thereafter. Provide more details on how this surplus will be managed to ensure a zero discharge facility.	All available water from dewatering of the mine will be recycled and used at the operations for dust suppression, beneficiation processes or in the processing plant. There will be no excess available to discharge off site. Storage facilities are part of the site management infrastructure and thus will be used if required as temporary holding facilities. Dewatering will commence prior to mining and water from the proposed pit will be used in construction therefore offsetting required water from the borefield. Any water available will be utilised and will displace requirements from the borefield. Refer to the water balance presented in Section 2.11.1

3.11 Department of the Chief Minister

UID	Summary of submission	Response
96	Expected population of FIFO workers (70%) is too high and further effort should be made to utilise the existing population and provide training pathways	The workforce figures quoted in the EIS are based on work completed during the social impact assessment. Published statistics were used in discussions with local agencies for validation purposes. Based on the information provided, and interviews conducted, a 70% workforce sourced from FIFO is likely to be realistic. The availability of reliable and job-ready individuals in Alice Springs and other local communities is predicted to be small, and most are already employed.

UID	Summary of submission	Response
		The Project will target locals to maximise local opportunities, but there are a large number of local people who are not currently job-ready without some form of job preparedness training. Arafura will work with local providers and trainers to provide job readiness training. This has been included as a commitment. A key objective of the workforce planning is to maximise local participation. Arafura will hire from the NT wherever possible and FIFO is considered the last resort.
103	This project has the potential to favourably contribute to the Northern Territory economically and socially for a significant amount of time.	Agreed.
104	The Proponent has invested in studies necessary to evaluate the pros and cons of the mine proposal	Noted.
105	There are obvious environmental risks associated with the activities which need to be managed appropriately with any permanent impacts offset accordingly.	The Nolans Project has identified around 165 risks and the EIS demonstrates how these risks will be managed or mitigated to an acceptable level. The requirements for offsets will be determined by the regulator.
135	Lewis Lake is noted as being 40 km away in the executive summary and 30 km away in Ch 8	Lake Lewis is 90 km SSW of Nolan Bore (Pit Location), 82 km SSW of the proposed processing site.
136	Will the lake and surrounding environment will be impacted considering the flow of water through the bore fields is westwards and may contribute to the water table in the lake?	Refer to Section 4.3.
137	Concerned that the water source is not considered sustainable in the long term - the use of this water may impact existing or future users	The average extraction rates for the borefield are not sustainable in the long term; however, extraction from the borefield is only required during life of the mine (i.e. for a period of 55 years). The extraction rate for the Southern Basin is considered sustainable based on the 80/20 rule where extraction less than 20% of the total storage is considered sustainable. Refer to the Water Resource Assessment (Appendix 3) for further information.
138	What is the expected recovery time of the aquifer once mining activities have ceased?	The isolated aquifer beneath the pit will never recover. The borefield will not fully recover within 1000 years based on current modelling. Refer to Section 4.22.
290	Suggests that the Proponent is encouraged to utilise renewable energy such as solar to supplement their power supplies in addition to the gas turbine (and steam) options. This could form part of the recommendations	Refer to UID 292 (ALEC).

UID	Summary of submission	Response
363	Comprehensive management plans for the radioactive materials need to be included with the final EIS	A final Radiation Management Plan will be provided to DPIR as part of the mining authorisation process. Approval from DPIR will be required prior to the commencement of mining. This has been included as a commitment.
407	Supports proposed Stuart Highway Upgrade Requests details on how much it will cost, who is facilitating and who is funding.	Noted. The only upgrade will be required for the intersection of the project access road with the highway. Detailed costings have not yet been completed. Arafura will continue to liaise with the Department of Transport and NTG during detailed design and costings phases. Funding arrangements have not yet been finalised.
408	Has consideration been given to the long term impacts the project will have on the railyards at Alice Springs? Will upgrades be required to ensure capacity meets demand and is there scope for Arafura to contribute?	The railway operator has also confirmed that the Alice Springs rail yard facilities can manage both inbound and outbound freight services without an upgrade, due to available space and freight handling capacity.
409	Can Port of Darwin's facilities safely store materials waiting for export during all-weather events. Any spillage into Darwin Harbour will be unacceptable	Discussion has been held with the operator of the Darwin Port regarding the facilities currently available. Advice received is that the Port has capacity to manage and meet all project requirements. It is noted that the Darwin Port is operated under the Ports Management Act including the implementation of an ISO 14001:2015 certified Environmental Management System.

3.12 Department of Transport

UID	Summary of submission	Response
410	The Traffic Impact Assessment may not have addressed the impacts of proposed project traffic within the Alice Springs intersections adequately	Project traffic will utilise Whittaker Street and Smith Street within Alice Springs. The DoT does not currently maintain any permanent counting stations along these streets on which to base a quantitative impact assessment. Whittaker Street and Smith Street form the established truck access route into the Alice Springs Freight Terminal. Peak production at the mine is expected to generate an additional 6 vehicles per day to the Terminal (Appendix V of the EIS).
411	The proponent hasn’t entered into specific discussions with the DoT regarding the proposed intersections on the Stuart Highway, however, these upgrades are subject to approval from the DoT and therefore, a rigorous evaluation	Noted.

3.13 Department of Environment – Heritage

UID	Summary of submission	Response
222	Consultation Traditional owner input into the cultural heritage surveys should have been undertaken as best practice however this did not occur.	Three archaeological surveys have been completed for the project (mine and processing site (including Kerosene Camp Creek), the haul road and the bore field). The survey undertaken in 2006 for the mine and processing site engaged a senior traditional owner as a field assistant. No traditional owner input was included in the later surveys (refer to UID 223). Sacred site clearance surveys were undertaken by AAPA and included on-site consultation with traditional owners. These surveys were undertaken for the mining and processing site in 2008 and the borefield in 2013. These surveys identify sacred sites.
223	The Indigenous and Historic Cultural Heritage Assessment –Appendix U, identifies that the findings of this report should be presented to the Anmatyerr traditional owners and custodians and that their approval should be sought prior to submitting a work approval application. This report should also be used in negotiating an Indigenous Land Use Agreement (ILUA) with Traditional owners. Insufficient on ground consultation with traditional owners has been undertaken at this stage. No reason has been given as to why this did not occur other than the relevant traditional owners were unavailable. Evidence of onsite consultation with traditional owners will need to be carried out and provided as the project progresses to ensure that cultural heritage has been adequately dealt with and areas of high significance including identified/non identified sacred sites are protected as required under Territory law. This may be carried out as part of the ILUA process.	The CLC were provided with a copy of the Indigenous and Historic Cultural Heritage Assessment Report (Appendix U) and were contacted on three occasions prior to the submission of the EIS, to provide input into the survey findings, but did not respond to the request. Both Arafura and the archaeological survey team sought assistance from the CLC on a number of occasions, to facilitate the participation of the Traditional Owners in the 2015 archaeological survey but this was not possible for reasons that the CLC did not share with Arafura. Further consultation and agreement with the CLC and TOs regarding the management of archaeological and sacred sites and will be sort prior to works commencing (refer UID 204 and 207). This has been detailed as a commitment. Since 2011 there have been four formal, CLC facilitated meetings with Traditional Owners. These meetings include three on-country meetings and one at the Pioneer Football Club in Alice Springs on: • 16 March 2011 • 5 September 2012 • 11 June 2015 • 26 April 2016 Another large, on-country meeting with the CLC and traditional owners was held in late May 2016 just prior to lodgement of the EIS. All aspects covered by the EIS were discussed and a long session of question and answers took place with the traditional owner group of more than 50 people. Additionally, Arafura has been advised by the CLC that more intensive consultations, with the smaller traditional owner groups, providing further clarification has since occurred to supplement the consultation process. Arafura has made an offer to

UID	Summary of submission	Response
		participate in the more intensive engagement process with the CLC but has not yet been called on to participate. The CLC has expressed concerns about having meetings and raising expectations when there is ‘nothing new to say’ and has several times advised that third parties hosting independent meetings with traditional owners is not recommended practice. Therefore, Arafura has limited engagement to those meetings facilitated by CLC. As mentioned above, and below, negotiation of the ILUA/management agreement including with Traditional Owners is proposed and is a commitment,
224	Require agreement from the traditional owners that the consultant process to date and the proposed future processes are acceptable as a way of providing adequate heritage consultation and possible protection /mitigation mechanisms.	Agreement from the traditional owners that the consultant process to date and the proposed future processes are acceptable will be sort prior to works commencing. This process will be facilitated through the negotiation of the ILUA / mining agreement. This has been detailed as a commitment. The proponent will continue to engage with the CLC and traditional owners regarding the management of cultural sites through all phases of the project as detailed in the CHMP. This engagement includes consultation and/or onsite meetings with traditional owners to discuss potential impacts and mitigation measures (also refer UID 204 and 207). Details of all meetings completed with traditional owners, the CLC and all stakeholders are recorded in a database.

UID	Summary of submission	Response
225	The summary of consultation key issues identified in Chapter 6, page 6-6, identified two overarching issues surrounding indigenous heritage. These were: Access to land/connection to country Impact on sacred sites Arafura acknowledged that they would work with traditional owners to discuss the protection of key sites of significance. However Arafura acknowledged that traditional owners were unable to participate in the heritage survey and that it is possible that the heritage assessment provides an under-representation of cultural sites and/or values associated with the study area. No reason was given as to the unavailability of traditional owners to participate in the field surveys. Given that consultation occurred over a period of seven years, active involvement of traditional owners in this survey process should have been able to be arranged.	Both Arafura and the archaeological survey team sought assistance from the CLC on a number of occasions, to facilitate the participation of the Traditional Owners in the 2015 archaeological survey but this was not possible for reasons that the CLC did not share with Arafura.
226	Aboriginal Areas Protection Authority Certificate (Doc: 201223519) Condition 12. No damage to occur under this certificate. Table 1A1-2 contained within this document identifies indirect impact on site RWA8, RWA9. What does indirect impact mean? Prevention of damage to these sites would need to be discussed and agreed with traditional owners under the broader consultation process as well as negotiation on the ILUA.	In the context of RWA 8 and RWA 9, indirect impacts are considered to be vibration or dust and related with works occurring in the vicinity of the sites but outside any designated exclusion zones. Exclusion zones will be clearly marked with signs indicating no unauthorised entry, and flagging or barriers will be installed along the boundaries of key areas and access roads adjacent to the RWAs. Indirect impacts will be managed so not to damage to the identified features of the sacred site. The CHMP will be provided to the CLC and Traditional Owners for approval. This has been included as a commitment.
227	Consideration will be given to realigning the proposed access road and service corridor in order to avoid or reduce impact to RWA8. Once the design has been finalised, an archaeological mitigation program would be put in place to sample, collect and document a representative sample of archaeological materials	Refer UID 208 (CLC).

UID	Summary of submission	Response
	between 318843E-7496897N to 317744E-7498669N which covers the area of possible alternative routes. Damage to RWA8 is prohibited under Aboriginal Areas Protection Authority Certificate (Doc: 201223519) Condition 12.	
228	Aboriginal Areas Protection Authority Certificate (Doc: 201223519) Condition 12 prohibits damage to RWA8 Realignment of the access road should demonstrate the site will be protected from damage as required under the identified certificate.	Refer UID 208 (CLC).
272	A high density of archaeological sites are located near the Yalyirimbi Range in the vicinity of the proposed accommodation village, and the narrow valley between the processing site and the mine site where the access road and service corridor. The study found the Yalyirimbi Range to be a particularly archaeologically sensitive zone. Induction of mines staff should include should clear protocols on interacting with indigenous heritage including artefacts outside but adjacent to the project site.	The site induction will include clear protocols on interacting with indigenous heritage including artefacts outside but adjacent to the mine. This has been included as a commitment.

3.14 Environment Centre NT

UID	Summary of submission	Response
73	Concern about the preference to manage the waste piles as capped landforms	Refer to Section 4.1.1 for further discussion on alternative closure strategies.
74	The EIS should explore long term management plans of comparable operations, and discuss best-practice alternatives for the long term management of radioactive mining waste, including consideration of backfilling the open pit void.	Refer to Section 4.1.1 for further discussion on options considered for Mine closure.
102	Request a firm commitment from the government and proponent that these elements will not be recovered as ECNT firmly oppose every stage of the nuclear fuel stage	Arafura is seeking approval to mine rare earths and phosphate only. Uranium and thorium would be managed as a waste product with other residue materials in well-engineered and constructed storage facilities.
131	The proposal fails to meet the requirement, from the Terms of Reference, to keep water extraction within the sustainable limit and the EIS states this.	The average extraction rates for the borefield are not sustainable in the long term (i.e. indefinitely); however, extraction from the borefield is only required during life of the mine (i.e. for a period of 43 years). Thus, the project is seeking approval for groundwater extraction greater than the sustainable limit of the aquifer (when limiting the aquifer to the area modelled and not the whole system). This is considered an appropriate use, especially considering the lack of competing beneficial uses.
132	This project should be disqualified due to anticipated unsustainable water impacts.	Water use from the Southern Basins is temporary, required during the life of the mine. For further information on the impacts to the pit aquifer refer to UID 70.
133	The EIS should include a description of how Arafura will work with Water authorities to better understand and manage the Southern Basins within the evolving policy environment, as well as a commitment to monitor and limit impacts on local vegetation.	Arafura will follow all directions by the Controller of Water and in conformance with the NT Water Act and its regulations. Arafura is seeking a Water Allocation from the Controller of Water even though it is not a compulsory requirement under the Act. Refer to Section 5.4 for further information on the monitoring of groundwater dependant vegetation.
134	The supplement should also fully explore what economic cost the expected impact on local water resources will present to the NT beyond the life of mine.	Refer to UID 120 Part B (CLC).
287	The EIS should specify the role of each RSF, including the likely schedule for progressive rehabilitation	The RSF will hold the PAPL process residues. These facilities consist of multiple cells to enable operational cycling across the cells periodically. Deposited process residue will settle and consolidate. Once cells are filled to capacity and so they will be covered progressively

UID	Summary of submission	Response
		once filled. As a cell of the RSF reaches maximum storage capacity, this cell can start closure/rehabilitation works. The cycle time for deposition will be determined once representative residue material is available from the current pilot test programs to be completed by mid-2018. The testing will characterise the physical properties of the residues. Additionally, the closure design plan can be refined for the next cell based upon the performance of the rehabilitated cell. This approach can demonstrate to the regulator that the closure methodology is reasonable and sustainable. The schedule for progressive rehabilitation will be detailed in the RSF/TSF Operating Manual (refer to Tailings Management Plan (Appendix A) of the Tailings and Residue Storage Aspects – Appendix 2) There will likely be multiple cells for process solids residues (mainly gypsum) which will also contain uranium and thorium and there will be a liquid storage cells for the evaporation of reject brine liquors from the process. These liquid holding cells will be smaller in size and also multiple so solutions can be cycled through the cells. This will allow the evaporated solids to be removed periodically for disposal in to the process solids RSF.
288	Should evaluate options for renewable energy sources for the site, the plant, the bore field and worker accommodation	Refer to UID 292 (ALEC).
289	Locating the separation plant in a foreign jurisdiction may result in a lower standard of environmental performance than Australia. It would be welcome to see a statement from the proponent about their expectations of basic parameters and benchmarks of environmental performance.	The jurisdictions being investigated for the separation facility have strong and robust regulatory systems and processes through which the facility will be governed. The proponent will ensure that any facility owned and operated as part of the project will be designed and operated to meet all applicable legal requirements of the jurisdiction chosen. It is intended that this plant facility will be operated in accordance with industry best practice and will meet and be in accordance and compliance with recognised Australian and International standards for Safety Health and the Environment.
314	Conflicting statements on whether uranium and thorium will be commercially recovered (does not intend, does not initially intend, consideration may be given if the market improves)	The project seeks to mine rare earths and phosphate only, and will be appropriately authorised to do so under the Mining Management Act. Arafura is not seeking approval to commercially recover uranium and thorium at this time. Uranium and thorium will be managed as a waste product with other residue materials in well-engineered and constructed storage facilities.
361	A formal decision to proceed should be fully informed by the RMP and RWMP	Noted.

UID	Summary of submission	Response
362	Given the acknowledgement that radiological hazard from dust and radon gases are comparable to the Ranger Uranium Mine, Arafura should audit and consider management practices based on ERA at Ranger to establish a baseline for Nolans	Arafura has engaged two very experienced independent radiation professionals to guide their management processes. These specialists have many years' experience in the mining industry, specifically in managing and guiding radiation management practices at Australia's most significant uranium mines. A final Radiation Management Plan prepared by independent qualified radiation professionals, detailing management practices, will be submitted for approval as part of the mining authorisation process.
459	The draft does not acknowledge imminent reforms or directions of water policy in the NT.	Arafura will conform to NT water policies, water regulations and directions by the NT Controller of Water Resources and Department of Primary Industries and Resources in respect to water resource management and development. This has been included as a commitment.
460	The proponent should acknowledge the foreseeable developments in the relevant water policy environment, and describe what role they may play over time.	Refer to UID 459.

3.15 Geoscience Australia

UID	Summary of submission	Response
56	The provision of hard rock cover material for rock armouring of TSFs, particularly in those areas that could be affected by extreme storm events, is important for stabilisation purposes, particularly in the case of radiogenic material. A suitable site from which to obtain large volume of clean hard rock needs to be located.	Waste rock from the mining operation will be used for the capping of the TSFs. It has been characterised both geochemically and radiologically and deemed to be suitable for use as a capping medium. Refer to Section 4.28.
75	How was the one metre of benign cover material reached?	Refer to Section 4.1.3.
76	Open pit remaining as a pit void. Explain whether this is best practice for mine rehabilitation. Identify measures to mitigate social and environmental issues that could result from the open pit being used as a recreation site by humans, and as	Refer to Section 4.1.1 for further discussion on pit closure. The project site would not be accessible to the public without the station owners / leaseholders consent and so the likelihood of public visitation is low and therefore the risk to public health and safety is considered low. The utilisation of waterbodies by fauna is discussed in Section 4.19.

UID	Summary of submission	Response
	a water source for fauna such as migratory birds. Will the site be fenced post closure?	The pit will not be fenced post-closure. Following closure a rock bund wall will be placed around the pit perimeter to limit access. Arafura will comply with the widely used and accepted guidelines (WA Guideline for Safety Bund Walls Around Abandoned Open Pit Mines) when closing the pit. A rock abandonment bund provides the most secure long term method of limiting access to the pit and pit lake. This has been included as a commitment.
77	“No commitments have been made by Arafura to third parties in relation to the closure of the Nolans Project”, although the proposed development has a long mine life, decommission is an important consideration and there is risk of commercial or force majeure events closing the operation prematurely.	All closure planning will be updated on a regular basis to ensure its relevance to the site. A detailed closure plan will be prepared for approval and authorisation by DPIR during the mining authorisation phase. This plan will include provisions for early closure and a care and maintenance scenario.
78	An objective of the mine closure and rehabilitation is to make the site suitable for use by future leaseholders. Explain what percentage, if any, of the site will be available for future use, such as via long-term fencing or prohibited entry requirements.	The final pit area will not be suitable for use by future leaseholders. The area of the proposed pit is about 135 hectares. This area represents around 0.003% of the Aileron Station, which is a total area of 4078 km^2. The rest of the site will be returned to pastoral activities if agreed with stakeholders and regulator.
79	Confirmation of the source for clean inert waste rock needs to be detailed.	Refer to UID 56 above.
80	Consideration needs to be given to ensure access to the pit lake is prevented. It could be hazardous is people or animals are able to access the pit.	Following closure a rock bund wall will be placed around the pit perimeter to limit access. Arafura will comply with the WA Guideline for Safety Bund Walls Around Abandoned Open Pit Mines, when closing the pit. A rock abandonment bund provides the most secure long term method of limiting access to the pit and pit lake. This has been included as a commitment.
81	The proponent’s recognition that continuous stakeholder engagement and communications will occur during rehabilitation design is noted as being an important component of the planning.	Arafura has had discussions with key stakeholders including CLC, pastoralists and the government regarding post closure land use. Ongoing consultation, including with Traditional Owners, will take place regarding rehabilitation and closure planning. This has been included as a commitment.
82	The proponent states the TSF will have a low permeability (10-8 m/s) soil liner, and in the risk assessment identifies not having enough of this material this as a risk.	An assessment of quantities required for the construction of the TSF and RSF has identified that approximately 1,550,000 m^3 of low permeable material. Further geotechnical assessment (as detailed in Appendix 2) will determine the quantity of material available within the Mine. The potential of not being able to source enough low permeable material for the construction of the TSF from within the Mine is a risk but is a financial rather than an environmental risk, and has not been included in the environmental risk register.

UID	Summary of submission	Response
		Refer to UID 499 (NT EPA) for further information on risks associated with not being able to source enough low permeable material for closure.
83	The proponent notes they will comply with relevant radioactive waste management legislation, specifically capping/closure methods in Section 2.2, however do not mention any radiation control barriers. Additional discussion could be provided about the proposed tailings and residual cover methods and likely exposure levels.	Refer to Sections 4.1.3.
84	Arafura notes the likelihood of earthquake occurring, however the proponent does not identify a time period this will occur over. The FTSF & RSFs will be rehabilitated to permanent features of the landscape, so may be affected by seismicity.	Geoscience Australia have assessed the seismic risk of the area; it is considered low. Major earthquakes are a rare event in Australia and none have been recorded in the project area. The nearest major earthquake occurred about 300 km to the north near Tennant Creek in 1988 and that area has been the focus of numerous seismic events ever since. Geoscience Australia's database of historic earthquakes (since 1955) was queried using a series of concentric search radii centred on the Nolans Bore (-22.59 and 133.24). No earthquakes have been recorded within 25 km of the mine site. Three earthquakes have been recorded within 50 km of the mine site, nine are within 100 km and 42 are within 200 km. Most of the recorded events are small insignificant earthquakes, with only five of these events within 200 km described as significant (>3.5 ML or Mb) in this database. The nearest significant earthquake had a magnitude 4.8 Mb and occurred about 38 km SW of Nolans Bore on 2/8/1968. The location of this earthquake coincides with a major E-W crustal structure in the Arunta basement rocks. This structure remains distal to Nolans Bore. Earthquake loadings in accordance with ANCOLD design guidelines will be applied where relevant for the detail design of the tailings dams and other storages, as per AS 1170.4—1993. Refer to Appendix 2 for further information.
85	The proponent notes the "Alyuen community suffered from water stress which has reportedly led to families moving…" It is unclear what caused water stress, whether there were issues with supply or quality, and how the Project may affect this situation. (The community is approximately 15 km from proposed mine site.)	Historically Alyuen, Aileron Station and the Aileron Roadhouse have had issues with the reliability and quality of their respective groundwater water supplies. The area around these locations generally has limited groundwater availability, relying primarily on fracture based groundwater aquifers, which are unreliable and generally poor quality. The roadhouse is the only one of these locations that still maintains a bore that they periodically use for garden purposes. The Aileron stations bore and Alyuen bore have not been functional for a long time, and they have relied on water carted in.

UID	Summary of submission	Response
		With the discovery of the groundwater in the Southern Basins, Arafura identified an area in the eastern end of the Southern Basins where the Central Desert Shire subsequently drilled bores to provide a reliable source of better quality groundwater. The Central Desert Regional Council, the pastoral station and the roadhouse then jointly funded supply infrastructure to provide all three locations with permanent, reliable water supplies.
86	The proponent notes it will undertake regular monitoring of groundwater for the long term sustainability. It is not clear on the time period defined by long term. Please provide clarification as to how it will be determined that the site is closed and no longer requires monitoring by the proponent.	Groundwater monitoring will be undertaken through operations and will continue until the mine Regulator issues a Certificate of Closure for the Mine. As a minimum, Arafura will commit to a period of monitoring for two years post-active mining of the pit. This has been included as a commitment.
87	The proponent states future climate change projections point to a hotter, drier climate for the WA Goldfields. This statement was referenced as a CSIRO report from Loechel et al. 2010. The reference for Loechel et al. 2010 is missing in the reference list. Additional information contrasting the climate of the WA Goldfields and the Nolans Project Area is needed so the reader can understand the similarities in the climate between the two and asses if this assumption is valid. Information from the Climate Change in Australia website suggest the Nolans area is in the north rangelands, an area which climate projections show changes to rainfall are possible and unclear. http://www.climatechangeinaustralia.gov.au/en/climate-projections/future-climate/regional-climate-change-explorer/sub-clusters/?current=RLNC&popup=true&tooltip=true	Refer to Section 4.2.
106	It would be of considerable use if the proponent could provide a table or list of work that is expected to be undertaken in following phases of work. During the EIS, comments were made about ongoing or expected work, and a list summarising this work would help to clarify.	A list of commitments that will be undertaken in following phases of the project (subject to project approvals, investments decision to proceed with the project, regulatory requirements and the like) is provided in Section 5.

UID	Summary of submission	Response
144	No description of this aquifer, including an estimate of the volume of water contained locally in the vicinity of the mine site, had been provided. However, due to the low permeability of the rocks in the area it's unlikely to be suitable for alternate use. This information cannot be found in Appendix K (Groundwater).	The extent of the aquifer corresponds to the extent of the mineralised zone. Based on the mineralisation zone and pumping test analyses completed it is expected that the aquifer is in the order of 100 m to the north, west and south and 500 metres to the east of bore NBGW819. Refer to the Hydrogeological Open Pit Dewatering Investigation Report (Appendix 6) for further information. Baseline chemical groundwater data indicates that the aquifer discharge is not suitable for human consumption (4,430 mg/L TDS). In addition, based on U and fluoride (F) levels (as well as TDS) this water is marginal to not suitable as a stock watering resource (beef cattle assumed) (Appendix 6).
145	In the Reynolds Range and in the adjacent Anmatjira and Yundurbula Ranges, there are some long-term freshwater springs. These springs are recognised to have cultural and environmental significance.	Refer to Section 4.16.
146	The EIS states that: "Temporal groundwater level monitoring should commence significantly (at least one or two years) before the commissioning of pumping to provide a background dataset and should continue through the life of the project and into closure" (page iii, Appendix K). However, the proponent has not stated specifically that they will generate a baseline dataset. Provide details on whether this dataset already exists, or if it is currently being collected or scheduled to start to be collected.	Baseline groundwater monitoring has commenced in the Southern Basin. Monitoring includes quarterly SWL surveys and water quality testing (when equipment is available). Arafura has also recently installed data loggers into eight bores to collect real time data. Refer to the Water Resource Assessment (Appendix 3) for a copy of the data. The frequency of this testing will increase as the project moves into the development phase and will comply with monitoring outlined in the Water Management Plan (Appendix 4). Monitoring, as per the WMP, will commence a minimum of 24 months prior to the extraction of water from the Southern Basins. This has been included as a commitment.
147	The caption of figure 5 is misleading, as the AEM will show conductivity, not depth. Figure 5 is hard to relate to the region as there is no clear geographic or geological underlay.	The caption of Figure 5 should state 'Geophysics (AEM) displaying point data for top of bedrock, oblique view looking West at 30 degrees with Vert Exaggeration 10 (red displays the deep and blue the shallow – see key in mAHD)' A conductance map is provide in Appendix 16. The figure is geo-referenced to provide geographical context.
148	Most figures are missing key geographic information such as hydrogeology overlay and all mine infrastructure. As such these figures are difficult to	The model figures report (Appendix K of the EIS) rely on the reader having seen the reference to the model boundary and key features presented in Figure 1 of Appendix K of the EIS. The 'hydrogeology overlay' varies layer by layer and is presented separately as relative to the model boundary (Figures 17 to 22 of Appendix K). In an attempt to demonstrate the

UID	Summary of submission	Response
	interpret. Drawdown diagrams (Figures 35–55) could include error bars.	3D geometry, hydrogeology overlay and key geographic features, a Digital Appendix has been provided to aid the EIS reader (Appendix 8). Combining all of these and mine infrastructure on water level or drawdown diagrams is not feasible as individual figures, rather the EIS reader must familiarise themselves with the boundary and mine features. The pit location and borefield extraction points were not defined on the drawdown figures, because they were considered to be self-evident by their associated point sources of drawdown. Figures 31 – 34 have been represented to include: • 0.1 m and 1 m drawdown contours (for the 2.7 GL/year scenario) • Mining infrastructure • Surface waterbodies • Groundwater users • Aerial overlay Refer to Section 4.22 for the updated figures. Error bars are difficult and costly to produce with these models, but also the use of error bars would likely be confusing/misleading with the existing model outputs. Error bars are not applicable because a stochastic analysis of model/model parameters and inputs/outputs has not been undertaken.
149	The proponent has successfully identified groundwater resources and basin geometries from the AEM dataset. There is no mention of the system, the processing or modelling conducted, nor is there any conductivity depth images (CDI) or 2D image slices of the AEM data to validate these statements. It appears there is an assumption the reader has knowledge of previous geophysical reports and datasets. Could this be attached as an appendix, or a summary of the data be provided	Groundwater was not known in this area before Arafura's activities began. There were no bores in this Cenozoic basin area on Aileron Station. The nearest bores in this basin were around Day Creek on Napperby Station. The nearest bores on Aileron Station were all in basement or shallow calcrete aquifers, with limited volume. There has long been speculation that Cenozoic basins were present in this general area, but no confirmatory drilling had ever occurred. The landforms and vegetation features evident on the satellite imagery suggested there were likely to be Cenozoic palaeochannels/basins concealed beneath the sand plains in this area. Arafura took a geological approach to groundwater exploration in the region. The detailed airborne magnetic data over the project area and the NT geological service regional airborne magnetic data were analysed and it was found that: • the magnetic surveys lacked high frequency detail in what is now referred to as the southern basins area, suggesting significant Cenozoic cover over the basement.

UID	Summary of submission	Response
		• the magnetic surveys indicated shallow basement north and south of the Hann Range – with depth to magnetic basement modelling indicating shallow to moderate depths on the western side of Arafura's dataset. • large areas of granitic basement with a general lack of magnetic character dominate further west, meaning magnetic features, which might be used to indicate depth to basement, are limited in the west. • the sedimentary units of Ngalia Basin are essentially non-magnetic and they dip north under the sands plain, and overly the granitic basement, but clearly underlie the Cenozoic basins in some areas. TEMPEST airborne electromagnetic (AEM) survey data was sourced from open file company reports, which are available from Northern Territory Geological Survey, NT DPIR (Rafferty 2008, Blair 2009, Rafferty 2009, Moore 2012). The AEM surveys were all acquired by Fugro Airborne Surveys with the details of the acquisition and processing of each survey reported in Rafferty (2008, 2009), Blair (2009) and Moore (2012). The AEM datasets were acquired as part of exploration to identify and target palaeochannels for uranium. These reports provide CDI images of all flight lines. The data was reprocessed by David McInnes of Montana GIS, using in-house proprietary software and 1D Layered Earth Inversion (LEI) modelling. The AEM data was processed station by station, using an automated process to build up and generate conductivity-depth data for each flight-line section. The five Layered Earth Inversion (5LEI) model of AEM flight-line section data was used to plan the location and target depth of drilling. Drilling has demonstrated that the estimated depths to resistive basement typically approximate the depth of the basement rocks in drilling, and the target depths are within the anticipated error. The overlying conductive units are consistent with brackish water within the overlying Cenozoic sedimentary units and the top of the conductor broadly corresponds to the top of the saturated zone or Standing Water Level in the drill hole. The conductivity-depth data was digitised to highlight the contact between the resistive basement and the overlying conductive unit. The conductance map provided in the Appendix 16 highlights the Cenozoic basin architecture, however caution is warranted as the conductance is a product of conductivity and thickness/depth. Thus, a thin unit of very brackish water will have the same conductance as a thick unit of fresh water.
150	75 water bores were drilled specifically as part of the project investigation which is a large dataset to use for early scoping. Are the locations of these bores provided on a specific map? This would help to understand the spatial coverage of the extensive work.	The location of water bores drilled as part of the Nolans investigations are depicted in Figure 3-9.

ARAFURA RESOURCES

Scale: As shown

Date: 3/10/17

Drawn: B Fowler

Map Showing Location of Groundwater Related Drill Holes Drilled by Arafura

Figure 3.9

UID	Summary of submission	Response
151	The following sentence doesn't make sense: "Combined these provides a sound dataset where formation logging is incomplete". Assume proponent means 'complete'. If incomplete, is work ongoing? Also replace 'provides' with 'provide'.	Arafura acknowledges the incorrect use of the plural 'provides' and this should have been written as 'provide'. The sentence must also be read in the context of the previous sentence, i.e. "The basin geometry for the Ti-Tree Basin has been defined by a dataset of mineral exploration drill holes and water bores. In addition, the Napperby Formation geometry has been extensively mapped and modelled." We do mean 'incomplete' because not all mineral exploration and water bores are logged to the formation level, but coupled with the mapping and modelling of the geometry of the Napperby Formation we were able to produce a sound dataset to represent the formations. The word 'sound' here refers to the definition 'based on valid reason or good judgement'. Although the formation logging is incomplete it is not ongoing as the formation logging typically is undertaken by the geologist or hydrogeologist at the time of drilling and no later access drill cuttings etc. is likely to be possible. As such, we have used what data we have to inform our basin geometries.
152	Explain if regional drill holes, not in the immediate vicinity of the mine site, were used to conceptualise mine interaction with regional groundwater flow?	Regional drill holes, not in the immediate vicinity of the mine site, were used to conceptualise mine interaction with regional groundwater flow (refer Figure 12 in Appendix K in the EIS). This was the secondary focus of the study (after conceptualising the Southern Basins borefield interaction with regional groundwater flow).
153	"Recharge throughout the Ti-Tree Basin has been the subject of multiple studies and this assessment makes use of the previous findings and estimates". Provide reference to these documents, include them as appendices or summarise them in this EIS. Please summarise the existing quantitative assessments of recharge in the mine area and into the Southern Basins bore field.	Refer Section 4.7.
154	Figure 13 Groundwater chemistry by aquifer type is inconsistent with the hydrogeological units listed in 2.3.3 (pg 10-11). Provide further clarification as to how the aquifer type relates to the lithological units.	Clarification is provided in the table below. Table 3-10Hydrogeological units related to aquifer type Hydrogeological Unit | Aquifer Type

<table>
<tr><th>UID</th><th>Summary of submission</th><th>Response</th></tr>
<tr><td></td><td></td><td><table>
<tr><td>Quaternary</td><td>Alluvial, Alluvial/Fluvial, Calcrete</td></tr>
<tr><td>Napperby Formation Equivalent</td><td>Ti Tree Basin Aquifer</td></tr>
<tr><td>Napperby Formation Equivalent Moderate</td><td>Ti Tree Basin Aquifer</td></tr>
<tr><td>Napperby Formation Equivalent High</td><td>Ti Tree Basin Aquifer</td></tr>
<tr><td>Southern Basins Tertiary 2</td><td>Reaphook Palaeochannel</td></tr>
<tr><td>Southern Basins Tertiary 2 Moderate</td><td>Reaphook Palaeochannel</td></tr>
<tr><td>Waite Formation Equivalent</td><td>Ti Tree Basin Aquifer</td></tr>
<tr><td>Hale Formation Equivalent</td><td>Ti Tree Basin Aquifer</td></tr>
<tr><td>Southern Basins Tertiary 1</td><td>Reaphook Palaeochannel</td></tr>
<tr><td>Palaeozoic Ngalia Basin</td><td>Weather Basement/Basement</td></tr>
<tr><td>Proterozoic Basement Rocks</td><td>Weather Basement/Basement</td></tr>
<tr><td>Proterozoic Apatite</td><td>Weather Basement/Basement</td></tr>
<tr><td>Proterozoic Gneiss</td><td>Weather Basement/Basement</td></tr>
<tr><td>Mine Void</td><td>Weather Basement/Basement</td></tr>
<tr><td>Deep Proterozoic</td><td>Weather Basement/Basement</td></tr>
</table></td></tr>
<tr><td>155</td><td>The proponent notes the groundwater model is a Class 1 Model and identifies for a project of this magnitude, the modelling should be upgraded to a Class 2, where classes are defined in the Australian Groundwater Modelling Guidelines 1. GA recognises this EIS presents groundwater modelling in its early stages. It would be useful if the proponent could provide details of the follow up modelling to occur and how it</td><td>Refer Sections 4.22.5 and 4.22.6.</td></tr>
</table>

UID	Summary of submission	Response
	anticipates the additional work would increase the class, and thus potentially the reliability, of the model.	
156	Arafura state there has been no sensitivity analysis conducted and there is limited assessment of the uncertainty associated with the numerical modelling. Without sensitivity and uncertainty analysis, it is difficult to understand the full applicability of the model and its appropriateness in represent the site being modelled. Please advise whether uncertainty analysis will be included in future modelling or if possible append any sensitivity/uncertainty analyses already conducted.	The EIS Appendix K states “No formal sensitivity analysis has been undertaken on the model parameters.” and “It should be noted that there is a high degree of uncertainty around the regional basement hydraulic conductivity and that the values applied reflect not the primary hydraulic conductivity, but the hydraulic conductivity of a representative elementary volume of the rock mass which includes potential fracture and fabric permeability.” An aspect of sensitivity analysis is addressed in the model calibration stage (i.e. numerous combinations of hydraulic conductivity and recharge) are applied to the model to result in the statistically best solution (for steady state water levels in this case), which is then used in the predictive work. For predictive assessment, the second of these quotes (and in part the first) is now addressed by the sensitivity run (Model 307) which applies a lower hydraulic conductivity to the bedrock parameters. Likewise, the sensitivity to the specific yield applied to the model is tested by another model run (Model 400) and the sensitivity to the borefield pumping rate is tested by another model run (Model 301 and 303). The result of these quite different model scenarios is that while all of these changes affect groundwater levels (and drawdowns) the difference in outcomes are negligible. One reason for this is there are no identified vulnerable receptors within the system. A key reason for this is that the primary driver for groundwater flow in this system and therefore the key uncertainty to address in a model of this scale is the geometry of the basement. The reason for this is that the basin sediments and sedimentary rock are indisputably orders of magnitude higher in permeability than the basement rocks. In this case, the geometry of the basement is reasonably well understood. For this reason, a decision was made early to focus on the known detail of basins geometry and materials. Admittedly, this makes the models complex (not a desired outcome for models), as does the period of time we are considering for closure. We believe; however, this approach was entirely appropriate for a system which required an understanding of the potential interactions of the influence of the borefield, the mine void and an existing water resource (the Ti-Tree Basin).

UID	Summary of submission	Response
		Elsewhere, and in different settings, sound groundwater models are presented for similar projects where no (or little) geometry, and no (or little) spatial discretisation is required to represent a groundwater regime and its response to a mining proposal. This lack of complexity allows a different approach where formal sensitivity and uncertainty analysis can be undertaken with 'relative' ease. This approach applies for example a range of possible combinations of specific yields, storativity, recharge and hydraulic conductivity values to a very limited number of materials (often only one) and can then compare the outcomes of each model (often assessing for example 100 different combinations of these parameters). It should be noted that this approach rarely presents results that are valid to a calibrated solution, rather they present a range of possible outcomes. Such an approach in our setting (and with our complex model) would be computationally challenging, expensive and time consuming. Given the result of the models we have run such an approach is not warranted. Additional modelling effort is, however, considered warranted as the project progresses: • in attempting to lower the number of parameters (i.e. group like with like); • ongoing assessment of the geometry in the models; and • calibrating the models to temporal data (including assessing and refining specific yields, storativity, recharge and hydraulic conductivity values). The ongoing assessment of the groundwater models has been included as a commitment.
157	In Table 8 there are two stated values of hydraulic conductivity for each geological formation, the PEST Calibrated and Calibrated. What field tests were used to inform these values and how much data were available to parameterise K values? It is unclear which values were used for the final predictive modelling from this table. More explanation on the calibration process is required.	Refer Section 4.22.2.
158	The proponent specifies values for specific storage and specific yield and state these were consistent. It is unclear how these values were determined. Please list the reference for this information or the data that underpins their derivation.	Refer Section 4.22.3.

UID	Summary of submission	Response
159	These studies appear to be only referring to the Ti Tree Basin. The assumption is that the Ti Tree Basin and Southern Basins have the same hydraulic properties. Has this been substantiated through data collection and analysis?	The numerical model calibrates hydraulic properties based on water levels in the Southern Basins. Pump test data and interpretations have been documented in the Water Resource Assessment (Appendix 3). An assessment of the pump test data is provided in Appendix 17.
160	No conceptual diagram has been provided for the Southern Basins bore field, yet this system is highly impacted by the project.	Figure 4 of Appendix K of the EIS provides a conceptual model of the Reaphook Palaeochannel which is where the borefield is located. In addition to this, the Southern Basins borefield area conceptual model is covered in Section 3 (Conceptual Hydrogeological Models) and conceptual diagrams for the relevant mechanisms are provided in Figures 9, 10, and 11 of Appendix K of the EIS. To aid the EIS reader further, a digital appendix containing a visualisation of the model geometry and conceptual hydrogeology is provided in Appendix 8.
161	Provision of a cross-section through the hydrogeological model would assist in understanding its set up.	Due to the broad area and significant complexity in geometry, sections through the model vary significantly. Key sections that demonstrate the key model areas have been made and represented in the digital appendix (Appendix 8). An extract from the digital appendix is presented below (Figure 3-9 and Figure 3-10). The digital appendix contains a visualisation of the model geometry and conceptual hydrogeology (Appendix 8).

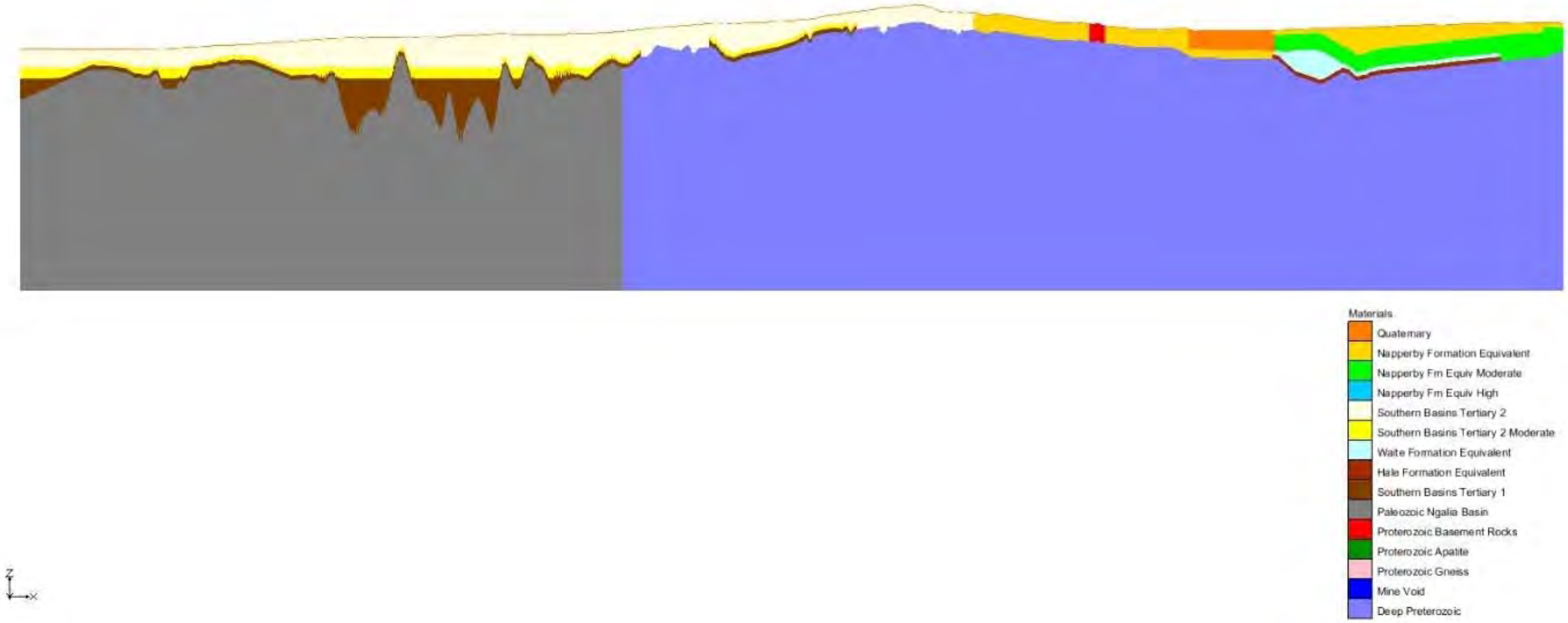

Figure 3-9 Reaphook Channel (left) through to The Margins (high point) and the south-eastern extreme of the Ti-Tree Basin (right) (West to East)

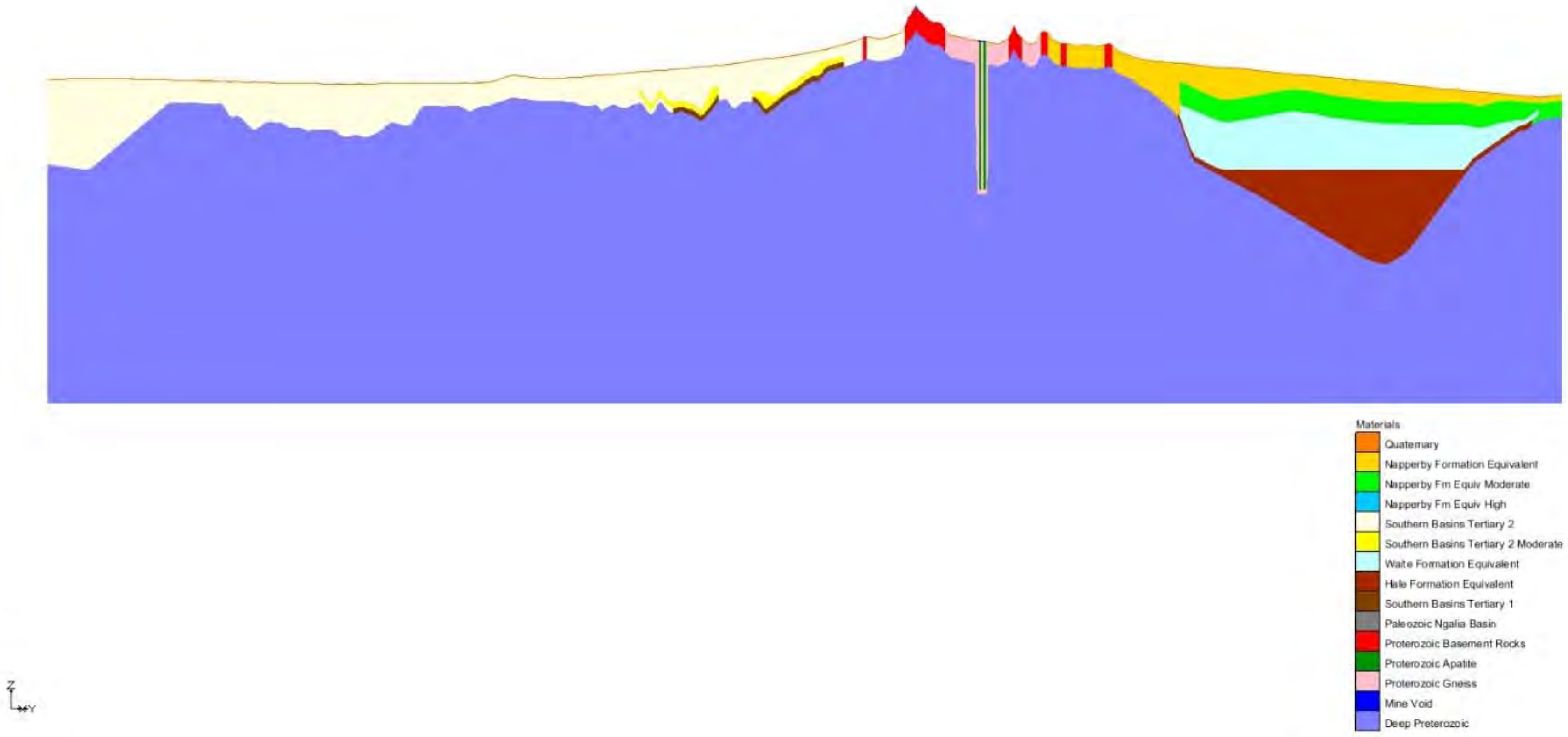

Figure 3-10 Reaphook Channel at its shallowest through to Ti-Tree Basin (Southwest to Northeast)

UID	Summary of submission	Response
162	"Existing values for hydraulic conductivity for basin materials were used as starting values and the groundwater model was manually calibrated". It would be useful if the existing values for hydraulic conductivity are provided, including a description of what tests were used to derive the values, or what previous study they were taken from.	Water Studies (2001) tabulated horizontal conductivity for a two-layer model with the following horizontal hydraulic conductivity values: • Layer 1 0.2 m/day • Layer 2 Zone 1 7 m/day • Layer 2 Zone 2 24 m/day Similar to our approach Knapton (2007) stated, that "the initial values of hydraulic conductivity, specific yield and specific storage were adopted from the Water Studies model (Water Studies, 2001)", and that calibration resulted in a reduction in the main aquifer from 7 m/day to 5 m/day. As such, our study used the following values for equivalent model areas as a starting point for the manual calibration: • Layer 1 0.2 m/day • Layer 2, Zone 1 5 m/day • Layer 2, Zone 2 24 m/day Both the Water Studies (2001) and Knapton (2007) work drew on detailed study of the Ti-Tree Basin dating back to the 1960s. The GHD study also drew considerably on these works, however, was unique in that we had valuable input from Graham Ride who had not only undertaken the first wave of that work and had followed the development of the Ti-Tree Basin for over 50 years, and had now undertaken the Southern Basins and The Margins field investigations for Arafura. From this insight, coupled with interpretation of test pumping of six bores within the Southern Basins (as documented in GHD, 2015 which is provided here as Appendix 17) we were able to make informed initial hydraulic conductivity parameter value estimations.
163	Scenarios about breaches of contaminated water from the processing site or from storage facilities have been described in this system; however no quantitative analysis such as modelling accompanies them. Will the scenarios of contamination from these facilities be explicitly modelled, and if so in what time frame?	A Failure Impact Assessment (FIA) of the TSF and included as Appendix J of the EIS. Further assessment of the potential impact of a failure of the TSF has been completed and is presented in Appendix 2 (Section 2.2.5 and Section 2.3.4). An estimate of the runout distance from the RSF, in the event of failure, has been made based on • the volume of residue contained within the RSF after 10 years of operation, • the estimated outflow volume, and • the local topography downstream of the RSF location. The estimated runout distances are considered conservative given that the RSF was considered to fail as a single cell rather than the multiple cell design that is applicable. The

<table>
<tr><th>UID</th><th>Summary of submission</th><th>Response</th></tr>
<tr><td></td><td></td><td>runout distance has been calculated at 49 km (worst-case). Refer to Appendix 2 for further detail.</td></tr>
<tr><td>164</td><td>The overview states that the hydrogeological investigation used inputs from field studies of the three sites under consideration: Ti Tree Basin, mine site and Southern Basins and Margins Area. However, the details of the field studies are not included in this document, such as what types of analyses were undertaken. This could be summarised in more detail, or relevant reports could be attached.</td><td>The following table presents a summary of the field work undertaken by Arafura that the EIS (Appendix K) drew upon.
Table 3-11 Summary of field studies
<table>
<tr><th>Area</th><th>Author</th><th>Bores Drilled</th><th>Pumping test</th><th>Slug tests</th><th>Airlift yields</th><th>Water quality locations</th><th>Water level locations</th></tr>
<tr><td>Mine Site or associated Basement</td><td>EES</td><td>10</td><td>1</td><td>9</td><td>Yes</td><td>10</td><td>2</td></tr>
<tr><td>Ti-Tree Basin</td><td>Reed and Tickell #</td><td>#</td><td>#</td><td>None</td><td>Yes</td><td>1</td><td>1#</td></tr>
<tr><td>Southern Basins</td><td>Ride</td><td>23*</td><td>6</td><td>None</td><td>Yes</td><td>31</td><td>20</td></tr>
<tr><td>The Margins</td><td>Ride</td><td>30</td><td>None</td><td>None</td><td>Yes</td><td>29</td><td>26</td></tr>
</table>
numerous historical work and mapped groundwater contours from Reed and Tickell
* not including adjacent monitoring bores

The relevant reports are also detailed in the Water Resource Assessment (Appendix 3).</td></tr>
<tr><td>165</td><td>Extraction from the bore field results in groundwater drawdown. The EIS states that existing vegetation would be capable of extending root systems during the extraction period. Has the ability of vegetation to extend their roots in this time frame been confirmed by specialist ecologists or through field trials?</td><td>The ability of vegetation to extend their roots in this timeframe been confirmed by specialist ecologists. Refer to Section 4.5 for further information on groundwater dependant vegetation and Appendix 11, Appendix 12 for an assessment of impacts.</td></tr>
</table>

UID	Summary of submission	Response
166	"…pit sump dewatering in the Ti-Tree Basin". Is the pit located in the Ti Tree Basin? Other parts of the document do not state this, and the figures including basin boundaries do not show this.	The local isolated aquifer within the planned pit, consisting primarily of the oxidised ore body and associated fracture zone and weathered rock aquifers, will be progressively dewatered as the ore is removed. This aquifer is an isolated local aquifer within the Arunta Complex basement rock, 25 km up-gradient of the Ti Tree Basin. It is not part of the Ti Tree Aquifer, and there is no evidence that any groundwater from this pit flows into the Ti Tree Basin.
167	Explain how monitoring results will be used to validate numerical modelling, and whether the monitoring design will be adapted based on modelling results (i.e. will monitoring and modelling feed into each other and be iterative processes?).	Refer to Section 4.22.6 and 4.22.7 for further information on use of groundwater monitoring results to validate the groundwater model.
168	"Monitoring will be undertaken adjacent to the point of potential contaminant discharge and at boundary locations". Sample locations should also measure potential impacts to Ti Tree Basin. Will regional bores - such as in communities be measured?	The Water Management Plan, including details of the groundwater monitoring program, is provided in Appendix 4. The positioning of monitoring bores across the borefield has been chosen to monitor both onsite and offsite drawdown of groundwater. This data will be used to validate the groundwater model and it is assumed that any impacts would be identified at the monitoring locations prior to being identifiable at community bores. Community bores have not been included in the groundwater monitoring program. One monitoring bore (MB312) has been positioned with the intent to measure potential impacts to the Ti Tree Basin (i.e. any potential connectivity through the Margins).
169	Was consideration given to impacts to stygofauna resulting from groundwater drawdown? No stygofauna studies are included in the EIS.	No stygofauna, or other aquatic invertebrates, were recorded from any of the five samples from the Mine pit or two samples from reference sites to the north of the Mine in the Ti Tree Basin. The Stygofauna Pilot Survey, including impact assessment, is attached as Appendix 15. As per Appendix 15, calcrete aquifers are known to contain significant stygofauna communities in other inland areas in Australia. No calcrete aquifers were intersected in the Reaphook Paleochannel aquifers in any of the 27 groundwater investigation bores. No calcrete aquifers were intersected in any of the investigation bores drilled into the associated Reaphook Paleochannel feeder aquifers including: • aquifers in the eastern extension of the Reaphook Paleochannel extending to near the western end of the Hann Ranges

UID	Summary of submission	Response
		• the linked “herringbone” paleochannel aquifers to the north of the Reaphook Paleochannel aquifers. Calcrete aquifers occur in the Laramba Borefield in the Paddy Well area on Napperby Station 22 km WSW from the centre of the proposed *Arafura* Borefield (RC 22 (Arafura Production Bore PB1). These aquifers were located and logged by the NTG (Knott - WRB) 1982. PWC operate a borefield obtaining the water supply for the Laramba Community from these shallow calcrete and silcrete aquifers overlying shallow basement rock (Vaughan Springs Quartzite of the Ngalia Basin). Calcrete aquifers were intersected in two Arafura water investigation bores on the boundary between Aileron Station and Amburla Station in a small paleochannel of the Northern Burt Basin which links with the main Burt Basin to the south. These bores are 25 km south of the proposed Arafura Borefields. Calcrete occurs at the surface in the south-western corner of Aileron Station and is believed to cap shallow Arunta Basement Rock NW of the Aboriginal Family Outstation. Gneiss rock outcrops at this outstation and the AEM electromagnetic images indicated shallow basement in this area. It is not known if calcrete occurs below the water table in basement lows in this area. This area is about 25 km south of the proposed Arafura Borefields. A calcrete sheet outcrops west of the Stuart Highway on the southern boundary of Aileron Station and over the adjacent Yambah Station. There are several stock bores in this area of Yambah Station that extract groundwater from calcrete and alluvial aquifers in this area. There aquifers are recharge from local infiltration and from a narrow shallow paleochannel in the NE Burt Basin. The calcrete sheet is 30 km SSE of the proposed Arafura Resources borefields.
221	Permanent soaks are known to occur in shallow alluvium along some major watercourses, including Napperby Creek and the Lander River. These are important camping and meeting places for Aboriginal people.	Refer to Section 4.16.
237	The Woodfoorde River Lineament is a possible neotectonic feature associated with reactivated basement structures. This feature lies immediately to the north of the mine site, and controls the channel of the Woodforde River for approximately 35 km. There have not been any recorded earthquakes associated	Refer to Section 4.21.

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	with this feature. This feature may represent an area in the landscape which is more susceptible to fluvial incision than the surrounding landscape.	
238	Please clarify: “Prevailing winds are from the southeast and mean monthly minimum and maximum temperatures range between 4.9 ºC in July and 37.6 ºC in January”. Clarify monthly ranges.	Update Section 7.3.2. to read …”Prevailing winds are from the southeast and mean monthly minimum and maximum temperatures range between 5.2 ºC (not 4.9) in July and 37.3 ºC (not 37.6) in January. Mean annual rainfall at Nolans site is about 310 millimetres and mean annual potential evaporation is about 2,400 millimetres.”
239	This paragraph states that the mine site is located “near the southern margin of the Ti Tree Basin”, and Figure 7-1, amongst others, shows the mine site to be some distance outside the basin. However, other appendices (i.e. X-L) state that “The mine site is situated within the Ti-Tree Basin” (Section 3.1.1).	Update Section 7.3.6 to read …”Regionally, the mine site is located outside, rather than near, the southern margin of the Ti Tree Basin (Figure 7-1).”
240	“The Margins area is considered to be a subtle groundwater divide”. There are no references for this statement and no data interpretation included to explain how it is known that the Margins represents a groundwater divide. The inclusion of groundwater head data and potentiometric surface maps would provide confidence to the statement. Additionally, no description exists for the hydrogeological conditions northwest of the Margins, in the area between the mine site and the Southern Basins bore field. Is this area an extension of the Margins? Does it also represent a groundwater divide?	Refer to Section 4.8.
241	Description of groundwater recharge is provided but it does not include references or data. Describe data analysis underpinning assumptions about recharge rates.	Refer to Section 4.7.
242	Monthly rainfall and evaporation values correspond to an average year. However, by using extreme values, a sense of worst-case conditions could be evaluated. Show how the system could be further stressed if it receives low rainfall and high evaporation. This is	Refer to Section 4.7 for further information on aquifer recharge and the recharge assumptions in the groundwater model.

UID	Summary of submission	Response
	necessary due to the highly variable climatic conditions experienced between years.	
243	While hydraulic gradients will be from the WRD to the pit void during dewatering, it is not clear what the potential for throughflow of contamination from the WRD via the pit is. Clarification that the pit lake will entrain all or most contamination from WRD should be provided. 8.5.3 outlines that the majority of the flow from the WRD and TSF areas will be redirected to the pit void.	Drawdown associated with the pit post-closure is detailed in the Groundwater Report (Appendix K of the EIS). The drawdown contours illustrate that all WRD and TSF are located within the drawdown cone (refer Figure 34).
244	Flow in the hyporheic zone immediately below the streambed may represent a potential contaminant pathway in the "surface water" system. However, it is assumed that streams are sites of potential recharge to the local and medium scale groundwater systems (that is, the streams are disconnected losing streams). In the event of a containment failure, therefore, there is the potential for contaminants to enter the groundwater system via the stream beds. This information is not discussed here. While this is a low likelihood pathway (except in extreme flood events) it warrants discussion. This is separate to seepage risk and monitoring (8.5.5), which is well articulated.	Refer to Section 4.17
245	"Should overflow from tailings and residue storage facilities occur during dry conditions then contaminated outflow would seep into the shallow alluvium of adjacent local creeks. Anecdotal evidence suggests that subsurface flow occurs within the alluvium of creeks and this could presumably provide a path for the dispersion of contaminants". Does the proponent mean "during wet conditions", rather than "during dry conditions"? It is assumed that the proponent will undertake modelling to confirm that the design of TSF and RSF will not result in overtopping that includes scenarios of high rainfall events.	Yes – it should be "during wet conditions", rather than "during dry conditions". TSF and RSF will be constructed to an acceptable engineering standard and will meet the ANCOLD standard for tailings storages. Accordingly, there will be allowances for freeboard in accordance with these design standards and design criteria. Given the location of the project in an arid setting with relatively low rainfall, the likelihood of overtopping are considered rare. When determining the criteria for freeboard it is intended that a conservative approach will be adopted to increase the safety margin and thereby lowering likelihood of such an event. Refer to Appendix 2 for further detail on the TSF and RSF design framework.

UID	Summary of submission	Response
291	Although at low risk of earthquake hazard, it would be remiss of GA not to mention these events. This may have a bearing on the design of the bore field, and more broadly feed into the ANCOLD risk rating for the RSF and TSF.	It is standard industry practice to design all facilities in accordance with engineering standards i.e. ANCOLD. This will include ensuring that facilities and structures account for seismicity in their respective designs.
321	Provide detail of erosion/landform modelling be undertaken to ensure that the rehabilitation design does not allow for eventual long-term exposure of contaminants via runoff, flood or wind erosion.	Landform modelling has not yet been completed as detailed design has not been undertaken. This work will be completed once mining commence when representative waste rock is available for the test programs. The design programs will also include landform modelling. Landform modelling will be undertaken and incorporated into the Closure Plan. This has been included as a commitment.
372	A wash down area and a wheel wash facility is detailed for vehicles that come in contact with radiation – is there an additional protocol to minimise the crossover of vehicles from radioactive areas to the outside? For example there could be provision for dedicated in-mine vehicles.	As part of the plan, both design and operational controls for radiation are considered. A conceptual RMP has been developed and is presented in Appendix X - J. In section 2.5 of the conceptual RMP, a description of vehicle cleaning facility is provided i.e. The following general operational controls will be implemented for radiation management; • All maintenance work (including identified clean-up work) within a Controlled Area will be carried out under a Radiation Safe Work Permit. • Equipment exiting the Supervised Areas will first require formal decontamination clearance. This will require a concreted clean-down area with water supply and sump. • All workers working in the Supervised Areas will shower at end of shift before leaving the site. Change rooms will be located at a Clean / Dirty boundary. Work clothes will be laundered on site, with a laundry located adjacent to the main change room. • Movements of vehicles through the Clean/Dirty boundary will be kept to a minimum, with wash down bay and facilities provided.
373	Nolans is a significant uranium resource, in the top twenty identified in Australia. Following REE ore beneficiation, uranium will go to tails and be deposited in the TSFs, leaving a significant, potentially mineable resource	Noted.

UID	Summary of submission	Response
374	Radiation risks are dealt with in Chapters 5 and 12, however, Risk Table 11-1 doesn’t reference this risk. Table 12-20 indicates that Radon and Thoron decay monitors would rotate between off-site locations. Processing represents a unique risk due to decay causing the build-up of 227Th and 227Ac decay chain daughters after a few months, and what may have been considered “safe” at one time subsequently presenting a radiation risk.	Chapter 11 states that the assessment did not include human health and safety risks associated with radiation exposure and that these are addressed separately in Chapter 12 and Appendix P of this EIS. These radiation risks are also detailed in the Environmental Risk Register (Appendix F of the EIS). Th227 and Ac227 are decay products of the U235 decay chain. In nature, the average U235 concentration is approximately 0.7% by mass (and approximately 4% by activity concentration) of the uranium concentration. Therefore, since the ore contains on average approximately 200 ppm uranium (approximately 2.5 Bq/g), there will be approximately 0.1 Bq/g of the radionuclides in the U235 decay chain. These are relatively low levels. Th228 and Ac228 are decay products of the Th232 decay chain and will be present in the ore. The average Thorium concentration is 2,700 ppm, which equates to approximately 10 Bq/g of each of the radionuclides in the thorium decay chain. Arafura conducted preliminary analysis of the process flow sheet and determined a radionuclide balance across the process plant and this is shown in Table 8.2 of Appendix P of the EIS. When considering the radionuclide concentrations in a process flow, it is important to recognise that the build-up of the shorter-lived decay products in the U238, Th232 and U235 decay chains can only occur if the parent radionuclides are present. For example, ingrowth of Ac228 from the Th232 decay chain requires the parent Ra228 to be present. The final activity concentration after ingrowth is limited by the activity concentration of the parent radionuclide. When conducting radiation assessments, the methods also conservatively assume that the shorter-lived decay products are in equilibrium with the longer-lived parent. A Radiation Management Plan (Appendix X – J) outlines the monitoring program that would identify areas where radiation levels may be elevated.
375	The Bush Tucker Assessment states that consumption in the area is unlikely. The report would benefit from additional community input/evidence for this case; this in turn would help substantiate a low risk of community access to the site generally as indicated in Chapter 16, Heritage.	Noted. Onsite meetings with Traditional Owners to discuss the management of archaeological sites and/or sacred sites prior to any works being undertaken and the likelihood of bush tucker consumption from the mine area. This has been included as a commitment.
376	Mineral resources are defined for REE, phosphate and uranium. GA recognises that there is currently no market for thorium, but an estimate of this resource would add to the report and clarify likely thorium	Due to restrictions relating to the JORC code, Arafura is unable to provide a resource estimate, but we can confirm that the deposit contains about 150 Kt of thorium.

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	volumes to TSF. (Note - Appendix X_J 2.2 confirms thorium content as 2700 ppm Th).	
377	Potential exposure in pit, from ore and waste rock stockpiles and tailings are listed. Circuit and product decay chain radiation exposure should also be listed, noting Table 11-1 comment above (build-up of 227Th and 227Ac decay chain daughters).	Refer to UID 374 above for further information on decay chain radiation exposure at the process site.
461	Embankment piezometers and survey pins, with regular dam inspections are supported. It would be good to also include piezometers immediately adjacent to and outside the toe of the dam walls, to provide further assurance that seepage was not occurring. Could be part of the nested groundwater monitoring network outlined in 7.6.2 and 8.6.	The TSF and RFS embankments will be fitted with piezometers to enable monitoring of phreatic surfaces within the embankment. Further seepage detection bores will be located external from the dam walls. These monitoring bores will be sited outside the toe to the dam walls and at periodic intervals to pick up seepage, and at each location where there is potential risk of seepage as identified from examination of the stripped bedrock below the walls and observation of strata in keyed trenches (cut-off trenches). These bores are designed to provide data which may indicate seepage water is failing to report to the waste facility underdrainage system and would become redundant post closure. Refer to the Water Management Plan for specific locations (Appendix 4). Daily inspections will also be completed to inform the management of the tailings dam, and annual dam safety inspections will be completed by a suitably qualified person to inspect all the aspects of the dam, which includes the geotechnical stability of the dam and seepage. This has been included as a commitment.

3.16 NT EPA

UID	Summary of submission	Response
470	Provide details of what the design volume of ‘event ponds’ will be compared to flow rate in pipelines, in the event of a major pipeline failure (i.e. how long can pipeline failure be contained?).	The slurry pipeline will be approximately 8 km long and contained within a bunded corridor. It is proposed that the event ponds will be sized to contain 4 hrs of pipeline flow, which is in the order of 400 m3, and additional containment is provided with the bunded corridor. The slurry within the pipeline will essentially consist of ground rock material, which is not chemically modified, low in metals and geochemically stable. Leakages will be detected with flow and pressure sensors on a telemetry system, which will constantly monitor and compare input and output. Abnormal variances in the flows and pressures will automatically shut down the pumping system and trigger a maintenance alarm. Operation of the pumping system will include daily inspections of the pumps and the pipeline to proactively identify and repair emerging issues.
471	Why is impact of failure classified as ‘minor’ for environment? States that both the TSF and RSFs will have ‘low permeability soil liner’ – provide clarification on what constitutes ‘low permeability’? States that ‘Detailed chemical characterisation of these process residues is in progress.’ The ‘Supplementary Tailings and Residue Report’ provided by the Proponent on 8 July 2016 includes results of geochemical testing of four samples, including two tailings and two process residues. There is no justification provided to demonstrate that this number of samples is representative of these materials and therefore neither is the conclusion that they do not represent a significant risk of acid/contaminant generation. It is not appropriate to develop a TSF/RSF monitoring program ‘during operation’ – this needs to be developed prior to commencement of operations and as part of the EIS assessment, in order to demonstrate	Part A It was determined that a failure of the TSF would result in a local short term decrease in abundance of some species with no lasting effects on local population. The process being used to beneficiate ore does not require the use of toxic chemicals to concentrate the phosphate and rare earths, and the natural elements within the tailings are not readily bio available. A breach of containment would result in short term, localised impacts until the material was cleaned up and recovered but recovery would be achieved in a relatively short timeframe. Part B Low permeability materials are clay-like material (clay/silt fraction greater than 30% and Liquid Limits greater than 30% and Plasticity Index greater than 20%) with minimum 1 x 10-8 m/s permeability. The specified compaction for the low permeability materials is minimum 98% of the standard maximum dry density at – 1 % to + 3% optimum moisture content. Compaction tests will be completed on each layer and minimum one test for every 500 m^3 compacted in place (refer Appendix 2). Part C Tailings samples are rarely available in the EIS stage in any mining project. However, additional confidence in the beneficiation tailings can be derived from Stage 1 and Stage 2 samples of mineralised material, which will be the same as tailings but with lower rare-earth minerals. Arafura will repeat the testing program previously done on the new PAPL tailings and residues when these are available to confirm previous results. This will be done in mid-2018. Refer to Section 4.23 for further information.

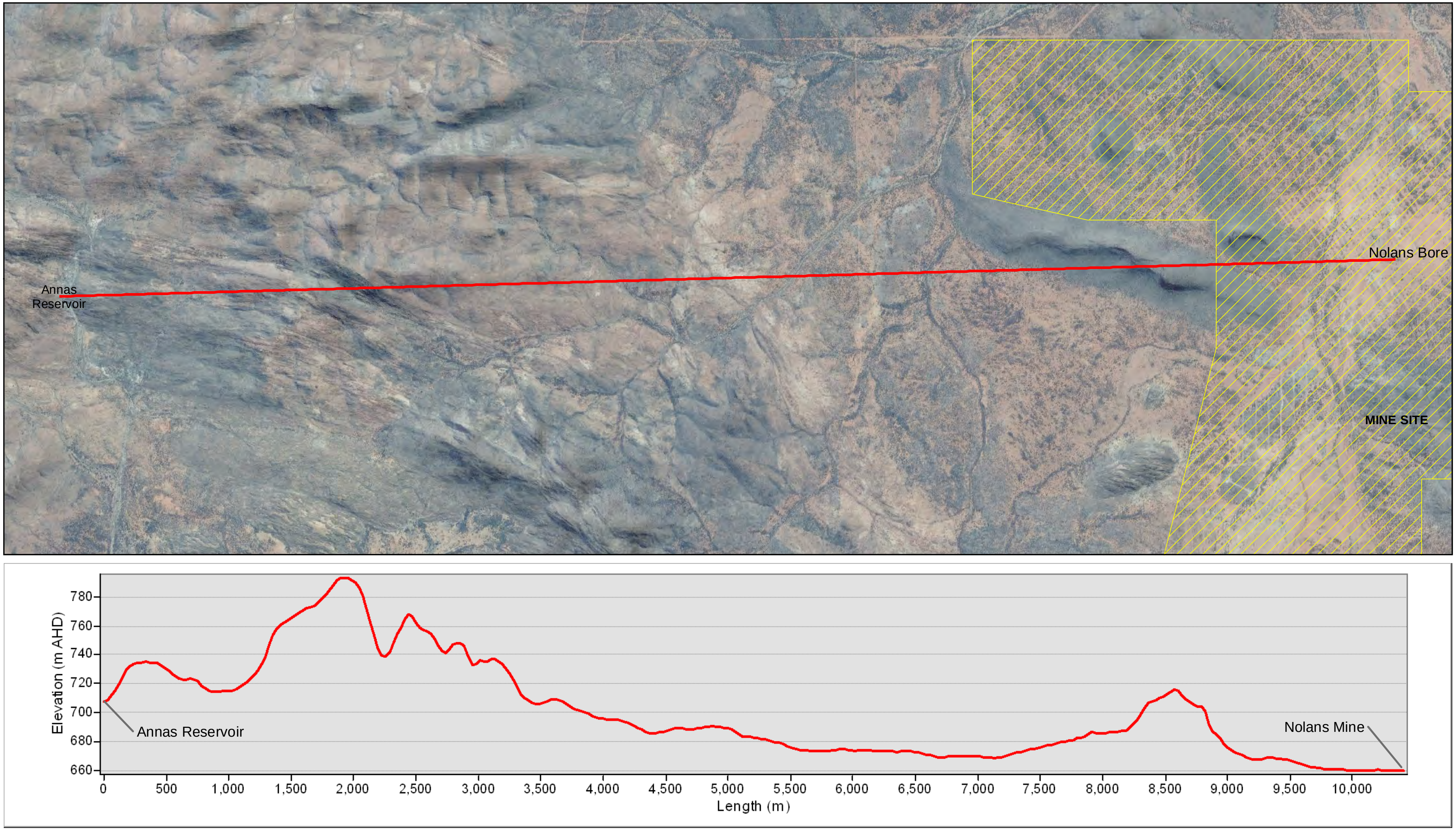
UID	Summary of submission	Response
	that potential impacts will be monitored adequately. The EIS Terms of Reference (Section 3.1.9) specifies that a residue/tailings management plan is required for assessment. 'It is proposed that the TSF and RSFs will be progressively covered with a layer of benign stable rock during operations if practicable to limit the area of exposed residues.' What factor(s) would determine 'if practicable' in the above statement?	Part D A draft Operations and Management Manual for the TSF is provided in Appendix A of the Tailings Management Plan (Appendix 2). The Manual includes details relating to the inspection and monitoring of the TSF/RSF infrastructure. The Manual will be finalised prior to the commencement of operations and will form part of the MMP submitted to the Regulator for approval. For further information on the monitoring associated with unintentional seepage from the TSF/RSF refer to the Water Management Plan (Appendix 4). Part E The progressive covering of TSF is the preferred operation. Progressive covers will be used if the TSF is a multi-cell design, however, if the TSF is a single cell is then it is not 'practicable' to progressively cover the facility and the TSF will be covered during the closure of the Mine.
472	States that waste rock will be 'quickly classified into its respective category (radioactive or benign) by the truck passing under a sensor'. Is the proponent able to confirm that there is equipment available for screening of rock in mine trucks that would accurately distinguish whether the radioactivity is above/below 1 Bq/g, taking into account the potential for shielding of radioactive materials by benign materials within the truck?	Section 3.5.5 of Chapter 3 of the EIS describes the general method for identification and management of materials containing radioactivity concentrations greater than 1 Bq/g. An initial indication of the material will be provided by the grade control management system and this will be confirmed via two radiometric analysers. The gamma radiation from each truck will be measured and will be used to direct the truck driver to the correct area for delivery of the load. Each truckload of material will be directed to the ROM pad, the stockpile or the WRD. This methodology is in use at other facilities in Australia and such equipment will be procured for use at the Mine. This has been included as a commitment.
473	The baseline geochemical sampling undertaken is deficient. According to Appendix L - Table 5, the total number of samples that underwent laboratory analysis (including ABA/NAG) was 154; a small proportion of the desired number of samples that would be needed to meet the 'rule of thumb' for a geochemical assessment to be 'quasi-representative', as specified in Section 4.2.1. This number of samples is also substantially less than the recommended additional 853 'pre-production' samples specified in Table 16. The 'Supplementary Tailings and Residue Report'	Part A, C and D Refer to Section 4.27 and Appendix 16 for further information on additional test work completed for AMD and waste rock, respectively. Part B Refer to Section 4.23 for further information on tailings and residue characterisation.

UID	Summary of submission	Response
	provided by the Proponent on 8 July 2016 includes results of geochemical testing of four samples, including two tailings and two process residues. There is no justification provided to demonstrate that this number of samples is representative of these materials and therefore neither is the conclusion that they do not represent a significant risk of acid/contaminant generation. Given the inadequate number of samples that have been assessed for AMD potential, the conclusion in Section 5.1.5 that the level of AMD risk is 'medium' is not adequately supported. While the risk of AMD may well be medium or low with 'appropriate design and operational control measures' as concluded in Appendix L – Section 5.1.5, details of these need to be provided to demonstrate this is the case.	
474	Comparison of leachate data with ANZECC default guideline trigger values for 99 % ecosystem protection is not appropriate for this environment, as they were derived for highly sensitive ecosystems in the tropics; not ephemeral/episodic streams in arid environments. Comparisons against site-specific trigger values (based on local reference data) would be more appropriate but in the absence of these, leachate data presented in Appendix L - Table 9 should also be presented against ANZECC 80% and 95% hardness-modified trigger values to provide additional context.	Refer to Section 4.26.2.
475	The stated water demand for dust suppression is 267 ML/y, which according to Appendix I is based on 242 ML/y for 30 km of haul roads and 25 ML/y for the crusher. It appears that this could be an under-estimate, as it may not include water required for dust	Part A The stated haul road distance in the EIS requiring watering was incorrect. Roads requiring regular watering are limited to mine haul roads, pit ramps, floor, and the ROM pad and access road from the mine to the processing site. The total linear distance of haul roads

UID	Summary of submission	Response
	suppression for other areas of infrastructure (e.g. camp, ROM pad, active areas of WRDs etc.)? Appendix I Figure 4-1 shows that 242 ML/y for dust suppression will be available from 'RO Plant reject'. What would the quality of this water be and would it pose any risk to surface and/or groundwater if any contaminants (e.g. salts) are mobilised as run-off from roads and other areas during rainfall events? Appendix I Figure 4-1 also shows up to 1500 ML/y from pit dewatering going to dust suppression, which would likely exceed demand. This is contradicted by Appendix I Section 5.3, which states on one hand that water in contact with ore (including pit water) should not be allowed to leave the site but on the other hand, states that water used for dust suppression on internal roads would be classified as 'clean water' that is suitable for release to the environment. This should be clarified and if pit water is to be used for dust suppression, it needs to be demonstrated that this poses a low risk of contamination to the environment.	requiring dust suppression is approximately 12 km. Access road to the project, camp and processing site will be bitumen. The updated water demand for dust suppression is: • 18 ktpa for crusher plant • 60-90 ktpa general dust suppression It is expected that this demand will be met from mine dewatering (60 – 90 ktpa). In the very unlikely event that insufficient water is available to meet water requirements for dust suppression requirements, some additional water will be drawn from the borefield. If excess water is produced this will be used in the beneficiation process and will reduce the amount of make-up water currently being input from the Southern Basins and will report to the return water pond (refer Section 2.11.1). <u>Part B</u> Wastewater from the desalination plant will not be used for dust suppression. Wastewater will now report to a brine pond for management via evaporation. <u>Part C</u> The expected quantity of water sourced from mine dewatering has reduced from 1090–1500 Mlpa to 120–250 ktpa. This updated figure is based on a 6-8l/s pit inflow rate (the rate detailed in the Groundwater Report Appendix K of the EIS). All available water from dewatering of the mine will be recycled and utilised for construction and/or operational activities including dust suppression, beneficiation processes or in the intermediate plant (refer Section 2.11.1). Available water at site, including pit water, will be used to offset demand for water from the borefield in the Southern Basins. Section 5.3 outlines that 'clean water' includes water which originates from groundwater sources and meets at least stock water standards, will be used for dust suppression. If the water from dewatering does not meet these standards then it will be directed to the Return Water Pond or used for dust suppression at the crusher plant. Water used for the purpose of dust suppression will meet the criteria outlined in the Water Management (Appendix 4).

UID	Summary of submission	Response
476	Pit dewatering appears not to be planned to be utilised in processing, only dust suppression – does an alternative exist to internalise this water source for use in processing, to reduce Project demand on the borefield? How long would pit dewatering continue to produce a water supply? Table 7-4 appears to indicate that the bore field will not be required until Stage 5 – is this the case and if so, how many years following commencement of mining may this be?	The updated water balance is provided in Section 2.11.1. Mine dewatering reports to both dust suppression and the beneficiation plant (through the return water pond). Up to 2040 Mlpa of water from mine dewatering can be utilised in the beneficiation plant. Dewatering will commence prior to mining. The predicted water supply from the pit has been very conservatively modelled and the volume in storage is likely to have been significantly overestimated. Storage facilities are part of the site management infrastructure and these would be used if required as temporary holding facilities (i.e. turkey's nests). Pumping of the borefield will likely occur pre construction, and slowly ramp up during construction. Over a 3-4 year period the borefield demand will gradually increase. Full demand is unlikely to be required until late 2020 early 2021. Further borefield investigation will be done in the development phase of the project, prior to the construction phase, to locate the best positions for the proposed production bores within the proposed borefield areas.
477	Locations of surface water drainage in relation to proposed mining infrastructure shown in Main EIS Figure 7-2 do not match those shown in design drawings in Appendix E. Provide clarification of proposed mining infrastructure in relation to surface water drainage and if this differs from that shown in Appendix E, the design drawings should be updated to allow assessment of proposed locations in relation to existing drainage lines. It is stated that a turkeys nest will be required for storage of surplus pit water in early mine life. Appendix I Section 4.4 (Surplus water) states that the capacity will be 12 ML, equivalent to three days of dewatering. Is this capacity sufficient to manage periods of rainfall, or would pit de-watering need to be suspended if this occurs? The proposed location of the turkeys nest does not appear to be shown on any of the maps presented in the EIS. Proposed WRDs 3 and 5 appear to be located within the paths of existing drainage lines and mitigation measures to address the risk of flooding and potential issues resulting from ingress of surface water flowing	<u>Part A and C</u> There are discrepancies between the surface water drainage lines presented in Figure 7-2 and Appendix E of the EIS. This is a result of the generalisation of the mine site and processing site footprints in Figure 7-2 and the use of higher order waterways. WRD 5, proposed in the EIS, has now been removed from the mine design. Since submission of the EIS, a new concept mine layout has been developed for a LOM 55. WRD 5 is no longer proposed. However, temporary topsoil stockpiles may be placed in the former position of WRD 5, but either side of the creek. WRD 3 has been reshaped and renamed WRD4. Refer to Figure 2-1 for the updated layout. A framework to further refine WRD concepts is provided in Section 2.10.1. WRD and stockpiles no longer intercept existing drainage lines. Refer to the updated flood modelling provided in Section 4.14.1. The design of the former WRD 3/now WRD 4 and stockpile areas will include clean water diversions upslope, to divert water around the WRD/stockpile area (refer Water Management Plan – Appendix 4). These diversions will flow under gravity (i.e. no pumping). Where necessary, the design of the WRDs/stockpile areas will be modified to allow these clean water diversions to be constructed to allow gravity drainage. Refer to Section 4.10 for further information on the surface water management system that will be applied. <u>Part B</u> The turkeys nest dam is to be located outside of flood affected areas, and adjacent the pit, with the exact location to be confirmed during the detailed design phase. Excess water from a rare storm event will be retained in the pit.

UID	Summary of submission	Response
	into WRDs (e.g. contamination of surface/ground water) include construction of diversion drains on the upstream side of these WRDs. However, it appears from contours presented in Figure 7-6 that there may be some design constraints for these drains, particularly for WRD 3. The proponent needs to demonstrate that the WRD diversion drain construction is feasible and does not create risks associated with flooding, erosion and water quality. Appendix I – Figure 3-4 shows ~25% of days have some flow in the Woodforde River. How long do pools persists near the mine-site and processing plant after flow events?	Part D Out of channel ponding areas could persist for a short period following rainfall, however this period is expected to be relatively brief as: 1. The large rainfall events that would potential produce such ponding occur during the wet season, which also includes higher evaporation rates 2. The potential ponding areas are expected to be relatively shallow. The high evaporation rate combined with the relatively shallow depths of ponding mean that the potential areas of remnant ponding are expected to dry out within a few days following the rainfall event.
478	Appendix I – Section 3.3.1 states '… distinct creeks which eventually drain into the Southern Basins and Lake Lewis 70 km to the west..' However, Figures 2.6 and 3.3 do not appear to show this connection with Lake Lewis. Anna's Reservoir (mentioned in Section 16.3.2) does not appear to be described in EIS sections on surface or groundwater, or biodiversity. The Heritage site is described as a permanent waterhole, ~10km from the mine site. Describe its hydrological basis, biodiversity values and current status? To what extent could the Project impact on the hydrology and other values of the site?	Part A Refer to Section 4.3.1 for further discussion on the hydrology of Lake Lewis. Part B Anna's Reservoir is a rockhole and, by definition, a permanent or semi-permanent water body in bedrock that is recharged by rainfall only. These features are permanent above the deep groundwater water table and have no or limited interaction with (i.e. they may provide recharge to) the deep groundwater. As illustrated in Figure 3-11, Anna's Reservoir is located in the Reynolds Range about 10 km west and topographically 50m upgradient of the Mine site. Surface water (i.e. rainfall) recharge will not be impacted by the Mine site. Impacts to Anna's Reservoir are consider highly unlikely and therefore the water body has not been assessed further.



1:40,000 @ A4

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

LEGEND

▬ Existing Roads	▭ Borefield Area
▬ Long Section	
▨ Study Area	

Arafura Resources Limited
Nolans Project

Job Number	43-22529
Revision	0
Date	13 Oct 2017

Landscape profile from Mine Site to Annas Reservoir

Figure 3-11

G:\43\22301\GIS\Maps\4322529_010.mxd

Data source: GA - Placenames (2015). ESRI - Shaded Relief (2009). ARL - Water Bores, Proposed Mine Site (2015). Google Earth Pro - Imagery (Date extracted: 12/10/2017). Created by: CM

UID	Summary of submission	Response
479	Locations of baseline surface water sampling sites should be shown on a map. The Water Management Plan (WMP) states that baseline surface, groundwater and sediment monitoring is to be undertaken over a 30 month period prior to commencement of operations, which will facilitate development of site-specific trigger values. While it is acknowledged that surface water flows are sporadic, short-lived and therefore challenging to sample, it is considered an omission that the proponent does not appear to have collected any surface water data on site to date, given that a Notice of Intent was submitted for the project in 2008. No baseline stream sediment sampling appears to be have been undertaken either, which does not depend on surface flows. The proponent should confirm whether this monitoring program has commenced and if not, provide specific commitments and details in relation to: • when the program will commence • baseline surface water, sediment and groundwater monitoring locations • for groundwater monitoring locations - if bores are yet to be installed, when this is to occur • how the proponent will ensure that surface water samples can be collected in response to the sporadic and short timeframes of flows (i.e. logistics).	Further information on surface water sampling, including sampling locations and the results of sampling completed to date, is provided in the Water Resource Assessment (Appendix 3). Refer to the Arafura Water Database for a copy of all water monitoring data (Available on request). An updated and peer reviewed Water Management Plan is provided in Appendix 4. The Water Management Plan details the groundwater, sediment and surface water monitoring program including: • Locations • Frequency • Analytes The monitoring program will commence 24 months prior to the commencement of operations. This has been included as a commitment. Sediment sampling has been undertaken for exploration purposes and can be utilised for the development of a baseline. Arafura has installed 23 hydrographic stations and include the installation of 31 rising stage samplers. 6 samplers were washed away during 2016-17 wet season and will be re-established (refer Appendix 4).

UID	Summary of submission	Response
480	Has any consideration been given to the source(s), volumes and timing of availability of rock-armouring materials proposed for protection against flooding? The Kerosene Creek Diversion – Concept Report (Appendix A of Appendix I) identifies that there are some 'significant design constraints' in relation to the preferred diversion option D, including a limited slope (i.e. 0.1 % - almost flat) that is likely to result in issues with sediment deposition in the channel. It is stated that this could result in the flood immunity for the pit decreasing over time and recommends further hydraulic modelling to optimise the slope and cross-sectional geometry of the diversion to balance sediment transport. A further design constraint identified with the Kerosene Creek diversion is that it traverses a saddle, which would require deep excavation of 12 – 16 m depth over an 800 m section of the alignment and >6 m depth over a 2 km section. Such a deep excavation into rock may significantly alter the morphology, hydrology and possibly the water quality of the stream (e.g. create pools of water where they wouldn't have occurred naturally, evapo-concentration of any contaminants, geochemistry of rock in channel walls may impact water quality, etc.). Also, with such steep sides (i.e. 3V to 1H batters), the diversion may result in the risk of wildlife becoming injured/trapped.	Part A Yes – benign waste rock will be available from the pit at the commencement of mining (which is when the diversion will be constructed). Part B Refer to Section 4.15 and Appendix 13 for further detail on the diversion design. Appendix 14 details the Diversion Management Plan. Part C Updated hydraulic modelling for the diversion is discussed in Section 4.15. The environmental risk register will be updated after the completion of detailed design. This has been included as a commitment.

UID	Summary of submission	Response
481	The following environmental objective stated in EIS Terms of Reference Section 5.3.1 has not been adequately addressed: 'Proposed creek diversion(s) will maintain equivalent ecological functionality of the waterways, and minimise impacts to linked riparian and aquatic ecosystems for the short and long term.' The above information gaps pertaining to risks associated with modified morphology, hydrology, water quality and potential effects on wildlife associated with the proposed Kerosene Creek diversion channel need to be addressed further and where appropriate, additional mitigation measures proposed.	Refer to Section 4.15 and Appendix 13 for information on the design of the Creek diversion and further discussion and potential impacts. A Diversion Management Plan has also be developed and is provided in Appendix 14.
482	a) General It appears that the TSF and several of the WRD's are located above existing drainage lines on the mine site. What options have been considered in relation to the locations, configurations and/or design of WRD's and TSF to minimise the risk of the formation of preferential flow paths associated with construction over the top of existing drainage lines? Under what scenario could the mine / processing plant offsite discharges impact as far downstream as Lake Lewis (sensitive receptor)? How long do rivers south-east (unmapped in EIS) of the processing plant hold water after significant rainfall? If they occur, how far away are the pools from the processing plant? b) Waste rock dumps Although it appears that there will be limited opportunity for seepage to reach the base of WRDs due to low rainfall, there needs to be at least some idea of water infiltration and retention to demonstrate a low risk of contaminated seepage entering the underlying soils/groundwater. The WRDs should be	<ins>Part A</ins> WRD 5, proposed in the EIS, has now been removed from the mine design. Refer to Figure 2-1 for the updated layout. WRD and stockpiles no longer intercept existing drainage lines. Refer to the updated flood modelling provided in Section 4.14.1. Sunny day and flood event dam break failure for the RSF has been provided in Appendix 2. A RSF failure will not reach Lake Lewis or 'rivers to the south-east'. <ins>Part B</ins> Also refer to Section 4.25 for further information on the chemical and physical properties of WRD seepage and Section 4.27 for further information on the low likelihood of AMD. All dumps will have toe drains and sediment retentions structures (See Section 2.10.1 and 4.10) The final WRD design will be determined adequate test work can be completed on the typical waste rock. The test work program and final design will be detailed in the MMP and will be submitted to DPIR for approval. Then, once the WRDs are revegetated, evapotranspiration from vegetation will further limit the likelihood of infiltration and seepage to surface or ground water.

UID	Summary of submission	Response
	designed to ensure that any seepage that reaches the base does not infiltrate into groundwater or flow to surface water. This involves specifying the infiltration properties of the basement (and if appropriate, covers) material, not 'depending on the properties of the materials used' and this in turn will require determination of the volumes and sources of appropriate materials.	
483	TSF and RSF's These facilities may require spillways to prevent catastrophic failure in the event of an overflow during an extreme rainfall event, although this does not appear to be explicitly stated anywhere in the EIS. TSF drawings in Appendix E specify 'breaks in safety bund at 50 m centres (to allow drainage of rainfall runoff)' but there are not details of design/construction requirements to ensure these structures would be stable and prevent erosion that could result in a complete wall failure. Section 4.3 of Appendix I states that 'the design should be revisited in more detail to obtain a more robust check of storage areas and embankment heights'. This information should be provided, so that the proponent can demonstrate that there is no risk of overflow from storage facilities on site. Given that supernatant water in the RSF cannot be recycled, what is the proposed management of excess water to maintain water levels and processing operations in the event that the maximum capacity is exceeded at any given time? Under what site conditions and/or rainfall scenario could this occur?	<u>Part A</u> The risk of overflow is accounted for in terms of design in accordance with ANCOLD guidelines and industry best practice, failure impact assessment scenarios and operation framework. As stated in Appendix 2, a spillway design consistent with ANCOLD requirements and industry best practice has been provided to prevent overtopping of the embankment crest during extreme or unexpected events. ACTW undertook a Failure Impact Assessment for TSF for a sunny day and flood failure event. Refer to Section 4.12 for further discussion. An Operations and Management Plan framework prepared by Arafura (included as an appendix in Appendix 2), provides an indication of the commitments, standards and management practices for the operation and management of the TSF. <u>Part B</u> Refer to Appendix 2 for further information regarding the framework that will be applied to design the TSF and RSF. When detailed mine design is completed a full assessment will be done and the appropriate rating will be applied which will be used to inform the TSF design. This rating will influence aspects of the design like the freeboard the storage must contain e.g. a 1 in 100,000 annual recurrence interval (ARI) or probable maximum flood (PMF) 72-hour event. <u>Part C</u> The process residues has reduced as a result of the changes from a SAPL to PAPL process; however, the footprint of the RSF has increased to increase the quantify of water of evaporated. As discussed, all storage facilities will be designed to ANCOLD Guidelines (including freeboard requirements). The current piloting program to characterise tailings and

UID	Summary of submission	Response
		residues is anticipated to be completed in early 2018. The required test work will then be done to enable ANCOLD assessment and detailed design to be completed.
484	TSF and RSF's (cont) What is meant by 'low permeability liners' i.e. what level of permeability is considered acceptable, as it is stated in Appendix K Section 7.3 that all storage facilities should be designed and managed to ensure 'zero discharge occurs as leakage'? The draft design drawings presented in Appendix E specify 'Zone A2' but no permeability specifications appear to be provided. Permeability performance also needs to be considered in context of geochemical properties of the materials being stored (i.e. is it possible for the permeability to be compromised as a result of chemical interactions?). In addition to permeability specifications, provide volumes of low-permeability materials required for all site infrastructure and sources that have been identified on site (including laboratory test results). Failure to specify performance criteria for liners and identify sufficient material sources on site is considered a high risk, as inappropriately-constructed liners could lead to contamination of soils, surface and ground waters. An ANCOLD rating of 'low' has been assigned to the TSF, based on a 'severity of damage and loss' of 'medium', which has apparently been revised from a previous rating (Knight Piesold 2014) of 'high'. However, clear justification for this down-grading of the severity of damage and loss level does not appear to be provided.	Part A Low permeability liners are described in detail in Appendix 2. Refer to Table 2-3 for a materials balance of low permeability material. Part B The facilities were assessed as having an ANCOLD High C consequence category classification for the EIS. Since then this has been reviewed. When detailed design is completed a full assessment will be done and the appropriate rating will be applied which will be used to inform the design. This has been included as a commitment.

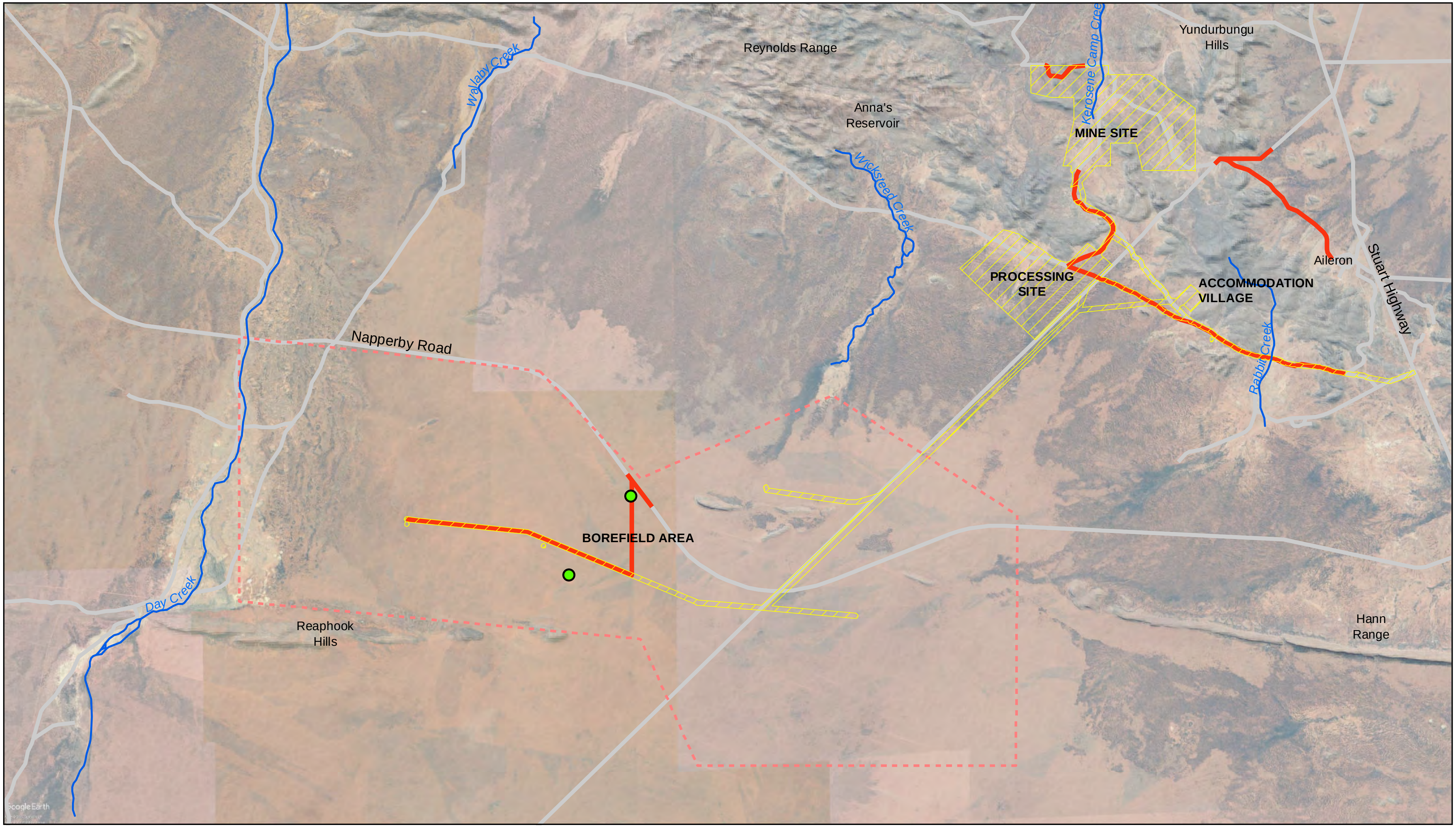
UID	Summary of submission	Response
485	Mine pit Section 8.5.5 states that there is a risk that the contaminated water predicted to accumulate in the pit could be discharged if the pit filled above adjacent groundwater levels (i.e. as a result of flooding). Appendix K Section 7.1 states that to avoid this risk, the catchment design should be such that the water balance can demonstrate that the pit lake will remain a sink in events 'far greater than any probable maximum flood'. The proposed mitigation to address this risk presented in Section 7.5.5 is a 1 m flood protection levee around the pit. Flood modelling presented in the EIS has been conducted for a 1 in 1 000 year ARI, although it does not appear to be explicitly stated where the height of the proposed 1 m pit levee would be in relation to this flood level. In order to demonstrate that the risk of discharge of contaminated water from the pit as a result of flooding (i.e. fill and overflow) is mitigated adequately, the proponent should provide the following: • details of the probable maximum flood (PMF) and if this exceeds the 1 in 1000 year ARI, update flood modelling predictions accordingly • clarification of whether the flood modelling undertaken takes into account the proposed Kerosene Creek stream diversion, including potential changes in channel morphology over time as a result of sediment deposition. If not, this modelling should be updated. • demonstrate that taking into account a PMF event, the proposed 1 m flood protection levee around the pit would be adequate.	Refer to Section 4.1.5.

UID	Summary of submission	Response
486	a) RO plant reject water Fig.7-8 shows RO plant reject water reporting to dust suppression. What will be the quality of this water and will it result in accumulation of salts and heavy metals (e.g. due to evaporation) on the roads? If so, evaluate the environmental significance of such accumulation. b) Acid plant and reagent storage facilities Provide details of the volumes of acid and other hazardous reagents that will be stored on site, where they will be stored and the storage infrastructure. Include an assessment of the risks of contamination to the environment associated with a leak or spill of hazardous reagents and/or products.	Part A Wastewater from the Desalination Water Treatment Plant will not be used for dust suppression and will now be directed to a brine pond for storage and further management. Part B All hazardous substances will be stored in accordance with Australian Standards. This has been included as a commitment. An accidental spill or release of reagents has been assessed in the Environmental Risk Register (Appendix F of the EIS) and resulted in a low risk ranking.
487	a) To what extent would the borefield drawdown impact any groundwater dependent ecosystems in riparian zones in Day, Napperby and other creeks within the bore field zone of impact? b) Provide references to peer reviewed literature to demonstrate the resilience of River Red Gums (and any other groundwater-dependent vegetation in the Project area) to lowering water tables. c) To what extent would pit dewatering draw on the Tea Tree or other shared upstream aquifers? Evaluate whether any such losses to upstream shared aquifers could be significant to water allocation planning and other users of those aquifers? d) Although existing basement bores in the Alyuen Community and the Aileron Station Homestead and Aileron Roadhouse area may not be considered	Part A – B Refer to Section 4.5 for further discussion on the potential impacts to groundwater dependant vegetation/ecosystems. Part C Pit dewatering and the resultant drawdown is detail in the Groundwater Report (Appendix K of the EIS). The pit is located in an isolated aquifer and not within the extent of the Ti Tree Basin. Further assessment of pit dewatering is provided in Appendix 6. Part D The groundwater model in the EIS identified a potential impact to the Laramba bore field of a 1.2 m drawdown between the 20 to 40 year life of the mine. However, water demand for the mine has since been reduced from 4.7 GL/year to 2.7 GL/year and results in a reduction in drawdown in the vicinity of the bore (refer Section 4.22). Arafura has developed a groundwater monitoring program as detailed in the Water Management Plan (Appendix 4). The western production bore (RC025) is located halfway between the borefield and the Laramba bore and will be used to monitor potential drawdown impacts. The Napperby Station

UID	Summary of submission	Response
	potable, are these bores still used for gardens, stock or other non-potable uses? Bores for the Napperby township and Laramba homestead could be affected by drawdown and stock bores exist in the vicinity of the mine pit and bore field that could be affected. Are there any agreements in place with these users or commitments that can be made (e.g. provision of alternative water supply), if bore-water supplies fail? Could the surface water body that Napperby Station Homestead sources drinking water from be impacted by the bore field? The location of this waterbody should be shown on Figure 8-3.	surface water body is up gradient from the Mine at elevation 750 m verse an elevation 600-650 m.

UID	Summary of submission	Response
488	(a) Figure 9-1 indicates that the flora / vegetation survey did not cover the area of groundwater drawdown from the bore field (or other potential off-site / off lease impacts), targeting areas of potential direct physical disturbance of vegetation (e.g. clearing). In order to assess potential impacts of groundwater drawdown on any groundwater dependent and/or threatened vegetation, baseline vegetation data and assessment of potential impacts needs to be presented for all areas that may be affected by this activity. (b) It is stated in Section 10.7.10 that “The Nolans Project TSF/RSFs will be quite small (approx. 244.03 ha) and will likely contain free- standing supernatant water”. Any water source in a dry landscape could potentially be utilised by birds as a primary watering point, particularly once the birds become accustomed to visiting the site. Mitigation measures to address	Part A Mapping and ground-truthing of vegetation along Day Creek and the associated floodplain was completed by Desert Wildlife Services after the lodgement of the EIS, and is provided in Appendix 9. Part B Refer to Section 4.19. Part C Ore mining will occur during daylight hours while waste mining will occur 24 hours a day. This activity will require vehicle movements within and between the mine site and processing site. Activities within the borefield will only occur during daylight hours except for emergency maintenance. The speed limit on the bitumen access road will be 100 km/h and on gravel roads will be 80 km/h. The speed limit will be reduced to 60 km/h when the road passes in close proximity to sensitive areas and on all gravel roads between dusk and dawn. Sensitive areas will be defined as roads passing in close proximity to threatened species habitats, including within

UID	Summary of submission	Response
	potential impacts on fauna from waste water need to be provided (i.e. not "Looking into, where necessary..") (c) It is stated in Section 10.7.12 that "Implementation of speed limits and possibly the reduction in vehicle travel at night" would be a mitigation measure to address potential impacts on fauna from vehicle strike. This needs to be addressed in more detail, as use of the word 'possibly' does not provide any assurance.	approx. 1 km of the known Great Desert Skink warren in the area supporting 'older' spinifex that possibly could be from 5-10 years post fire. Figure 3-12 below indicates specific areas where a 60 km/h speed zone will be imposed in close proximity (e.g. within 200 m of rocky habitat) to Black-footed Rock-wallaby and Great Desert Skink habitats. Signage that highlights the possible presence of wildlife will be installed where appropriate across the site. The implementation of speed limit strategy has been included as a commitment.



1:225,000 @ A4

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

LEGEND

- Waterways
- 60km/hr Speed Limit
- Other speed limits apply
- ▨ Study Area
- ⬚ Borefield Area

Arafura Resources Limited
Nolans Project
Environmental Impact Statement

Job Number	43-225929
Revision	0
Date	12 Oct 2017

Restricted speed areas near threatened species habitat

Figure 3-12

G:\43\22301\GIS\Maps\4322529_001.mxd

Data source: Google Earth Pro - Imagery (Date extracted: 25/07/2017). GA - Roads, Waterways, Placenames (2015). ESRI - Shaded Relief (2009). ARL - Water Bores, Proposed Pipelines, Borefield Area, Proposed Mine Site, Treatment Plant and Accommodation Village (2015). Created by: CW, CM

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489	General – it is unclear what the rationale is for listing 'planned controls' and 'additional controls' separately, when it appears that all the 'additional controls' listed should come under 'planned controls'. For example, 'seepage interception and collection system' is listed as an additional control under the column 'recommended to reduce risk' when it is clearly presented as one of the primary mitigation measures? Risk Ref. 20 – what is meant by 'controlled and managed site drainage and release to adequately dilute fluoride'? There does not appear to be any other reference to fluoride as a significant risk elsewhere in the EIS. Risk Ref. 31 – if sediment ponds are to be used to manage poor quality 'first flush' surface water run-off, will these ponds be lined to prevent potential seepage of poor quality (e.g. due to evapo-concentration) water to groundwater?	Part A Additional controls would only be required where the level of risk, with standard controls in place, is still at a level that would be considered unacceptable. Part B Reference to fluoride has been removed from the Risk Register. Elevated fluoride concentrations are naturally occurring and not considered a risk elevated as a result of mining activities. Part C Refer to Section 4.10.
490	Generally the risk assessment appears to be reasonably comprehensive in terms of identifying risk events and potential impacts. However the following issues have been identified: the occurrence of reductions in risk ratings for threats and increases in risk ratings for opportunities without a clear justification for the changes, particularly where the information informing the decision has a low data quality value. the occurrences of reductions of the consequence rating e.g. reference 24 and 75 in Appendix F. The consequence of a risk event is usually fixed, with added controls normally only altering the likelihood of an event occurring. In both cases, there is no apparent	The risk register is a 'live' document and is updated as new information/data becomes available, additional mitigations are developed or a change in activity occurs. The identification of potential risks, an assessment of the risk and the determination of mitigation controls is detailed in each of the technical studies (refer Appendix H to W). These studies have been used to confirm or reassess the risk rankings in the risk register. In addition, the participants at the risk workshop have significant experience in the field of mining in remote NT and/or community consultation and community development. Participants have drawn on that experience in order to assess the likely level of risk. The risk register has been updated as follows: • Reference 24 – the initial consequence has been reduced to minor. The rationale for the consequence rating is that none of the proposed facilities will contain toxic liquors and so

UID	Summary of submission	Response
	reason for the change in consequence. For example, the overtopping of the tailings dam in a high rainfall event has a moderate consequence assigned. A biannual geotechnical inspection of the tailings embankment then leads to a minor consequence. There is no removal of the hazard or substitution of the hazard that could account for this. Similarly, reference 75 concerns the non-acceptance of the closure plan by Department of Mines. The consequence of the site not being relinquished by the company at closure is deemed major. With regular updates of the plan and continued stakeholder engagement, the consequence then becomes minor – how? This particular risk also includes an increase of the likelihood from rare to unlikely; again without reason and, it would seem, counterintuitively.	even in the rare event that a release occurs, any impact is unlikely to be measurable or detectable. - Reference 75 – the residual consequence has been increased to major. The residual risk ranking is now moderate. An updated copy of the risk register will be provided to DPIR as part of the mining authorisation process. This has been included as a commitment.
491	The flora and fauna impact assessment also needs to cover the post-closure scenario, including potential risks associated with radon and implications for the design of covers (e.g. materials, thickness) over radiation sources. In particular, assess the radiation risks to burrowing fauna inhabiting the post-closure landforms.	Refer to Section 4.11.4 for information on background levels and Section 2.10.2 for NORM. Recent test work confirms that about 25% of all radionuclides will report to the TSF and the remaining 75% report to the RSFs. Arafura has conducted a radiological risk assessment for operations and found the impacts to fauna to be negligible (refer Appendix P of the EIS). Following closure, the process residues and waste mineralised mined rock would be buried and will be covered by at two metres of inert mined rock. This provides a competent physical barrier and will deter burrowing. Refer to Sections 4.1.3 and 4.1.4 for further discussion on the capping layer that will cover the WRD, TSF and RSFs post-closure.
492	‘A general area survey was conducted in a grid pattern across the mine site area and at sites remote from the project area. The remote sites are referred to as “background sites” and include two measurements in Kerosene Camp Creek and two measurements at the Aileron Roadhouse.’ Kerosene camp Ck sites (incl. ARA08011) are mentioned as being used as ‘background’ sites. Sites ARA8014-016 and ARA8011 are shown in Aerial	The monitoring locations, detailed in Figure 3-8, show that the sites are widespread and representative of the area. Furthermore it should be noted that it would be remiss to omit a few higher spots as isolated higher spots up to 1000m^2 or more occur in the region. This was explained in the regional geology and background section of Hussey in Appendix P of the EIS. These isolated spots are not mineralisation. They are natural concentrations in rocks and soils. The figure shows the location of the environmental monitoring sites based on a calibrated high-resolution detailed low-level airborne radiometric image. This image shows the natural variations in radioactivity and the environmental dose rate across the project area. The image is a linear stretch of the data with all values of 500nGy/hr or more all shown as red. Hence

UID	Summary of submission	Response
	gamma surveys (Figure 12-2) to be localised gamma radiation hotspots (another deposit?). Their use may therefore skew calculation of local 'background' radiation conditions, particularly if they represent a large proportion of the data points used to calculate a 'background' value (Table 12-1). Provide justification for selected locations and groupings of monitoring points underlying calculations of radiation levels onsite.	this image emphasises the variation in the lower values. The cooler colours on this image have lower natural background radioactivity. The warmer colours have higher natural background radioactivity. The images clearly shows that the selected sites are representative of the area. Arafura completed several detailed grid-based surveys over the deposits area to determine the natural environmental radioactivity in the deposit area. These and the environmental monitoring sites were used to confirm the calibration of the airborne survey, see Hussey in Appendix P of EIS. All environmental monitoring sites were originally selected based on Arafura’s knowledge of the region and geoscientific data. However, the actual spots were sited once ground-truthing was completed by Arafura’s Senior Field Supervisor at each location. The selection was primarily based on the vegetation and soil cover at or near each site. Some places were up to 100m from the proposed target spot. The instructions provided to field staff was to find a point near this target spot that was easy to access and had sufficient soil and vegetation (grass/trees) for paired sampling. This was considered a very important factor in the site selection we believe the assessment of radioactive uptake is also an important factor to understand. Hence the actual monitoring spot was not biased in its selection based on measuring background radioactivity at each site. This measurement was taken after the fact. Environmental monitoring sites within the pit were based on Arafura’s geological knowledge however the location of vegetation governed the actual site selection. These sites are considered typical of the deposit. They are not the areas of known highest radioactivity within the deposit footprint. The sites outside of the pit were selected as follows. • ARA8001-ARA8004 inclusive are long-term dust monitoring sites outside of the deposit footprint area. These are upwind, downwind and orthogonal to the prevailing wind direction. It made sense to add these to the list of environmental radiation monitoring sites to enable long term collection of data. • ARA8008 was selected as a low radioactivity area just outside of the pit. This site may be too close to the LOM pit but it will serve as a useful monitoring site for many years to come. The other sites were targeted by considering the location of the pit and infrastructure together with the prevailing wind direction and distance from the ML or pit.

UID	Summary of submission	Response
		• A group of sites were selected at about 1km from the ML. These are ARA8012, ARA8016, and ARA8018 to the W, NW and N. Another group of sites were selected at about 5km from the centre of the pit. These are ARA8014, ARA8015, ARA8017. These have variable but mostly low environmental radiation levels. Some of these are likely to form key additional downwind monitoring sites. • ARA8013 and ARA8019 were selected as distal background sites. ARA8013 is significantly upwind while ARA8019 is orthogonal and significant distance from Nolans. ARA0871 has been used as a standard background biogeochemical (vegetation) sampling site for almost 10 years. It made sense to include this site as well as the most distal upwind site. • ARA8011 was specifically targeted as example of an average outcrop of felsic granitic gneiss from this area. The radioactivity is slightly higher than its surrounds but it is similar to many other felsic gneiss outcrops in the region. Site ARA8012 would have similar radioactivity to ARA8011 if the soil was removed. This is also similar to some of the gneiss that hosts the deposit. • ARA6460 was specifically targeted by me based on geological reconnaissance mapping of radiometric exploration targets. This general location is another felsic granitic gneiss outcrop with naturally elevated radioactivity although it contains an elongate pod of biotite schist with near this spot. The monitoring site is located within an area of high natural background radioactivity and is similar to that observed at Nolans Bore. ARA6460 is not sited on the highest radioactivity. A larger area of higher background activity occurs about 7.5 km E of ARA6460. This site is also similar to Nolans Bore but it has not been targeted. Two sites were targeted within the processing site. The dose rate image clearly shows that the village site has similar of lower background radioactivity.

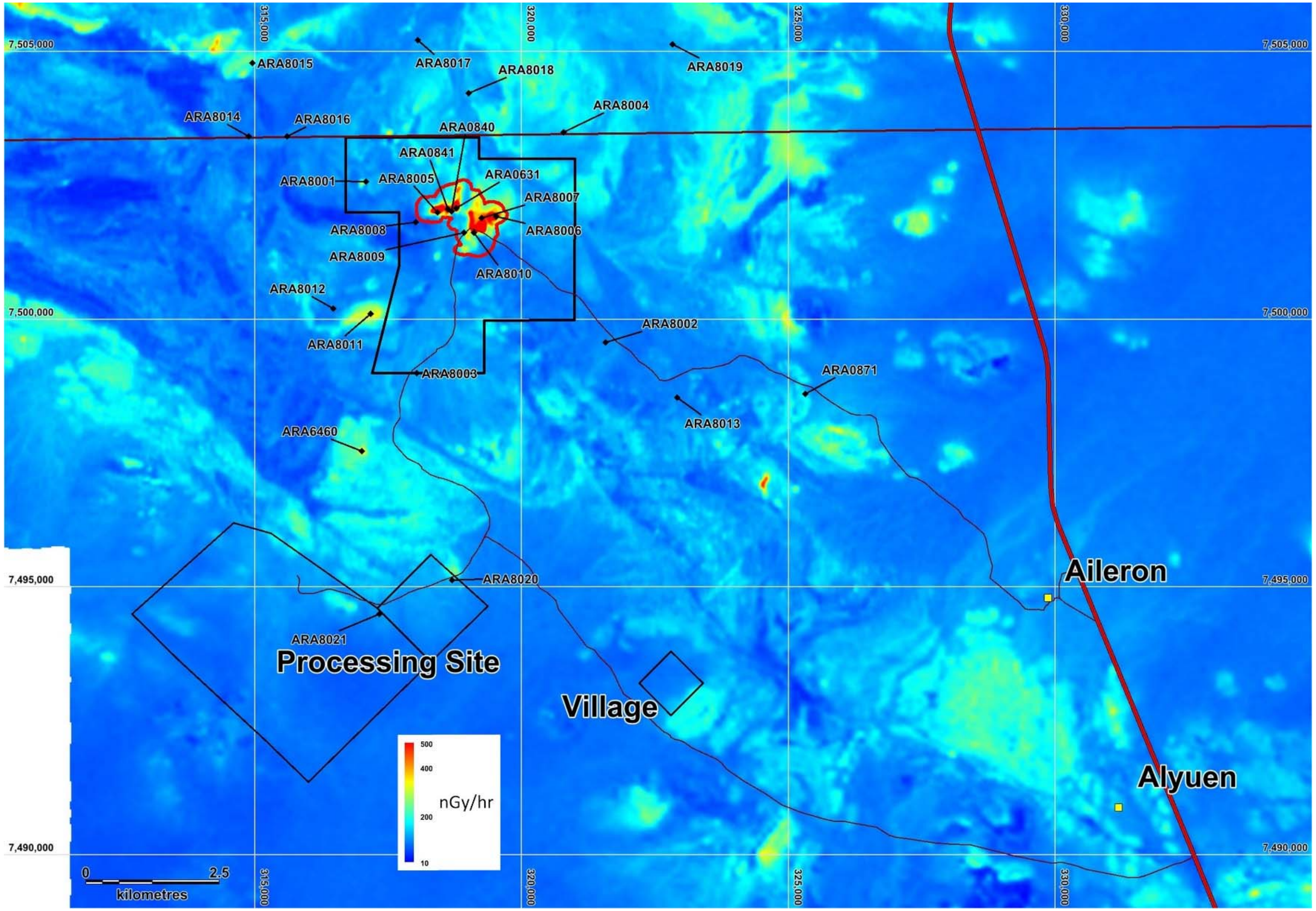

Figure 3-13 Radiation monitoring points (Appendix P of EIS)

UID	Summary of submission	Response
493	Do radionuclide levels in the deposit aquifer restrict the appropriateness of its use in processing or dust suppression?	Whilst level in the Nolans aquifer are elevated they are not dissimilar to other bores within the local area. The aquifer at the mine is not sustainable in the long term and will only water for a limited period. Given the aquifer will not support long term pumping it is unlikely that any concentration of radionuclides will have a lasting of detrimental impact. This water will be used in processing, beneficiation and dust suppression activities and will be mixed with borefield water prior to use. Runoff from areas requiring dust suppression will be managed by the sediment management system, therefore, any contaminants (including radionuclides) will be contained within this water management system (during storm events up to the 100 year 72-hour design storm event). At closure any contaminated material removed for disposal into waste dumps or tailings or residue storages.
494	The EIS states: 'Blasting is likely to be required during construction and operation of the mine. ... Blasting at distances to receivers of less than 500 m would be restricted by the maximum instantaneous charge. The maximum construction criteria for airblast overpressure is 115 dB(L) ... the airblast overpressure and ground vibration levels for the assessed charge masses are expected to be well under the criteria at the nearest sensitive receiver located approximately five kilometres from the source.' Figure 14-1 shows blast volume at 500m to be 120-130dB, and still over 100dB at 2km distance, whereas Figures 14-3 and 14-4 providing noise contours seem to be based on a noise source of only ~70dB at the mine site edge (<500m from the pit). Clarify why maximum noise emitting activities are apparently not modelled for impacts on sensitive receptors.	Figure 14-1 and Figures 14-3 and 14-4 display different information, in different units of measurement and are not comparable. Figure 14-1 predicts the airblast overpressure from blasting activities and Figures 14-3 and 14-4 predict both the noise contours and mitigated noise contours from (worst-case scenario) operational activities. These activities are assessed separately as they are assessed against different criteria. Figure 14-1 illustrates that blasting activities (utilising a MIC less than 100kg) meets the ANZECC criteria for human comfort at 1600m from the point source. The nearest sensitive receptor is 5km from the mine pit. Figure 14-4 illustrates that (worst-case scenario) operational activities meets the noise criteria, as described in the Noise Report (Appendix R of the EIS), at all off-site sensitive noise receptors.

UID	Summary of submission	Response
495	What are the implications to the project, should authorisation to disturb Aboriginal archaeological sites not be granted? The EIS states: 'Traditional owners were unable to participate in the heritage survey. Efforts were made to arrange an on-site meeting however it was not possible to discuss the survey with the Anmatyerr traditional owners during the field investigation. Thus, it is possible that the heritage assessment provides an under-representation of cultural sites and/or values associated with the study area. Appropriate levels of Indigenous consultation should be demonstrated in the EIS. The EIS states: 'Arafura has undertaken sacred site clearance in the study area, and Authority Certificates were issued by AAPA in 2008 (C2008/205) and 2013 (C2013/205). Copies of the AAPA Certificates are attached to the Indigenous and Historic Cultural Heritage Assessment (Appendix U).' Given that both AAPA certificates provided in Appendix U have lapsed, what are the implications to the project, should authorisation to disturb any of the identified sacred sites not be granted?	Part A The Cultural Heritage Assessment (Appendix U of the EIS) outlines that works approval for two of the fourteen archaeological sites of high significance will be sort. Both sites are proposed to be disturbed or destroyed by either the access road from Stuart Highway or the access road between the mine and processing site. Should works approval not be granted then the relocation of these road will be investigated. The remaining twelve sites of high significance will be avoided. Part B Refer to UID 222 regarding traditional owner engagement in surveys. Part C Refer to UID 223 and 224 regarding traditional owner consultation. Part D The Certificates issues relate to exploration, mining and access to the mine. It is considered highly unlikely that additional sites or conditions be identified in a subsequent Certificate for the same activity over the same subject land. RWA 8 (refer Certificate C2013/205) may be disturbed through the upgrade of an existing track. Should this now be permitted (after further discussion with Traditional Owners, CLC and AAPA) then the proposed access road between the mine and processing site will be relocated to the west or east to avoid the boundaries of RWA 8.

UID	Summary of submission	Response
496	‘These WRDs will also be designed as water-retaining structures i.e. to encourage water infiltration and assist vegetation establishment on the tops of the dumps. The tops of the dumps will be broken into a series of small cells so when it rains, water is retained and the vegetation can establish rapidly. These retention cells will also assist in reducing erosion risk from water discharge down the dump face…. The company’s geochemical characterisation studies on waste rocks indicate that a small percentage (around 1%) of these particular waste lithologies may require additional management that could include encapsulation within benign waste rock. Confirmation of the quantity of waste rock that falls into this category will be determined pre-production following additional classification studies during pre-strip, etc.’ Suitability of the concept of having waste rock dumps as water-retaining structures will depend on the demonstrated characterisation and AMD (including neutral drainage) potential of the underlying contained waste material. Where AMD potential exists in the contained waste rock/ tailings, then designs should aim to limit water and oxygen access to the contained material for the long term (i.e. >1000 years), allowing for predicted climate change trends to continue to occur in the region to a worst-case extent. Will the above-described 1% of material requiring additional management be situated within the ‘water-retaining’ WRDs? Where encapsulation is proposed, demonstrate that sufficient low permeability materials will be available.	Refer to Section 4.27 for a description of the AMD assessment, risk and management. Arafura could readily neutralise this potential AMD waste rock material if required by utilising the superficial calcrete units that outcrop within ML26659. Confirmatory ANC tests completed on several samples from the area indicate this material has the capacity to neutralise about 650kg of H_2SO_4 per tonne (Dean 2012). Comprehensive whole rock assays were not done on this test material, only the major elements were assayed.

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497	a) 'Targets for rehabilitation will be native flora species. The target ecosystems will evolve with the post-closure rehabilitation planning and the results of rehabilitation trials.' Pre-disturbance seed collection is recommended for any species of conservation significance identified within the Project footprint, particularly any localised or short range endemic species. b) The EIS identifies the closure risk (p.18-6,18-7) that: 'Contaminants in groundwater are concentrated by evaporation from the pit lake post closure, resulting in elevated concentrations of harmful materials and then become mobile through animal ingestion.' A 'low' risk rating has been assigned to this identified issue. What long term depth and water quality is predicted for the pit lake, and how hazardous / toxic would the water be to wildlife, including birds, reptiles and mammals (rock wallabies) if consumed? It has been assumed (10.7.10, p.10-36) that fauna will not be attracted to Project water bodies, resulting in allocation of a low risk rating. Justification of this assumption needs to be provided.	Part A Refer to Section 4.18 for information on seed collection. Part B Refer to Section 4.1.5 for information on pit lake water quality post-closure. Part C Refer to Section 4.19 for further discussion on fauna utilising waterbodies.

UID	Summary of submission	Response
498	The EIS states that 'waste rock dumps will remain on the surface rather than be backfilled into the pit and will be progressively rehabilitated.' What opportunities exist for the return of any 'problematic' (e.g. PAF, radioactive) material to the pit for encapsulation and burial, following completion of mining? Compare long-term environmental and safety risks, costs and benefits for in-pit post-mining storage of problematic material, with the long term storage methods proposed in the EIS. Environmental objectives (Section 18.1) – provide clarification on how 50 m-high waste rock dumps within a relatively flat landscape would be 'compatible with the surrounding landscape…' as specified in the EIS Terms of Reference? At least preliminary consultation to seek broad agreement on post-closure land use should be undertaken as part of the EIS process, as this could potentially have a significant influence on mine design. Provide justification for assigning a 'medium' risk to 'unexpected early closure' (Table 18-1, Appendix F), given that the closure plan at start of operations is only proposed to be 'preliminary' and there does not appear to be an agreed post-closure land use.	<u>Part A</u> Refer to Section 4.1.1 for further discussion on closure strategies. <u>Part B</u> Final landform design will be determined following completion of detailed landform design studies that are planned to be undertaken when representative mined material is available for test work from the mining process. A 50 m WRD height was determined to blend in with natural landforms in and around the mine site. Furthermore, the WRDs will not be visible from the nearest public access point to the mine site (i.e. the Stuart Highway about 10 km to the east) due to the presence of hills east of the mine site that are 30-100 m above the surface RL of the planned WRDs. <u>Part C</u> Arafura has had discussions with key stakeholders including CLC, pastoralists and the government regarding post closure land use (as detailed in the Community Consultation Report – Appendix H of the EIS). Ongoing consultation, including Traditional Owners, will take place regarding rehabilitation and closure planning. This has been included as a commitment. <u>Part D</u> With regard to returning some material to the pit - the potential mine life of the project reduces the opportunities to return the small amount of PAF (» 2-3Mt) or the waste rock that is greater than 1 Bq/g (» 116Mt).. It would require the stockpiling management of very large amounts of rock until the resource is exploited. The costs of picking up this quantity of material and returning it to the pit is very cost prohibitive and would delay the opportunity to successfully rehabilitate these waste dumps progressively and effectively. Backfilling of higher risk material into the mined pit voids may be considered best practise in some instances, however this requires a case by case assessment, which includes an orebody sterilisation risk. The orebody is relatively unexplored at depth, but is believed to be significantly deeper than the current proposed pit, therefore backfilling is not a considered a feasible option at this stage due to the high potential for orebody sterilisation. The volume of any 'problematic' (e.g. PAF) is considered to be very small, and as such it may be possible to keep it separately in a smaller WRD so it might be returned into the pit once the orebody is fully mined, or once the risk for sterilisation is addressed.

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		The final WRD height was chosen to match the approximate height of topography surrounding to the west, east and south east of the WRD's i.e. landscape is not flat, hence the proposed landforms do fit within their surrounds. All closure planning at the start of an operation is conceptual and will be subject to significant change as the operation progresses and develops. There is a need to complete a reasonable amount of test work before a definitive closure plan can be prepared for approval. All closure planning will be updated on a regular basis to ensure its relevance to the site. A more detailed closure plan will be prepared for approval and authorisation by DPIR. This plan will include provisions for early closure and a care and maintenance scenario.
499	Provide an assessment of the risk of 'Insufficient cover material available on closure', as this does not appear to be presented in either Section 18, the risk register (Appendix F) or the closure report (Appendix W). – This is particularly important, given that it does not appear that a 'preliminary mass balance' assessment has been conducted in relation to cover materials required for remediation of WRD/TSF/RSF, nor their availability on site. Clarify design of WRDs being inward-draining (i.e. promote infiltration) and the potential requirement to minimise/prevent infiltration for any PAF materials.	Part A Refer to Section 4.1.2 for an assessment of the risk of insufficient material not being available on closure. A framework to refine the WRD design has been developed and is included in Section 2.10.1. The framework includes a commitment for further construction and closure material resource investigations to quantify the material required and the availability. Part B There is potentially a very small amount of PAF waste, which is intended to be isolated and encapsulated into a designated area within the WRD with a low permeability cover. The cover will be designed to prevent infiltration of water and oxygen. A framework to refine the WRD concept design has been developed and is included in Section 2.10.1 above of the Project Description. The concept includes: • Undertake designs to develop water management and drainage design and • To refine WRD seepage models' accuracy to optimise drainage and storage designs to provide a bases for WRD infiltration and storage cover design requirements. • Refining the design of the WRD based on updated geochemical classifications, updating block model and the like.

UID	Summary of submission	Response
501	The EIS, including the WMP, refers to the “Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory” and the “Waste Management Guidelines for Small Communities in the Northern Territory” as key documents for the planning and operation of the landfill. NT EPA recommends the proponent also consult “The Central Australian Remote Landfill Operating Manual” (available from the Local Government Association of the Northern Territory), in conjunction with the guidelines for practical operational methods in the remote Central Australian context.	Reference the requirements of the Central Australia Remote Landfill Management Manual (LGANT) will be added to the Waste Management Plan. This has been included as a commitment.
502	The EIS Terms of Reference specifies that WMP should undergo a process of peer review by an independent, appropriately qualified expert, with feedback included as an attachment. This has not been provided.	A copy of the peer reviewed Water Management Plan is provided in Appendix 4.
503	The EIS Terms of Reference cross-reference (Appendix D) refers to Section 11.4.4 for discussion of effects of climate change but this does not appear to be covered in the referenced section, or anywhere else in the EIS document. Describe current modelling estimates of how climate change trends will affect the region of the Nolans Project. Describe how the predicted climatic regime could impact or is being incorporated into infrastructure designs (especially of waste storage facilities) to avoid long term environmental impacts within the altered climatic regime.	An increase in intensity of extreme rainfall events is projected with high confidence. Refer to Section 4.2 for a discussion on climate change. All storage facilities constructed will have an increased safety factor to provide additional contingency for significant rainfall events in accordance with ANCOLD guidelines. The facilities were assessed as having an ANCOLD High C consequence category classification for the EIS. Since then this has been reviewed. When detailed design is completed a full assessment will be done and the appropriate rating will be applied which will be used to inform the design. This rating will influence aspects of the design like the freeboard the storage must contain e.g. a 1 in 100,000 annual recurrence interval (ARI) or probable maximum flood (PMF) 72-hour event.

UID	Summary of submission	Response
504	The Waste Management Plan (WMP) provided as Appendix X-I is incomplete. The WMP says that the landfill design, location, size and layout will be determined during the construction phase (p. 3). Given that the proponent has estimated the total workforce required for the project, they should be able to estimate the type and volume of waste expected to be landfilled. From this, they should be able to estimate and propose a suitable size, design and layout of the landfill and identify 1 or more suitable locations for consideration prior to the construction phase. The EIS/WMP does not address landfill leachate management. This should be addressed in the WMP with consideration to site selection and ongoing operation and include options for lining of the landfill. The WMP refers to the landfill being regularly burned to control the amount of putrescible and windblown waste (Table 3-3: Waste Burning). Burning of waste is not supported by the NT EPA. Whilst it is referred to in the “Waste Management Guidelines for Small Communities in the Northern Territory”, it is in the context that burning is sometimes the only option for some communities due to limited resources being available to regularly cover the waste. NT EPA anticipates that the proponent will have suitable machinery, personnel and cover material available to cover waste daily without the need for burning.	The landfill is to be located adjacent to the RSF (refer figure 2-2). All recyclables and industrial waste (e.g. tyres, batteries, glass, aluminium, steel, etc.) will be disposed offsite where practicable. The landfill will be predominantly for putrescible waste from the accommodation village. Arafura will conduct landfill management in accordance with the NT EPA Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites (2013) and Waste Management Guidelines for Small Communities in the Northern Territory (2009) as well as the Central Australia Remote Landfill Management Manual (LGANT). This has been included as a commitment. Burning of waste will no longer be permitted. The Waste Management Plan will be updated to remove burning as a management option. This has been included as a commitment. The Waste Management Plan, including the final design parameters, will be appended to the MMP and submitted to DPIR for approval during the mining authorisation phase.

3.17 NT Police, Fire and Emergency Services

UID	Summary of submission	Response
197	The Officer in Charge, Ti Tree Station, would be responsible for supervising emergency operations in the location as a Local Controller under the Emergency Management Act.	The project will have its own trained emergency response personnel to deal with matters within the confines of the mining leases and associated project infrastructure. An Emergency Response Plan will be developed detailing the procedures associated with managing emergency events. Should an emergency or disaster occur, as defined under the Act, then the Officer in Charge, Ti Tree Station, would be responsible for supervising emergency operations as a Local Controller.
198	Consultation needs to occur with the Local Controller and the Local Emergency Committee so any emergency management can be implemented into the Local Emergency Plan. This should include the provision of information of the mine's Chemical Hazard plans to store and transport chemicals to or off the site to the Local Controller	Arafura will liaise with the Local Controller and Local Emergency Committee to discuss potential off-site emergencies (as identified in the risk assessment) so that consideration can be given to updating the Local Emergency Plan. This will include information regarding the transportation of chemicals, reagents and other products on Stuart Highway. The proponent will also provide copies of all MSD registers to ensure they have relevant and up to date information to manage an emergency situation should it arise. Arafura will work with the Local Controller to provide guidance, assistance, advice and management of those reagents and products in an emergency when called on to assist. Trained emergency response personnel will also be available to assist in emergency management as required by the Local Controller upon request. These have been included as a commitment.
199	Ti Tree currently has no Road Crash Rescue capability; however any required support would come from Alice Springs	Noted. A motor vehicle accident is an identified as an important risk for the project and it is intended that our emergency response personnel will be appropriately trained and equipped to deal with an incident involving a motor vehicle accident on-site.
400	The proponent should ensure they are cognisant of any relevant parts of the Liquor Act (NT) and Stronger Futures in the Northern Territory Act (Cwth) that may impact workforce or planned amenities at the work camp.	All facilities at the Nolans project site will be compliant with NT legislation.
401	The proponent should also conduct checks with Department of Business to as to whether the location of the mine falls into an alcohol restricted area.	The Project is not located within an alcohol restricted area.
402	The proponent should advise the local police station if they become aware of any protest action aimed at the	Noted - as part of the operational management system there will be a critical incident response plan. This plan will consider various scenarios and have plans in place to manage a

UID	Summary of submission	Response
	project, which may or may not require law enforcement intervention.	range of situations. It is intended to discuss these scenarios with local emergency response resources to ensure that all parties are aware of potential response requirements.
412	Expects a detailed traffic management plan will be undertaken	A Traffic Management Plan will be completed prior to the commencement of construction and submitted to the regulator for approval. This has been included as a commitment.

3.18 NT WorkSafe (Department of Business)

UID	Summary of submission	Response
200	We find that while many of the risks are high they are not dissimilar to similar mining projects. The methodology employed is recognised and appropriate for this project. It is well described in the EIS chapter 5. The constant issue is the application of NT legislation. Section 2 describes the NT legislation that applies. 2.2.3 describes the Dangerous Goods Act which is correct. 2.2.18 correctly describes the Transport of DG by Road and Rail. 2.2.22 correctly describes the WHS legislation.	Noted.
201	The purpose of the EIS is to describe the environmental concerns applicable to this project, however noting the other inputs and outputs especially as they relate to Safety on or around the site. The report has described at a high level the expected human safety concerns. Under Chapter 10 of the NT WHS legislation (Chapter 10 of the Regulations) the Operator will be required to submit a certified risk management plan which addresses all the expected risks at this project. The project is also subject to all the WHS requirements and will be monitored by NT WorkSafe throughout its life. This is recognised in the report.	The risks identified in the risk assessment are intended for the life of the project.

UID	Summary of submission	Response
	The report does mention transport risks but it is still unclear if it relates to whole of life cycle of the project however commitments have been made.	
202	We consider that the EIS encompasses enough information as it relates to Safety keeping in mind that this will be reviewed when the project commences. It is still unclear if the site will be the subject of Chapter 9 of the WHS Regulations as the volumes of chemicals are still under review. Discussions will occur with the proponent once final volumes are known. Off-site transport was discussed in Chapter 17 of the report.	Whilst the final chemical inventory has not yet been confirmed, the details and quantities provided in the EIS have been updated in light of the change from a SAPL to PAPL process. Refer to Section 2.10.5 and 2.10.6 for further information on the change. No large inventories of chemicals will be held onsite, with the project relying on the regular import of reagents to/from site. Once final holding volumes are known, Arafura will update the risk assessment in compliance with the appropriate regulation i.e. do the required quantities trigger Major Hazardous Facility status. This has been included as a commitment.

3.19 Office of Water Science

UID	Summary of submission	Response
35	Impacts will occur to riparian vegetation (i.e. they will die and not recover) in the vicinity of the mine due to groundwater drawdown. Consider whether this requires offsetting, if so a program monitoring vegetation health may be required.	Offsets for riparian vegetation, as defined under the EPBC Act, are considered unlikely as riparian vegetation is not utilised by either the Great Desert Skink or Black-footed Rock-wallaby.
89	The proponent indicates that the TSF tailings and RSF residue seepage composition are expected to mirror that of the WRD (Section 7.4.1). This should be confirmed via ongoing assessment and monitoring through the mining process and consider suitability of proposed management options, should seepage or exposure from erosion occur.	Test work to characterise the tailings and residues is currently being completed. The results of the test will guide the design of the TSF and RSF as outlined in the design framework (Appendix 2). Surface water and groundwater will be monitored at a frequency suitable to detect long term changes in water quality and water levels (refer Water Management Plan at Appendix 4). Nested groundwater monitoring bores will be installed surrounding the TSF and RSF to monitor for potential seepage. In the event that seepage is detected, then investigations would be completed to determine the most suitable mitigation measures to limit this seepage.

UID	Summary of submission	Response
		Standard engineering monitoring will also be included such as embankment piezometers and reference points to monitor embankment stability. Visual inspection will also be completed routinely to check erosion and in accordance with good industry practice. All structures will be operated in accordance with good engineering practice and will be periodically audited by qualified external geotechnical auditors / engineers for compliance and performance.
112	As noted by the proponent there are risks to surface and groundwater resources post closure from long term groundwater drawdown and seepage and erosion from final landforms.	A Closure Plan will be finalised on completion of the detailed mine design. The rehabilitation objective are detailed in Appendix W of the EIS. The Plan will be updated to include the use of landform modelling to aid the design of the rehabilitated landscape. It will then be submitted to DPIR as part of the mining authorisation phase. The Plan will require approval from DPIR prior to the commencement of operations. Further information on groundwater drawdown post-closure is provided in Section 4.22 and the Groundwater Report (Appendix K of the EIS) Further information on waste rock and residues and the risk of seepage is provided in Section 4.27 and 4.28.
170	The proponent states that the chemistry of groundwater flowing towards the pit is not likely to be greatly different from the existing groundwater chemistry in the area. Once in the pit, the net evaporation will result in a hypersaline pit lake. Flow will be radially towards the pit lake and thus contribute to the concept of a zero discharge site. The proponent states that the likely chemistry of this pit lake has not been modelled; however, it is highly likely to be of no long-term beneficial use.	Refer to Section 4.1.5.
171	Due to the lack of hydrogeological data there are significant uncertainties with the groundwater model drawdown predictions.	Refer to the Water Resource Assessment (Appendix 3) for further information on the hydrogeological data and Section 4.22 for further discussion on the groundwater model.

UID	Summary of submission	Response
172	As noted by the proponent the groundwater modelling is not considered to be definitive (i.e. absolutely correct), rather it presents their best estimate of the likely conditions and impacts. As a result OWS considers there is a significant uncertainty as to scale and extent of groundwater drawdown impacts. Drawdown impacts could propagate further than predicted and be greater in certain areas, which may include towards Lake Lewis.	Refer to Section 4.22 for further information on the groundwater model and commitments to develop the model from Class 1 to Class 2. Refer to Section 4.3 for further discussion on potential impacts to Lake Lewis.
246	The proponent indicates that the tailings storage facility TSF and Residue storage facilities (RSFs) will have a design storage capacity that is able to contain a 1 in 100-year ARI average annual rainfall whilst retaining sufficient additional freeboard to accommodate a probable maximum precipitation (PMP) 72-hour storm rainfall event. There is an estimated 4% risk of 1 in 1000 yr event during LOM (Page 7-8).	Refer to Section 2.9 and Appendix 2 for further information on the design considerations of the RSF.
247	The proponent states that dewatering of the open pit will capture any seepage of surface water from Waste rock dumps (WRDs) and other areas of the mine site as groundwater migrates towards the pit, thereby reducing the risk of potential impact on the surface water or groundwater of areas beyond the zone of groundwater drawdown. OWS considers that while likely to be the case for hard rock hydrogeology connected to the pit, consideration needs to be given, where appropriate, to monitoring shallow transport beneath waste rock and tailing stockpiles. In addition, the processing site is outside the predicted area of long term groundwater drawdown associated with the pit – therefore any leaching from this area (including the RSF's) is unlikely to report to the pit.	<u>Part A</u> Nested groundwater monitoring bores will be installed at key locations coinciding with site infrastructure, which is identified as a potential source of contamination, including within the vicinity of the waste rock dumps and the processing site. The location of these monitoring bores are provided in the Water Management Plan (Appendix 4). <u>Part B</u> Agreed – any leaching in the area surrounding the RSF is unlikely to report to the pit. Refer to Section 2.9 for further information on the design considerations of the RSF.
248	No modelling has been done of the long term water quality within the final void lake	Refer to Section 4.1.5.

UID	Summary of submission	Response
462	WMP indicates “Site Specific Groundwater Trigger Values (SSGTVs) will be determined from up-gradient monitoring bores. The location of these monitoring bores will be finalised once detailed design of project infrastructure is complete.” The proponent should consider that background water qualities within different geological units around the mine site may differ. This should be taken into account when determining site specific trigger values.	Noted.
463	Placement of surface water monitoring and monitoring bores will be determined during detailed design stage. Monitoring locations and new wells should be placed in areas which provide for early identification of contamination and reduce uncertainty in model predictions.	A copy of the updated Water Management Plan, including proposed monitoring locations, is provided in Appendix 4.
464	Trend analysis: The WMP states “The principal objective of the monitoring programs will be to assess change over time. A trend analysis will be utilised to determine potential impact to groundwater and assess if the impact is increasing, decreasing or constant.” When monitoring locations and sampling regimes are agreed, a suitable agreed methodology for trend analysis should also be agreed.	Noted - this has been included as a commitment.

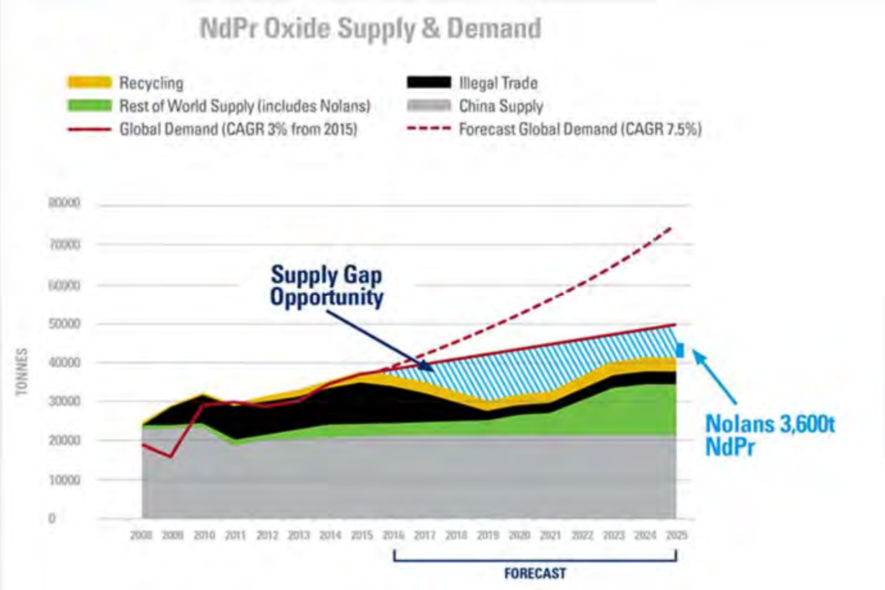
3.20 Power and Water Corporation

UID	Summary of submission	Response
139	The predicted impact is the effect (long-term – 1000 years) of leaving the open cut pit as a hole that will fill with groundwater and, due to evaporation, act as an artificial groundwater sink. This may be placated if there is a recommendation to partly fill the pit (upon mine closure) to a level that would reduce evaporation - ~30-40m below initial groundwater level. This option is not likely to be considered favourable due to the cost involved in relocation waste rock at the time of mine closure. There is claim that any water quality issues that may develop from this excavation and exposure of the groundwater system will be self-containing due to the 'sink' nature of the predicted impact.	Noted.
140	If the groundwater system acts in a way not predicted by the modelling (or the 'depth' of the sink is managed), there may be the development of an altered groundwater chemistry plume that may extend down-gradient. Down-gradient direction is identified as being towards the Ti-Tree Basin. It is recommended that consideration be given to revise the groundwater model predictions throughout the mine-life such that observed changes to groundwater systems and optimal mine closure actions are incorporated into the groundwater model to limit model assumptions and better predict groundwater response upon mine closure.	Down-gradient in relation to the Mine site (i.e. pit) is towards pit in the closure scenario. Ongoing groundwater monitoring will be undertaken to further validate the groundwater model through-out the mine life. Refer to Section 4.22.6 for further information on model validation.
141	The most notable impact to PWC would be the establishment of the proposed bore field (in the Southern Basins) the most western proposed production bore is 10km east of the Laramba bore field. The EIS models an impact to the Laramba bore field of a 1.2m drawdown between the 20 to 40 year life of the mine. This prediction will need to be verified by instigating a monitoring and reporting regime by the	Based on the description of the bore, it is assumed that PWC mean RC023 rather than RC025. RC025 is next to the Laramba pumping bore. RC023 is in the middle, and is included in the modelling. The monitoring of bore RC023 has been included in the updated Water Management Plan (Appendix 4). Refer to Section 4.22.6 for further information on use of groundwater monitoring results to validate the groundwater model.

UID	Summary of submission	Response
	proponent with remediation actions if the actual impact exceeds the predicted drawdown. It is understood that during the groundwater investigations bore RN 019035 was constructed. This bore is located midway between the western production bore [RC025] and the Laramba bore field. It is recommended that this bore be monitored during the life of the mine to verify and report on the accuracy of the EIS groundwater modelling.	
142	The Laramba bore field is likely to withstand the predicted impact of the proposed groundwater extraction for the Nolans Project as there is >15m water standing above the PWC pump infrastructure. Thus PWC would not object to the establishment and utilisation of the proposed bore field.	Noted.
143	It is uncertain of the exploration plans of Arafura – typically if new deposits are located mining and processing will continue and thus the need groundwater extraction may continue (or increase) beyond the proposed mine life (or the nominated extraction rate). PWC should retain the right to re-access their comments/interest in the use of the proposed bore field if new mining developments are proposed.	The EIS is seeking approval for LOM 55 years - any extension beyond this would require additional assessment and approval from the NTG.

3.21 Public Health Association of Australia

UID	Summary of submission	Response
57	A securely funded mitigation plan needs to be in place in the event of an early closure	Existing Northern Territory legislation requires an operator to calculate closure costs regularly and has in place a robust process to assist guide this calculation. The DPIR independently completes their calculation and then the results are compared, and a security is agreed and subsequently lodged.

UID	Summary of submission	Response
		A detailed Closure Plan will be included as part of the MMP approval process under the Mining Management Act which includes this calculation. NT legislation requires that this plan is updated regularly and bonds are adjusted according. This process encourages operators to work progressively on rehabilitation.
58	Condition of approval should be the requirement of a sizeable site rehabilitation fund	Refer to UID 57.
98	Recommends a feasibility study be undertaken regarding global rare earths supply and demand to limit oversupply	Arafura has studied and followed the nuances of the rare earths market for many years as part of the feasibility assessment of the Project. We have developed a good understanding of the market and the project has undergone a number of configuration changes during this development work to arrive at the current scope and scale. The project is being designed to meet projected product market demand. Global market demand for the next 8 years is illustrated in the figure below. 
99	Recommends the project be assessed simultaneously with the Separation Plant to ensure the latter meets strict Australian environmental and public health standards	Arafura will comply with any approvals or regulations required to build and operate the separation in the relevant country in which it is being built, and seek to in accordance with comparable industry stands that would apply in an Australian jurisdiction. Refer to UID 289.

UID	Summary of submission	Response
100	Consider downsizing the project to meet real global demands	Refer to UID 98.
101	Demonstrate the project's necessity and long term viability	Refer to UID 98.
114	Project will use more water than the earlier proposal, impacting future availability of groundwater	Since the EIS was submitted to the NT EPA, Arafura has submitted a variation (Section 14A) including that the Project will use 2.7 GL/year which is less than the 4.7 GL/year presented in the EIS. Under either scenario there is no indication the Project will impact the future availability of groundwater for any current, envisaged or proposed beneficial use other than over the actual pit area. Refer to Section 4.22 for updated detailed on the groundwater modelling.
282	Proposal is to mine a larger area than the original proposal in 2008, with some significant environmental impacts	A notice of intent was submitted to the NT EPA in 2008, however was subsequently withdrawn in 2014. An amended notice of intent was submitted in 2014 that described an updated project configuration. Onsite processing has increased the project footprint when compared to the 2008 notice of intent.
322	Risks associated with rare earths mining, particularly in relation to the radioactive materials coexisting with the rare earths in the ore bodies need to be minimised where possible	The Environmental Risk Assessment (Appendix F of the EIS) outlines the risks associated with radioactive materials and details the appropriate controls to mitigate the risk. All controls have been incorporated into the Radiation Management Plan (Appendix X_J). The Plan has been based on the ARPANSA Codes of Practice.
323	Recommends workers operate according to world's best practice safety standards regarding radiation exposure	All workers will operate in accordance with the ARPANSA Codes of Practice. This has been included as a commitment.
324	Recommends radioactive waste be managed according to world's best practice	The project will adopt the ARPANSA: • Code of Practice on Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing, 2005 (also known as the Mining Code) (2005) • Code of Practice on the Transport of Radioactive Material (also known as the Transport Code) (2008). These Codes are based on international guidance from the International Atomic Energy Agency (IAEA), the Recommendations of the International Commission on Radiological Protection (ICRP) and on the Reports of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). The implementation of the ARPANSA Codes will be detailed in the MMP and the MMP will be approved by DPIR prior to the commencement of operations.

UID	Summary of submission	Response
325	There appears to be no plans to monitor the health of the communities closest to the project	Dispersion of radioactive dust or gas with impacts to human health and dispersion to environment resulting in exposures above the recognised dose constraint is considered a rare event (Appendix F of the EIS). The likelihood of such an event impacting the nearest community (i.e. Laramba which is 50 km away) would be very rare resulting in a very low risk to people within the communities.
326	Recommends health monitoring take place at both a baseline and on an ongoing basis (should be included in the Mitigation and Monitoring strategy)	Arafura Resources has been carrying out environmental monitoring across the general region since 2010. Refer to Section 4.11.4 for further information on baseline monitoring. The Radiation Management Plan (Appendix X_J) outlines the routine occupational radiation monitoring requirements that will be implemented during operations.
327	Above ground storage of waste ore poses a risk of airborne distribution of radioactive dust and radon gas and should be minimised	Around 50% of all waste rock is designated as benign by ARPANSA definition (refer Section 2.10.2). The waste rock dumps will be constructed by building the outer skin then NORM rock waste material that reports above 1Bq/g will be dumped into this central part of the dump. Dust deposition has been considered in the Radiation Report (Appendix P of the EIS). Potential sources dust, such as the waste rock dumps, were modelled for dispersion using site-specific weather and atmospheric data from the site weather station that has been operational at Nolans since 2009. The dust and radon doses to members of the public residing at Aileron and Alyuen are shown to be far below the member of public (MoP) limit of 1 mSv/y. The subsequent Radiation Management Plan (Appendix X_J) outlines the mitigation controls for dust.
328	Monitoring of airborne radionuclides at strategic locations	Arafura will undertake monitoring of radiation at a number of monitoring locations as per the Radiation Management Plan (Appendix X_J). Table 2 of the Plan details the measurement method, location and frequency of monitoring.
391	Significant public and environmental health impacts due to the radioactivity present in the ores, in both the short and long term	A detailed assessment of the potential radiological impacts is provided in Chapter 12 and Appendix P of the EIS. The subsequent risk assessment has shown that the radiological impacts associated with the Mine are tolerable (low) or tolerable if managed to as low as reasonably practicable (medium).
392	Note the presence of radioactivity is sufficient enough to have triggered an EIS under the EPBC Act as Nuclear Action	The Mine was referred to the Department of Environment under the EPBC Act in February 2015. It has been determined that the project will be assessed under the bilateral agreement with the Northern Territory.
404	Diversion of rivers could have a significant impact on the health of the water catchment and should undergo a comprehensive impact assessment	Refer to Section 4.15 further discussion on potential impacts associated with the diversion.

UID	Summary of submission	Response
444	Recommends minimal use of water in the operation of the project	The project has undergone significant optimisation studies and this work continues to realise efficiencies throughout the project (refer to the water balance in Section 2.11.1). Arafura understands the need to minimise resource usage including water and has already successfully achieved significant reductions in project water usage. The estimates for borefield use have been reduced very significantly with the announced changes in processing methodology. This has resulted in a 50% reduction in estimated total raw water usage in the processing plant to that presented in the EIS. Domestic and process water from the Southern Basins will need to be pumped to the surface, transported long distances and stored in a series of large water storage tanks. Process water will be reused as much as possible but at different stages from different sources will require treatment and storage. Water from the pit is of different qualities and will need to be pumped, collected, filtered and blended for various uses within the mine site ranging from dust suppression to process water. Surface water and seepage water within the mine site will be collected, treated, stored and used within the Mine water supply system. Evaporation ponds will be used to dispose of excess water, which cannot be economically stored. Rainwater will be collected from roofs. Surface water in “non-contaminated” sites such as the mining camp will be used on landscaping. Reuse water from sewage systems will be used in landscaping. Water use will be required to conform to the various Acts, regulations and directions by Government.
445	Planned water use should be considered in the broader context of a Territory-wide water allocation plan	The Southern Basins is not within a water control district. Nonetheless, Arafura has applied for a water extraction licence under the Water Act. Arafura will operate the borefield in compliance with the licence requirements. This has been included as a commitment.
466	Recommend a firm commitment from both the government and proponent to never recover uranium and thorium	Arafura is seeking approval to mine rare earths and phosphate only. Uranium and thorium would be managed as a waste product with other residue materials in well-engineered and constructed storage facilities.

4. Additional information

4.1 Rehabilitation and closure

4.1.1 Alternative closure and rehabilitation strategies

Arafura evaluated options for closure of the Nolans Project based on minimising short and long-term closure financial risk. Alternative closure strategies considered include open pit backfill vs not backfilling the pit.

Potential benefits identified to backfilling the pit were: reduced visual impact, reduced post-closure footprint; and less exposure of WRDs to weather elements over 1000 years.

Potential negatives associated with backfilling the pit were:

1. **Not able to access ore beneath final pit void for future mining** - The full extent of additional mineral resources beyond the deposit at depth is unknown at this time. The option of backfilling the pit is considered too great a risk to sterilising ore beneath the currently planned pit limits. This would then reduce the potential to extend the current life of mine of the project beyond 55 years. The project is located in a regional area where long term economic benefits for the local community are not readily available. The Nolans Project potentially offers this region and the Northern Territory a significant opportunity where the community will gain significant long-term employment opportunity and community benefit for more than 50 years.

2. **Increased environmental risk -** It also places increased risk to the environment and places considerable additional stress on the management of the operation during operations. This occurs because all non- benign waste rock has to be double handled. If the waste rock dumps are not progressively rehabilitated then there is increased risk to people and the environment. The management of this material if simply dumped would increase significantly particularly around both dust and surface water management. If dumps are not shaped and closed, water will infiltrate more easily, generating greater sediment loadings etc. Following backfill the potential for seepage from the pit would need to be managed and no water/seepage recovery system is contemplated in the current design, other than with the TSF and RSF. It is uncertain how this could occur with the open pit without very significant additional expenditure. This option would also increase the post closure monitoring period because settlement periods would start again from the time a deposition.

3. **Waste rock stored (i.e. not rehabilitated) until closure** - The waste rock would be placed on the surface and effectively left as open dumps at the natural angle of repose until closure when the material is disposed in the pit.

   Waste dumps left unshaped and contoured are more susceptible to wind and water erosion. Leaving TSFs and RSFs uncovered until the end of mine life also presents significant management issues during the period after deposition ends. The most effective and least risky option is to complete progressive rehabilitation of these facilities as soon as they are available for closure. Arafura's closure concept has been based around a progressive rehabilitation strategy. Arafura did evaluate the backfill option based on no progressive rehabilitation (refer cost of double handling in the point below) and waiting until the end of mine life.

4. **Significant cost of 'double-handling' waste rock** – The cost of removal of all facilities, returning them to a single pit is estimated at $900M in today's dollars. A cost of this magnitude would likely make the project unviable and it would not proceed in any form. At the very least, such a condition would have a very significant impact on the life of the project because the lower grade material, and much of the deeper mineralisation, would be far less economic (if economic at all). It is likely to also impact the volumes of ore mined in the upper section of the deposit, with the addition of reclamation and relocation costs, to the cost of the ore and waste. This will result in a reduced mine life with the associated loss of community benefits and opportunity to recover these strategic minerals. Returning and backfilling material into open pits while in operation can only be done progressively with multi pit mining operations. That is, as a pit is mined out, exhausted of ore and it has been determined that no ore will be sterilised by backfilling - waste from a new nearby pit(s) or tailings can be transferred into the open void. As Nolans is a single open pit operation, such an option is not practical or safe.
5. **Limiting potential opportunity to reprocess tailings, a potential future resource** – Although not included in the scope of this mining project, the beneficiation tailings represent a potential resource which may be exploited in the future. Backfilling this material would limit this opportunity.
6. **Limiting progressive closure through-out operations** - Arafura's objective is to progressively rehabilitate disturbed areas as soon as they are available. As a consequence, it is likely that most WRDs will be closed down, rehabilitated and stable well before mine closure. Backfilling the pit would require disturbing areas that will have been demonstrated are already safe and stable. It is also proposed that tailings and residues storages will be progressively covered as these facilities are filled, closed down and available for rehabilitation. To disturb tailings or residues a second time would disturb the infrastructure and increase potential risks of release, and substantially increase the post closure monitoring period of the project.
7. **Tailings and residues moved to Ti Tree Basin catchment -** In response to stakeholder concerns about the proposed processing facility in the Ti Tree basin catchment, Arafura has proposed a two-site option with residues located some 8 km south of the open pit. The risks associated with disturbing the residue material to transfer it back to the pit would increase significantly. To transport this material back to Nolans would require to re-slurry the material and pump it to the open pit. This deposited material would then require a period of settlement and dewatering before rehabilitation could safely occur. The period of settlement required would be magnified by the post-closure pit lake. The period in which settlement would occur is uncertain.
8. **WRDs will still exist post-closure** - The total volume of materials extracted from the open pit will not fit back in the mined-out pit void. The beneficiation process and subsequent rare earths processing will increase the mined quantity of ore due to the addition of reagents, water etc. If the tailings and residues were returned to the pit these would then need to be allowed to settle again and consolidate, have the water removed and stored somewhere to evaporate before waste rock backfill could commence. The period while this occurs is unknown but again it would delay and add substantial cost to the closure of the site. Also, the waste rock is estimated to have a swell factor of around 30%. When combined, the overall volume of material will not fit back within the pit void, and a significant hill of about 150 Mt will still exist above the pit or some remnant waste dumps would remain. The backfilling would also effectively sterilise any potential future recovery of the deeper mineralisation or the remnant resources within the tailings or residues (refer to point 1).

Based on the considerations above, leaving the WRDs/TSF insitu and capping at closure was the preferred option based on acceptable residual risks and being economically viable. The strategy developed for closure is in aligned with the policies of DPIR and in accordance with recommended and accepted good industry practice including Mineral Council of Australia guidelines.

Arafura will continue to update the Closure Plan throughout the Project (as required by DPIR) and evaluate options and opportunities as they arise.

4.1.2 Closure cover material balance

Insufficient cover material available on closure has been included in the environmental risk register as a medium ranked risk.

The consequence of not sourcing enough cover material is considered ‘major’ and would result in an ‘inability to implement the closure design and achieve effective rehabilitation (e.g. materials not adequate causing erosion, or contaminated seepage resulting in non-sustainable ecosystems and downstream effects, or long-term exposure to radiation source)’.

The likelihood of not sourcing enough cover is considered ‘unlikely’ as cover material can be sourced from both the site or regionally as required. Preliminary investigations have been completed and have identified that suitable natural cover materials and construction materials are available locally. This preliminary survey was not extensive because of time and cost constraints at the time. Arafura will undertake more detailed and comprehensive evaluations of the both the mine and plant site and if necessary nearby areas once detailed design is completed and construction and closure volumes are quantified to verify that the volumes of suitable material is available.

The Northern Territory Government online mapping tool indicates that Calcarosol, Kandosol and Tenosol soils occurs within a 50 kilometre radius of the project site. These soils are described as either clayey sand or clay loam, of which the permeability will be confirmed with sampling and testing, and will be targeted for assessment.

Borrow pit location, borrow material quantities and rehabilitation of borrow pit will be agreed with the respective landholder and regulatory approval sought, prior to commencing construction works.

4.1.3 Capping – radiation management

Recent results of Arafura’s beneficiation piloting program confirms radiation level as follows:

- Ore – 11.7 Bq/g
- Tailings are – 5.85 Bq/g dry and 4.6 Bq/g wet (water in tailings helps reduce activity). About 25% U and Th report to tailings during beneficiation.
- Residues are – 15.36 Bq/g dry and 11.5 Bq/g wet (water in tailings helps reduce activity). Note: this assumes that all remaining U and Th end up in residues and doesn’t account for U that will go with the phosphoric acid.

Radiation measurements and surveys completed at Nolans during Arafura’s exploration and ongoing rehabilitation activities demonstrate that 30-50 cm of the natural occurring soil is sufficient to effectively mask and shield radioactive residues and mineralisation.

Arafura routinely uses a 1 m soil cover to bury all drilling residues as per our approved Mining Management Plan (MMP). Radiation measurements show that 1 m of soil cover effectively shields the radioactivity including from the highest grades of mineralisation at Nolans Bore. For example, the environmental dose-rate surveys associated with the most recent burial pit are shown in Table 4-1 below. Survey 1 was done soon after the pit was excavated, and prior to the disposal of any radioactive material. Survey 2 was done after about 1000 t of Nolans Bore drilling residues was placed in the pit. Survey 3 was completed after a nominal 1m of soil cover was placed on top the radioactive material. The location of this disposal area is shown in Figure 4 1.

The average natural background environmental dose rate around this pit is 0.30 µSv/hr. This is based on 16 additional surveys completed around the margins of this pit at the same time, with individual values ranging from 0.15-0.38µSv/hr. The environmental dose rate measurements across the rehabilitated pit average of 0.30 µSv/hr and is indistinguishable from the background in this area. Thus, the proposed 2 m of cover is considered an effective thickness to shield the radioactive material.

Table 4-1 Environmental dose-rate surveys in µSv/hr*

Location	Comment	MGA94E	MGA94N	Empty pit Survey 1 22/7/2016	On material Survey 1 28/07/2016	On soil cover Survey 1 31/7/2016
1	Outside NW end of pit	318932	7502079	0.25	0.32	
2	Within pit	318939	7502070	0.6	6.5	0.27
3	Within pit	318943	7502063	0.82	7.5	0.27
4	Within pit	318947	7502056	0.27	8.6	0.29
5	Within pit	318953	7502049	0.23	7.4	0.35
6	Within pit	318959	7502039	0.18	6.3	0.33
7	On access ramp	318965	7502031	0.32	3.6	0.34
8	On access ramp	318970	7502024	0.36	0.5	0.25
9	Outside SE end of pit	318975	7502015	0.26	0.36	0.35
10	Outside SE end of pit	318980	7502006	0.33	0.35	0.29

**as measured by Arafura's calibrated Ludlum Measurements Survey Meter Model 2241-3 across the centre of the MMP Approved disposal pit. Survey 1 was done soon after the pit was excavated, and prior to the disposal of any radioactive material. Survey 2 was done after about 1000 t of Nolans Bore drilling residues was placed in the pit. Survey 3 was completed after a nominal 1m of soil cover was placed on top the radioactive material. The location of this disposal area is shown in* Figure 4-1.

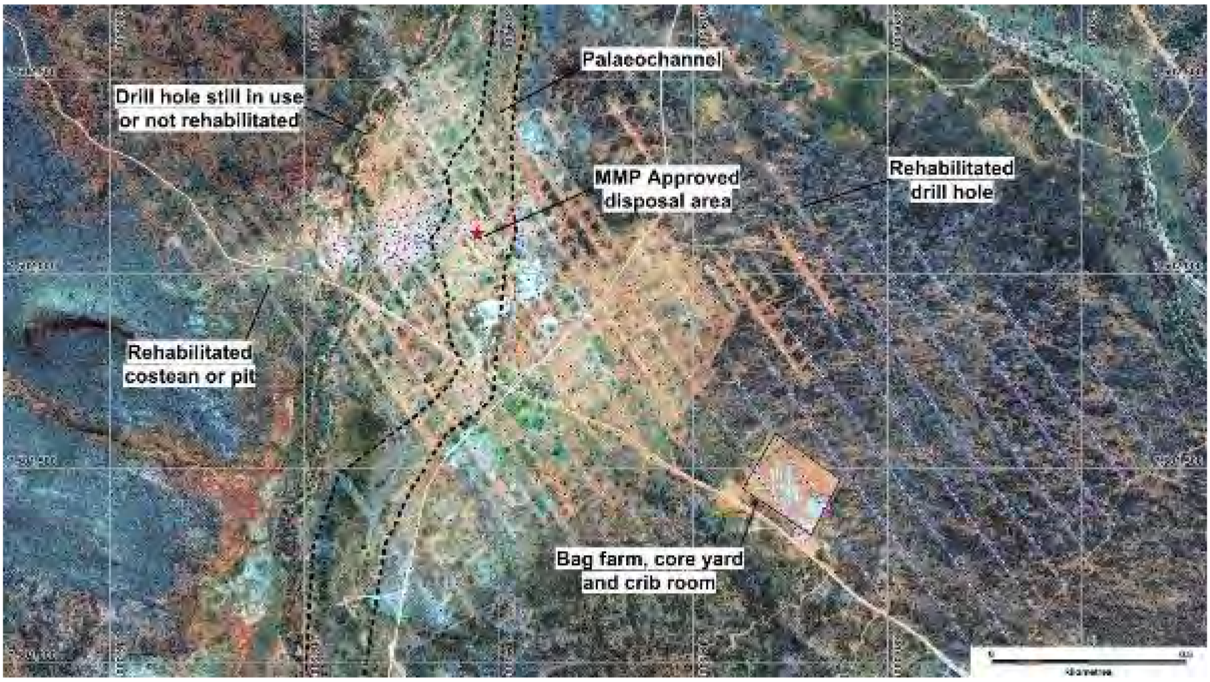


Figure 4-1 Location of MMP Approved radioactive disposal area within the 2-4m thick paleochannel that crosses through the centre of the deposit

4.1.4 Capping – longevity

An assessment of the effectiveness of the barrier system (i.e. capping) is provided in Appendix W of the EIS. The use of natural materials is preferred because they generally do not deteriorate if placed in accordance with specifications. A capping thickness of 2 m will be will provide adequate shielding of the underlying material (refer Section 4.1.3).

The waste rocks to be utilised as capping material will be more enduring and longer lasting than the soil layer which currently covers the deposit. It is a given that these waste rocks will be much more resistant to weathering and erosion than soil in the long term (this is explained in more detail below).

Drilling and excavation activities at Nolans Bore demonstrate that the country rocks are very hard, with extremely slow penetration rates observed in both percussion and core drilling. Ore characterisation assessment undertaken of both the ore and waste rock provides an indication of the strength and hardness of the material to be used as capping (Table 4-2).

Table 4-2 Comminution test work

Comminution	Ammtec 2016		ALS 2016
Parameter	MT1-3 Samples	Waste/Gneiss Samples	MT4-5 (Calc Silicate) Samples
Average CWI (kWh/t)	8.6	8.5	9
Range CWI (kWh/t)	3.4 - 15.8	4.9 – 16.4	6.1-16.0
Average BM BWI (kWh/t)	10.2	12.6	14

Comminution	Ammtec 2016		ALS 2016
Range BM BWI (kWh/t)	7.1 – 12.5	9.9 - 14.3	11.5 – 16.3
Average RM BWI (kWh/t)	-	12.05	10.3
Range RM BWI (kWh/t)	-	10.5 - 13.6	6.86-13.0
Average Axb	118.76	56.18	79.3
Range Axb	65.9-127.5	45.1-65.1	58-115.9
Average Ai	0.04345	0.4021	0.1791
Range Ai	0.024 - 0.063	0.335 - 0.469	0.158 - 0.204

Note: CWI = crusher work index, BWI = bond work index, Axb = JK drop test, Ai = abrasive index

The strength and competency of the waste rocks at Nolans Bore is due to their annealed (interlocking) crystalline metamorphic textures and their composition. Due to the nature of the fabrics in the waste rocks, this also means that the gneiss and pegmatite units, which form the bulk of the waste rocks, will naturally break up into large angular blocky boulders, while the schists (and mylonitised gneiss) will naturally tend to form blocky or tabular slabs. Thus, when the broken waste rocks from Nolans Bore are stacked and packed as a 2 m thick capping, the waste rock boulders will effectively "lock" into place and provide a stable interlocked erosion resistant barrier.

The outcropping rocks in the immediate surrounds are the same as those to be dug from the open pit. They are slightly to moderately weathered, and geological mapping indicates the current landforms are essentially stable with very slow erosion rates. Geological evidence indicates the sloping surface rises around the deposit have existed since the mid-Tertiary (Hill 2009). It is recognised that land surfaces and landforms don’t exist forever; they are slowly modified and eroded over geological time. However, it can be argued from a geological point of view that the observed land surfaces are ancient and closely approximate the actual geomorphic expressions expressed by the current geology given that erosion rates are very slow in Central Australia. Studies have demonstrated that weathering and erosion rates are extremely slow in central Australia with erosion rates for natural rocks and rocky areas varying from less than one and up to about 15 mm per thousand years (Bierman and Caffee 2002; Belton et al 2004; Heimsath et al 2010; Quigley et al 2010). These studies cover a large part of central Australia, and extend northwards into the tropics where there are much wetter climates. In general, the results from central Australia typically indicate the long term integrated erosion rates of less than 10 mm per 1000 years. Similar long-term erosion rates have also been measured at the Devils Marbles where average rainfall is about 340 mm. This is about 10% higher than the average around Nolans Bore and Alice Springs. It is noted from the above-mentioned studies, that areas with three or more times the average rainfall of central Australia (e.g. Kakadu) have slightly higher erosion rates but they are still about the same order of magnitude as those measured for more arid environments in central Australia.

The waste rocks are also chemically inert and contain only trace amounts of sulfide (as small pyrite cubes). AMD test work and initial mining planning assessments have shown that the vast majority of the waste rock are non-acid forming (refer to Section 4.27). Hence the waste rocks will not will not rapidly breakdown and degrade due to the oxidation of sulfide. The waste rocks are typical rock types and they do not contain components that will readily breakdown upon exposure.

Further testwork will be undertaken during operations to ensure this thickness is adequate from an erosion perspective, as detailed in the Closure Plan (Appendix W of the EIS).

4.1.5 Pit water quality post-closure

A conceptual water balance model of the final void is included in Figure 4-2. From Figure 4-2 it can be seen that there are three inflows considered in the model:

- Direct rainfall onto the pit lake.
- Runoff from the exposed surfaces of the pit.
- Groundwater seepages.

Pit losses are assumed to be limited to evaporation from the pit lake surface.

The water balance model is a mass balance for water and dissolved salt, where the change in the stored water is the difference between the inflows (rainfall, runoff and groundwater) and outflows (evaporation). It is assumed that there is no loss of salts from the pit lake.

A monthly time step was adopted for a simulation period of about 500 years.

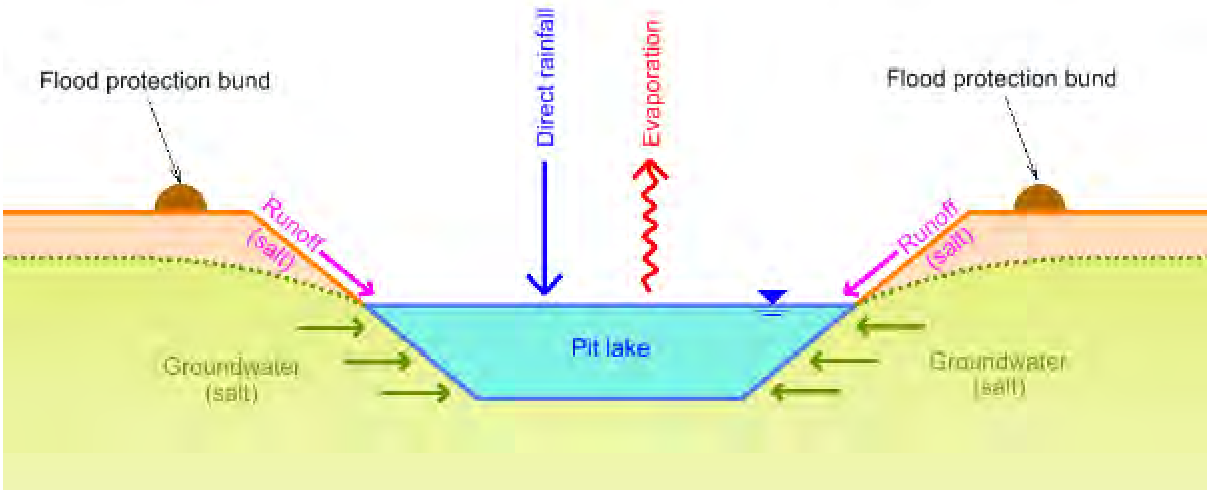


Figure 4-2 Conceptual pit water balance model

4.1.5.1 Pit geometry

The final pit void is represented in the model by relating the pit lake surface area and total lake volume to water level (Figure 4-3). The total volume of water has been calculated on the pit depth of 225 m.

The pit lake surface area is used to estimate the evaporation losses form the lake (resulting in the evapo-concentration of the accumulated salts within the lake).

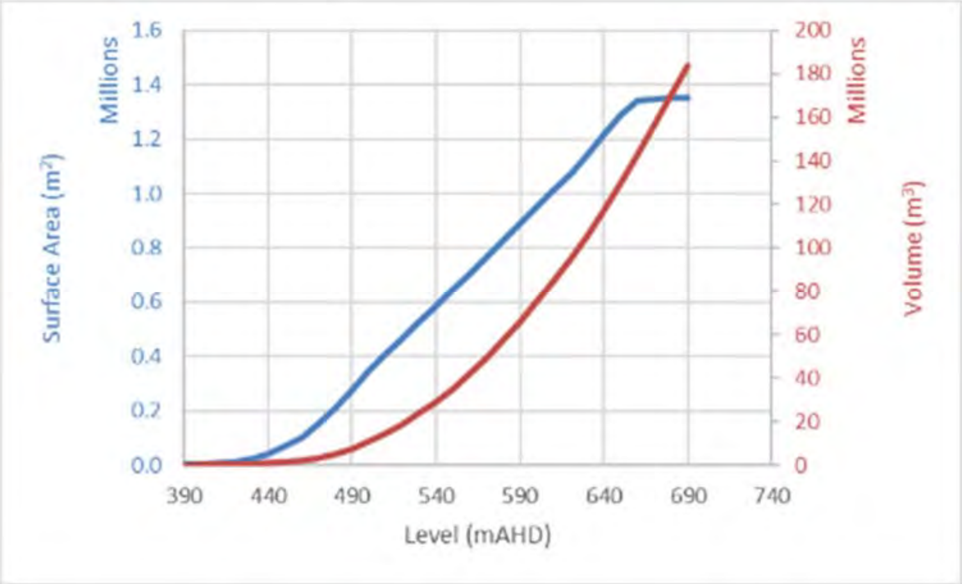


Figure 4-3 Final pit geometry

4.1.5.2 Groundwater inflows

Groundwater modelling provides an estimate of groundwater inflows for various pit invert levels (Figure 4-4). For the purposes of estimating the final pit lake water level, it has been assumed that this is a reasonable estimate of groundwater inflows into the pit for water levels within the pit lake as peak pit groundwater inflows have been predicted at approximately 4000 m^3/day and steady state post closure inflows at approximately 700 m^3/day.

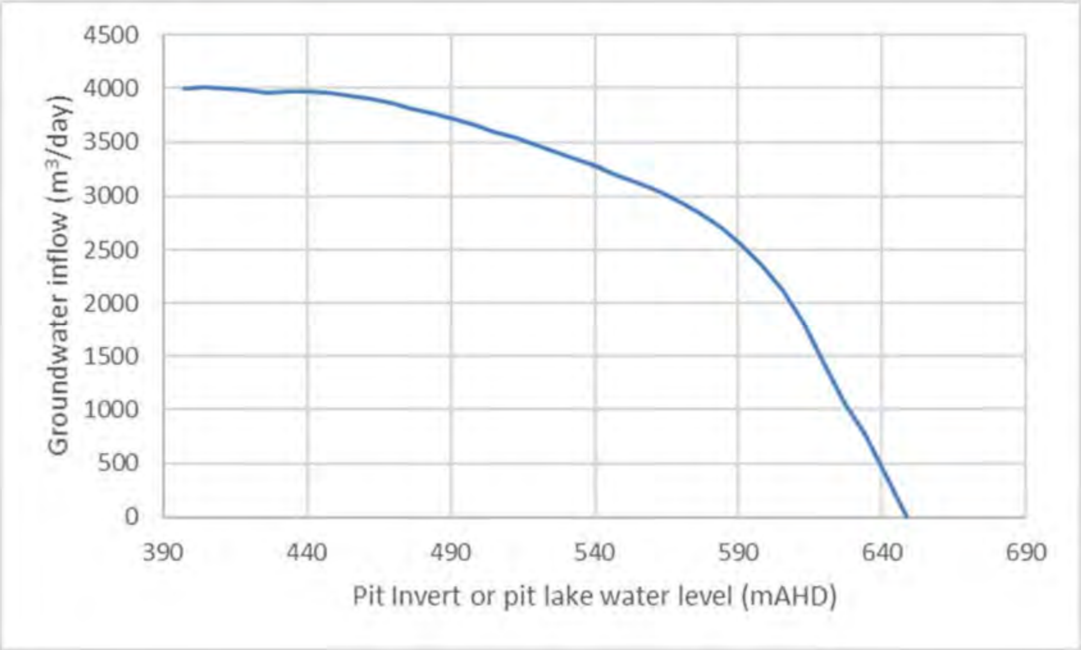


Figure 4-4 Groundwater inflows

Rainfall and runoff

Rainfall falls onto the surface of the pit lake and becomes runoff from the exposed surfaces of the pit. It has been assumed that 90% of rainfall onto the exposed surfaces of the pit walls becomes runoff.

Evaporation losses from the pit lake surface are included in the modelling.

A summary of the average monthly rainfall and evaporation is included in Table 4-3.

Table 4-3 Average monthly rainfall and evaporation

Month	Rainfall (mm)	Evaporation (mm)
January	22	237
February	27	263.25
March	37	288
April	38	304.5
May	42	247.5
June	32	239.25
July	17	173.25
August	19	111.75
September	14	83.25
October	15	93
November	10	130.5
December	8	182.25

Salt concentrations

Assumed salt concentrations within the three pit inflows are summarised in Table 4-4. By combining these salt concentrations with the estimated pit inflows (and evapo-concentration of accumulated salts within the pit lake), an estimate of salinity levels (and trends) within the pit lake may be made.

Table 4-4 Assumed conductivity and salt concentrations

Source	Average conductivity (S/cm)	Average salt concentration (g/m^3) A
Groundwater B	3000	1920
Runoff C	70	45
Rainfall	0	0

A Assumes a correction factor of about 0.64

B Average groundwater conductivity from groundwater bore data surrounding Nolans Bore.

C Average surface water conductivity from surface water quality observations at Arden Soak Bore (G0280010) and Allungra Waterhole (G0280004).

Results

The final void water and salt balance model was used to estimate the approximate long term stable water level within the final pit void, as well as the concentration of salts within the final pit void.

Water level

The modelling indicated that water levels are expected to reach equilibrium at around 612 mAHD within about 215 years following mine closure (Figure 4-5). At this point, average inflows (rainfall, runoff and groundwater) approximately equal evaporative losses (Figure 4-6).

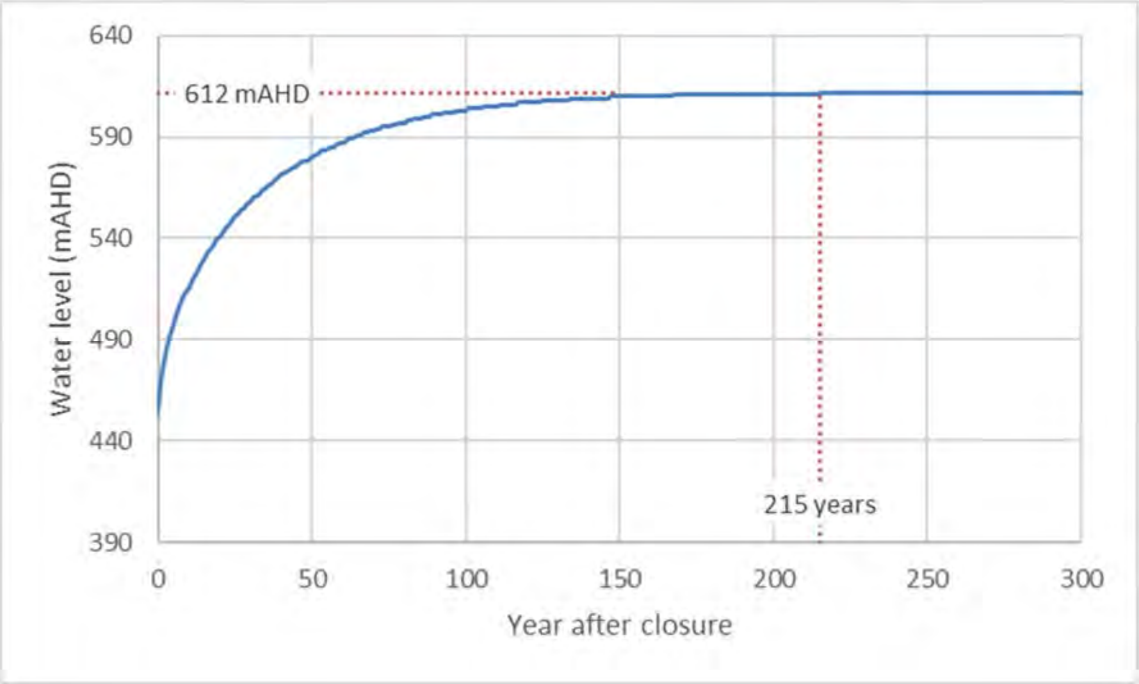


Figure 4-5 Modelled pit water level

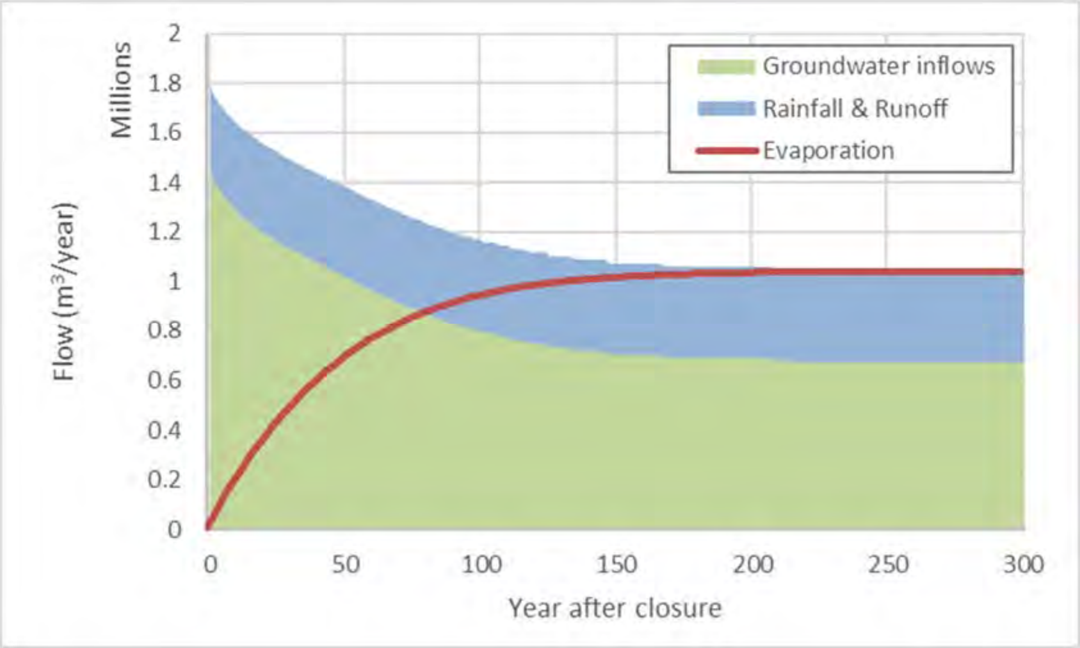


Figure 4-6 Modelled inflows and outflows

Salt concentrations

Modelled salt concentrations within the pit lake are shown in Figure 4-7.

The modelling indicates that salt concentrations within the pit lake are expected to exceed the local groundwater concentrations within about 50 years following closure, but are expected to remain within a range suitable for watering cattle (ANZECC ARMCANZ 2000) for about 100 years. After about 150 years, salt concentrations are estimated to become too high for watering cattle without loss of production (ANZECC ARMCANZ 2000).

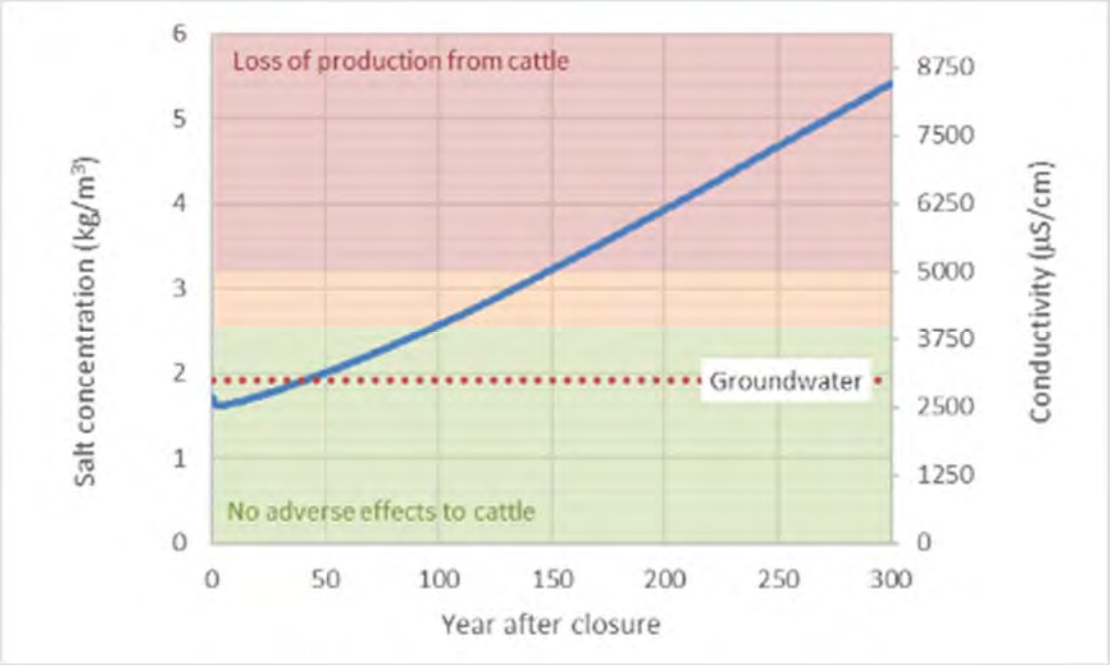


Figure 4-7 Modelled salt concentrations

4.2 Climate change

Australian climate change models for the North Rangelands region (Australian Government 2016a) indicate:

- Average temperatures will continue to increase in all seasons (very high confidence).
- More hot days and warm spells are projected with very high confidence. Fewer frosts are projected with high confidence.
- Changes to rainfall are possible but unclear and may result in a drier or wetter climate.
- Increased intensity of extreme rainfall events is projected, with high confidence.
- Time spent in drought is projected, with medium confidence, to increase over the course of the century.

Total rainfall over the last 45 years has decreased in the region in order of 20 – 30 mm per ten-year period (Figure 4-8). Although the direction of annual rainfall change, as a result of climate change, cannot be confidently projected, an increase in intensity of extreme rainfall events is projected with high confidence. An understanding of the physical processes that cause extreme rainfall, coupled with modelled projections, indicate a future increase in the intensity of extreme rainfall events but the magnitude of the increases cannot be confidently projected.

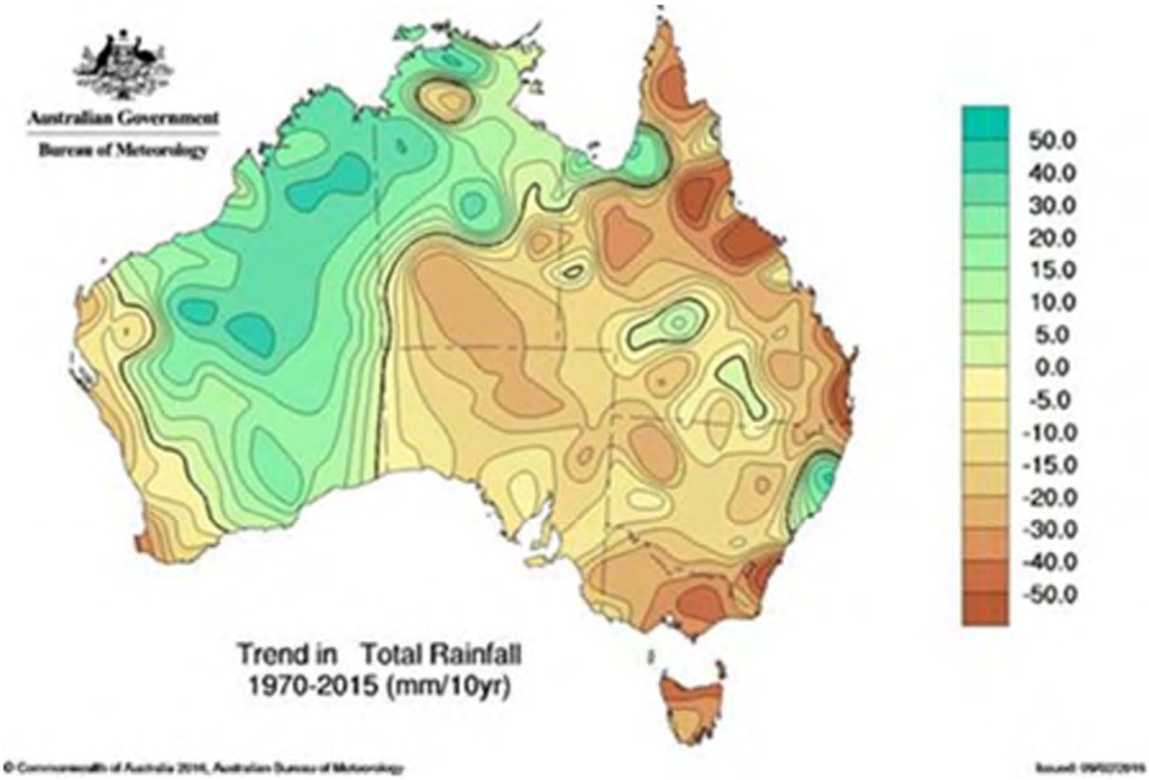


Figure 4-8 Trend in Total Rainfall between 1970 – 2015 (BOM 2015)

Modelled projections detailing seasonal changes in wettest day suggests an increase in rainfall totals for the seasons of summer and winter and a decrease for the seasons of autumn and spring. Figure 4-9 illustrates the best-case emissions scenario (RCP4.5 – blue bar) and the worst-case emissions scenario (RCP8.5 – purple bar) against natural climate variability (grey bar). The wettest summer day is predicted to increase in order of 2 – 6% and the wettest autumn day by 3 – 8% by 2090.

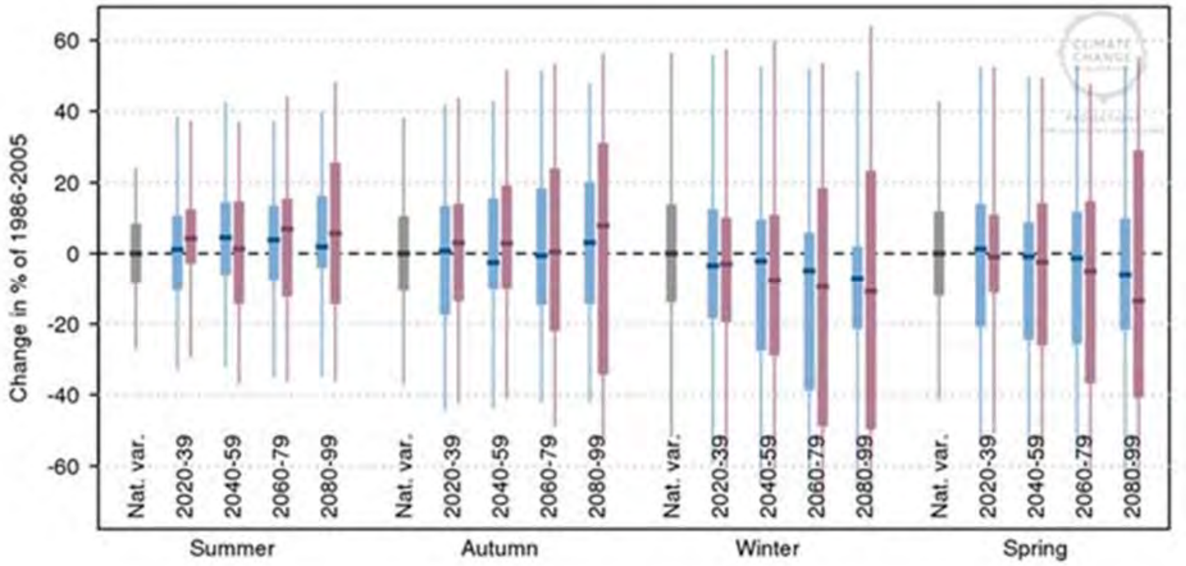


Figure 4-9 Extreme Data Explorer – Rangelands wettest day (Australia Government 2016b)

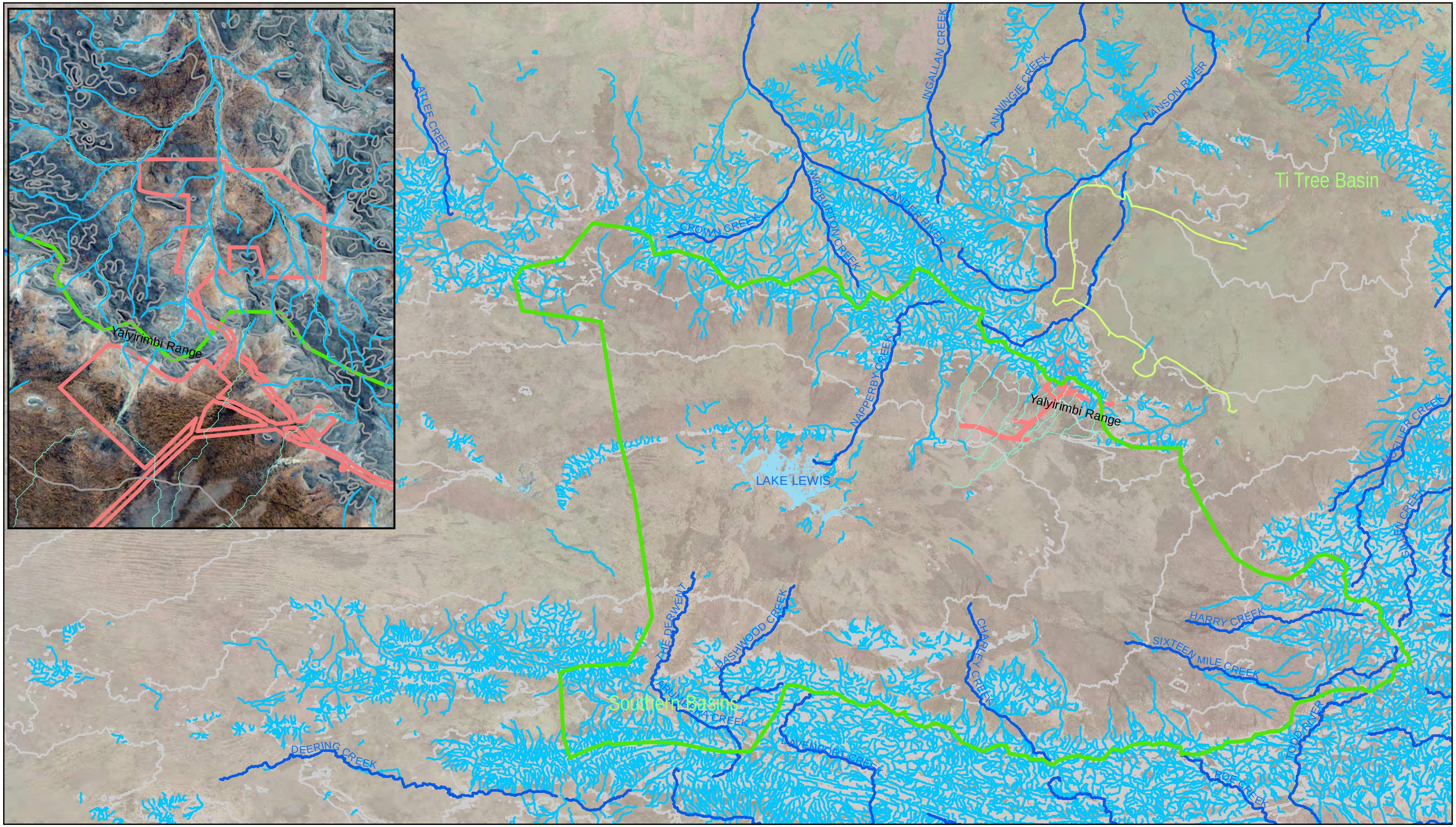
4.3 Lake Lewis

4.3.1 Hydrology

Lake Lewis is a transitory salt-lake composed of salt pans, clay pans, saline lakes and a number of islands within a 1,326 km² area. It is primarily a surface water feature, and water is delivered to Lake Lewis by low and unpredictable seasonal rainfall and run off from a large catchment including ephemeral creeks; two creeks to the south and two creeks to the north (Day Creek and Napperby Creek). The Napperby Creek (south from the Reynolds Range) directly feeds water into Lake Lewis, and populates the site with fish during periods of inundation (Duguid et al. 2005).

Lake Lewis is primarily a surface water feature which receives incident rainfall and runoff from a large catchment. The Napperby Creek is the only major creek that flows and directly connects and discharges into Lake Lewis just south of the Tanami Road (refer Figure 2-1 of Appendix I the EIS). Napperby Creek headwaters are in the Reynolds Range and it passes through and drains from the Yalyirimbi Ranges. Day Creek east of Napperby Creek, and Gidyea Creek west of Napperby Creek, both flow from the Yalyarimbi Ranges however these both disperse into sand plains several kilometres north of the Tanami Road. It is possible that some surface water from these two creeks reach Lake Lewis in extraordinary rainfall events.

Mapping of the surface water catchment to Lake Lewis was performed on 250K topographic contours. The surface water catchment for Lake Lewis is approximately 23,540 km^2. The footprint of the proposed development located on the Lake Lewis surface water catchment includes the processing site, accommodation village and the water supply borefield with areas of 15.9 km^2, 0.72 km^2 and 415.7 km^2, respectively. The total loss of surface water catchment area from the proposed development footprint is potentially a maximum of about 16.6 km^2. This represents a loss of approximately 0.07% of the total surface water catchment area for Lake Lewis. Refer to Figure 4-10 for Lake Lewis surface water catchment mapping.



Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

LEGEND

- Water Resource Basins
- Major Waterways
- Other Waterways
- Local Flow Paths
- Elevation contour
- 🟩 Lake Lewis surface water catchment
- 🟥 Project Areas
- Water bodies

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Environmental Impact Statement

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Lake Lewis Surface Water Catchment Area

Figure 4-10

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Data source: Geoscience Australia, GeoTOPO 250K, v3/2006; Department of Mines and Energy, Mineral Titles, Strike Download/10/03/2015; DPLE, Tenure/Cadastre, 2015. Created by: CM

Surface water recharge to the Lake has not been quantified by the groundwater model. Considering groundwater recharge only, a loss of 3% of recharge is anticipated. However, as a surface water feature, Lake Lewis is primarily recharged by rainfall. An example water balance for Lake Lewis has been developed to take into consideration surface water recharge compared with the values quantified by the groundwater model (Table 4-5). The steady state loss to Lake Lewis as a result of groundwater extraction has been calculated at 0.0015%.

Table 4-5 Example Lake Lewis Water Balance (not including runoff) with comparisons to the EIS model

Description	Value	Unit
Average rainfall	371	mm
Average rainfall	0.371	m
Lake Area	250	km^2
Lake Area	25000000	m^2
Incident Rainfall on Lake	9275000	m^3/year
Lake Lewis Area Model Catchment (Zone)	6751854936	m^2
Lake Lewis Area Model Catchment (Zone)	2504938181	m^3/year
Peak difference in ET (and drains) in model	712	m^3/day
Peak difference in ET (and drains) in model	260058	m^3/year
Steady State difference in ET (and drains) in model	103	m^3/day
Steady State difference in ET (and drains) in model	37620.75	m^3/year
Groundwater loss to ET	21600	m^3/day
Groundwater loss to ET	7889400	m^3/year
Peak loss factoring incident rainfall on lake	17164400	1.5%
Peak loss factoring incident rainfall on catchment	2512827581	0.01%
Steady state loss factoring incident rainfall on lake	17164400	0.2%
Steady state loss factoring incident rainfall on catchment	2512827581	0.0015%

4.3.2 Peak evapotranspiration and groundwater drawdown

Groundwater drawdown is a measure of the change in head between pre-mining conditions compared against during and after mining conditions. There is no modelled drawdown in the Lake Lewis area. The Lake Lewis area remains a discharge location from pre-mining to during and after mining. The conceptual model (and numerical model) allows for groundwater presenting at surface of Lake Lewis to discharge (i.e. leave the model), effectively modelling the process where water is removed via evapotranspiration (the sum of evaporation and plant transpiration) from Lake Lewis. Although there is no change in head (or drawdown) at Lake Lewis, however, the model is capable of predicting the relative difference between the amount of groundwater discharging there between the modelled pre-mining conditions compared against during and after mining modelled conditions. Appendix K of the EIS presents this as a “decreases in groundwater availability for evapotranspiration” and this decrease is highest (i.e. at its peak) at the end of mining (i.e. at the end of the borefield pumping). Thus groundwater drawdown refers to head, “peak evapotranspiration” is not a measure used in the report, however the measure expressed as the opposite a decrease in groundwater available for evapotranspiration which refers to the groundwater flow available for discharge at Lake Lewis.

4.3.3 Ecology

Lake Lewis is a site of conservation significance for threatened plants and animal species. The Australian Bustard (*Ardeotis australis*), Emu (*Dromaius novaehollandiae*) and Brush-tailed Mulgara (*Dasycercus blythi*) live in this habitat, and are listed as Vulnerable species. The Southern Marsupial Mole (*Notoryctes typhlops*) lives in the granite plains habitat of the northwest zone, and is listed as an Endangered species. Lake Lewis is an important wetland of national significance for a large number of waterbirds, including the Black-winged Stilt and Grey Teal (Duguid et al. 2005).

4.3.4 Potential Impact

An ‘impact’ on Lake Lewis associated with the project could be a gap in the salt accumulation in Lake Lewis, by a very small percentage, as a result of a 0.01% peak loss of water available for evaporation in Lake Lewis. This is not considered to have wider implications to the Lake.

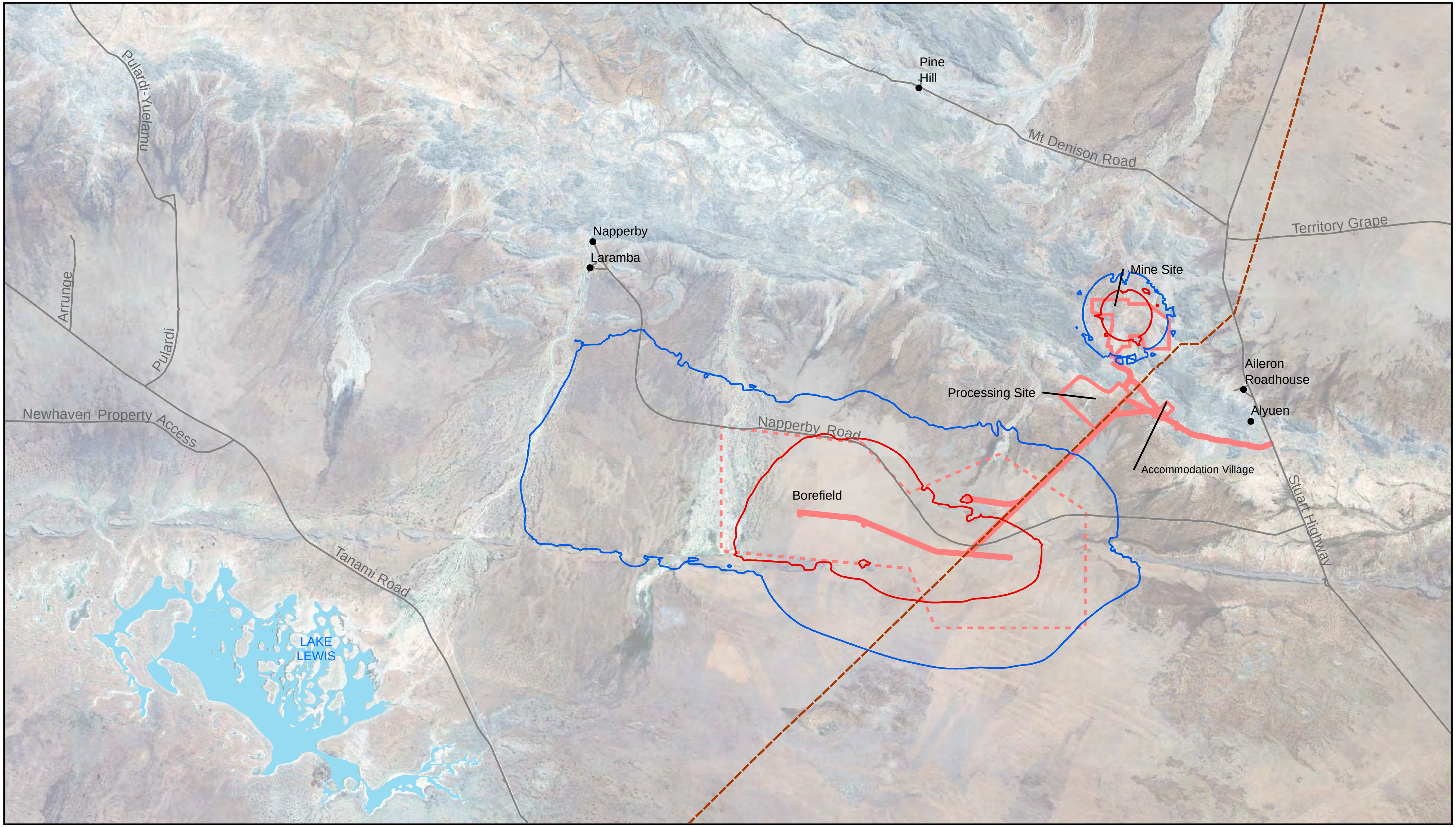
4.4 Groundwater Drawdown

The 0.1 m and 1 m drawdown contours for the 2.7 GL/year scenario (Model 301 [303]) are presented as Figure 4-11 to Figure 4-14. The drawdown contours for other scenarios are presented in Appendix 10 for EIS Model 139 and Models 307 and 400.

The calculations for the 0.1 m and 1 m drawdown areas, in hectares, are presented as Table 4-6 and Table 4-7. The calculations detail the area of drawdown for various times including mid-mining, end of mine, after 100 years of closure and after 1000 years of closure.

Figure 4-15 and Figure 4-16 provide a graphical comparison of the drawdown areas between the various modelled scenarios.

It should be noted that drawdown areas are not synonymous with induced areas of inflow which are considerably smaller than drawdown areas.



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0 5 10 15 20

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

Drawdown (m)

- 0.1
- 1

- Gas Pipeline
- Major Roads
- Project Areas
- Borefield Area
- Waterbodies

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Mid-Mining Drawdown (2.7GL/year) Figure 4-11

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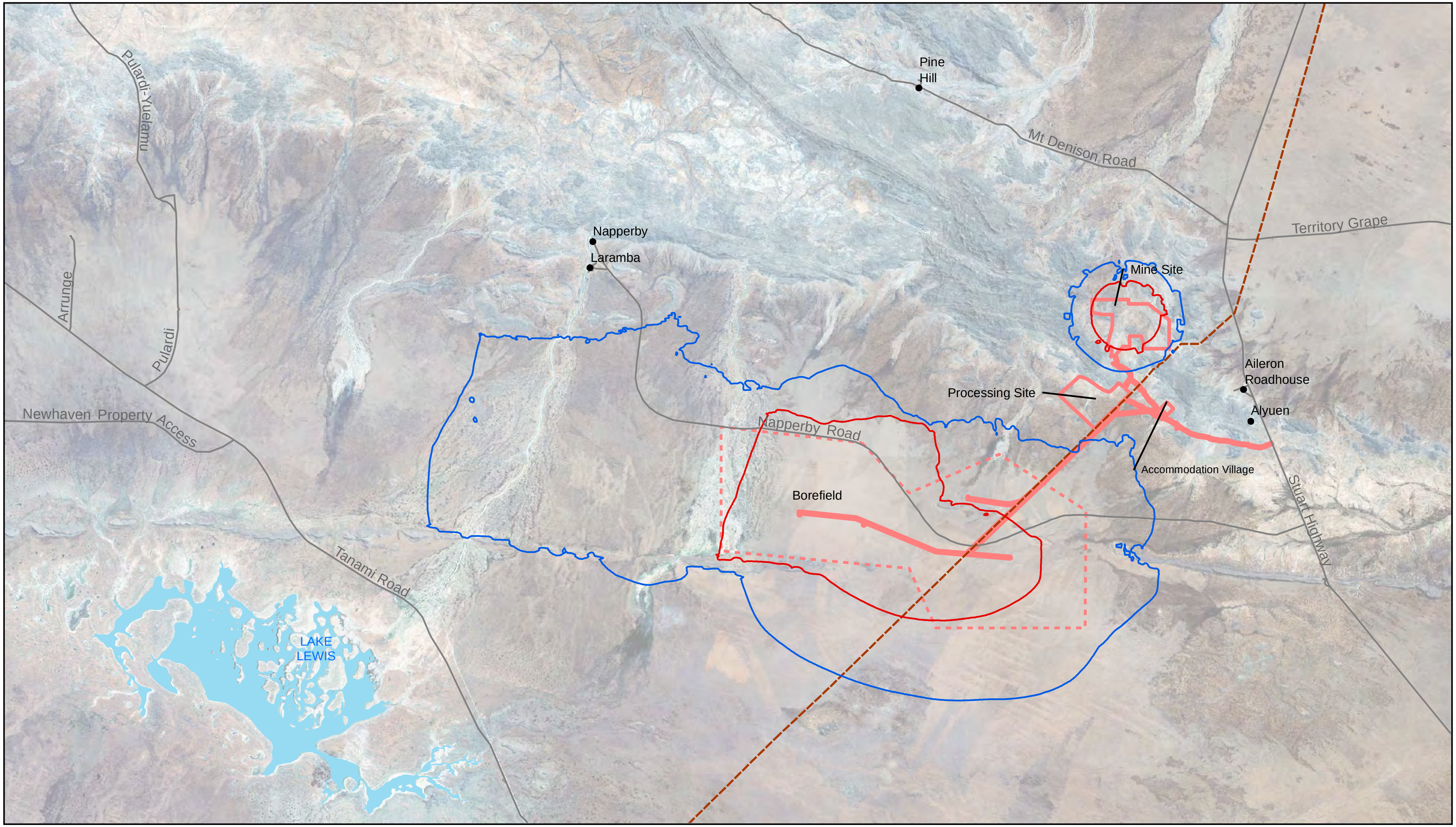
Level 5 66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 04/02/2015). Ride - Groundwater Data (2015). ARL - Project Areas (2015). GA - Placenames, Railways, Gas Pipeline, Major Roads, Waterbodies (2015). Created by: CM



1:500,000 @ A4

0 5 10 15 20

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

Drawdown (m)

- 0.1
- 1

- Gas Pipeline
- Major Roads
- Project Areas
- Borefield Area
- Waterbodies

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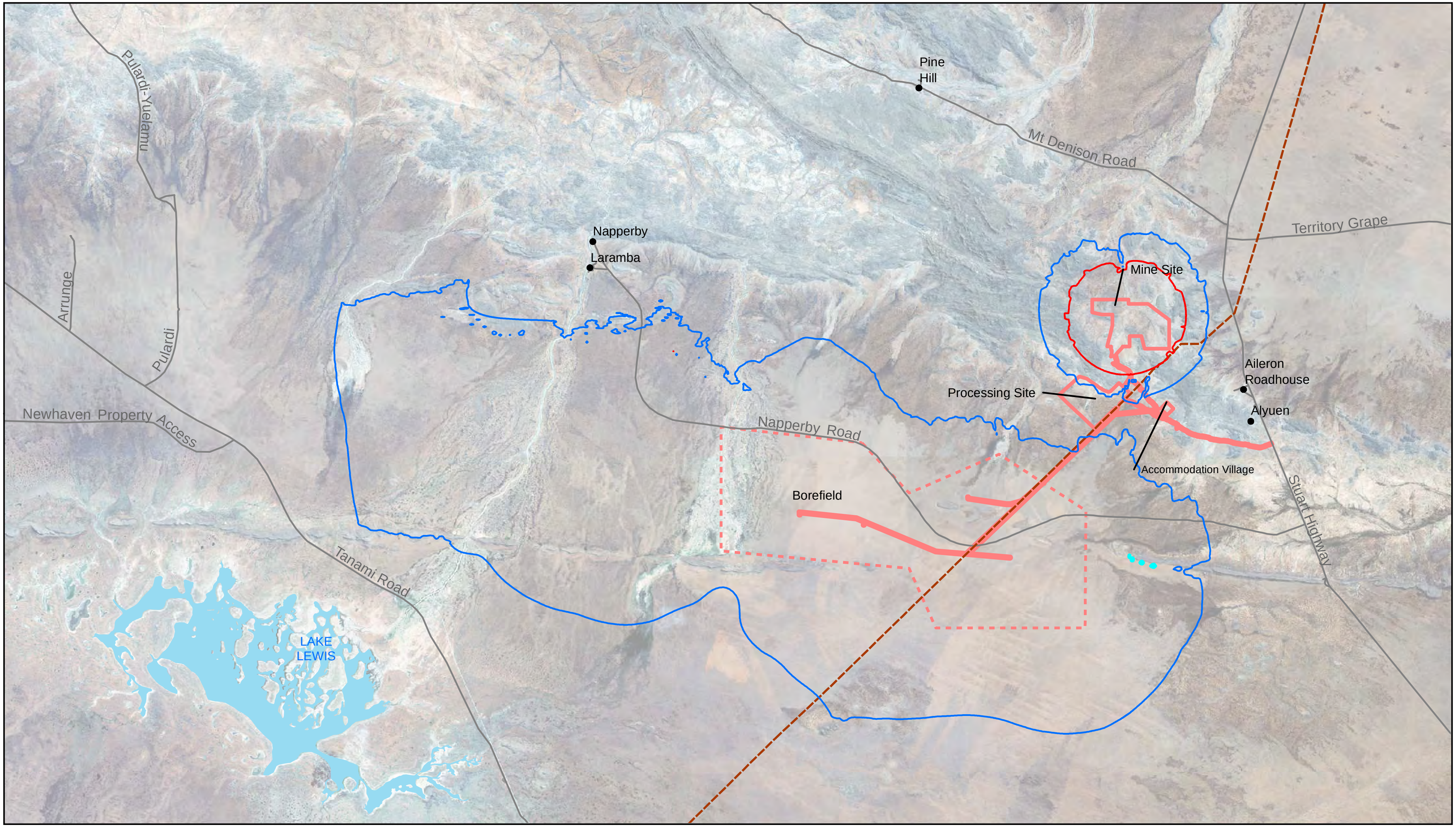
Revision	0
Date	10 Nov 2016

End of Mining Drawdown (2.7GL/year) Figure 4-12

G:\43\22301\GIS\Maps\PDF\Lee Drawdown Maps\Figure 2 End of Mining Drawdown.mxd

Level 5 66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 04/02/2015). Ride - Groundwater Data (2015). ARL - Project Areas (2015). GA - Placenames, Railways, Gas Pipeline, Major Roads, Waterbodies (2015). Created by: CM



1:500,000 @ A4

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

LEGEND

Drawdown (m)

—	0.1
—	1
- - -	Gas Pipeline
—	Major Roads
▭	Project Areas
┄	Borefield Area
🟦	Waterbodies

Arafura Resources Limited
Nolans Project

Job Number	4322301
Revision	0
Date	10 Nov 2016

100 Years of Closure Drawdown (2.7GL/year) Figure 4-13

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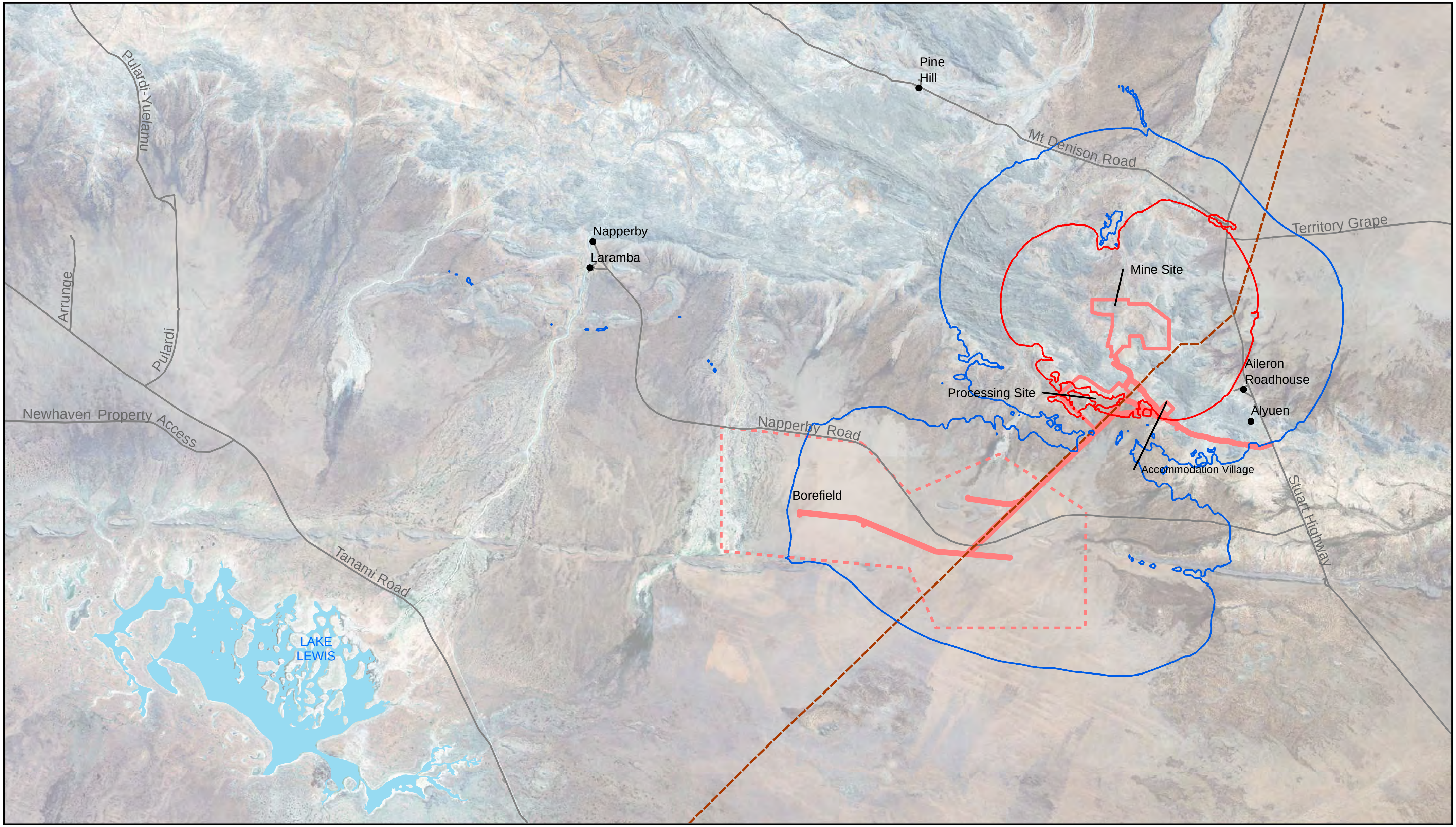
Level 5 66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 04/02/2015). Ride - Groundwater Data (2015). ARL - Project Areas (2015). GA - Placenames, Railways, Gas Pipeline, Major Roads, Waterbodies (2015). Created by: CM



Arafura Resources Limited
Nolans Project

Job Number	4322301
Revision	0
Date	10 Nov 2016

1000 Years of Closure Drawdown (2.75GL/year) Figure 4-14

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Level 5 66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 04/02/2015). Ride - Groundwater Data (2015). ARL - Project Areas (2015). GA - Placenames, Railways, Gas Pipeline, Major Roads, Waterbodies (2015). Created by: CM

Table 4-6 0.1 m Drawdown Area (ha) Calculations

	EIS Model	Supplement Model	Arafura alternate Model	Specific yield (0.4)
GHD Model No.	Nolans139	Nolans301 (303)	Nolans307	Nolans400
Steady state model (RMS)	2.83	2.83	3.27	2.83
Southern Borefield Rate (GL/year)	4.7	2.7	2.7	2.7
Basement Kh (m/day)	0.01	0.01	0.001	0.01
Mining Years	40	40	40	40
Southern Borefield Total Extraction (GL)	188	108	108	108
Further PEST Adjustment	No	No	Yes, all including recharge on basement	No
0.1m Drawdown Area (hectares)	(hectares)	(hectares)	(hectares)	(hectares)
Southern Borefield Mid-Mining	127787	108944	105377	185606
Southern Borefield EOM	171717	148337	140695	212503
Southern Borefield EOM + 100 years	243110	208600	206015	254438
Southern Borefield EOM + 1000 years	90308	74045	0	181178
Nolans Pit Mid-Mining	5063	5063	1382	8488
Nolans Pit EOM	8455	8455	2191	11132
Nolans Pit EOM + 100 years	18916	18916	4012	35483
Nolans Pit EOM + 1000 years	86978	86978	10236	203491

Table 4-7 1 m Drawdown Area (ha) Calculations

	EIS Model	Supplement Model	Arafura alternate Model	Specific yield (0.4)
GHD Model No.	Nolans139	Nolans301 (303)	Nolans307	Nolans400
Steady state model (RMS)	2.83	2.83	3.27	2.83
Southern Borefield Rate (GL/year)	4.7	2.7	2.7	2.7
Basement Kh (m/day)	0.01	0.01	0.001	0.01
Mining Years	40	40	40	40
Southern Borefield Total Extraction (GL)	188	108	108	108
Further PEST Adjustment	No	No	Yes, all including recharge on basement	No
1m Drawdown Area (hectares)	(hectares)	(hectares)	(hectares)	(hectares)
Southern Borefield Mid-Mining	45583	27859	28621	61125
Southern Borefield EOM	64618	38158	39416	80899
Southern Borefield EOM + 100 years	36363	0	0	1950
Southern Borefield EOM + 1000 years	0	0	0	0
Nolans Pit Mid-Mining	1815	1815	403	3412
Nolans Pit EOM	3433	3433	626	4725
Nolans Pit EOM + 100 years	9267	9267	894	16476
Nolans Pit EOM + 1000 years	35733	35733	2130	62688

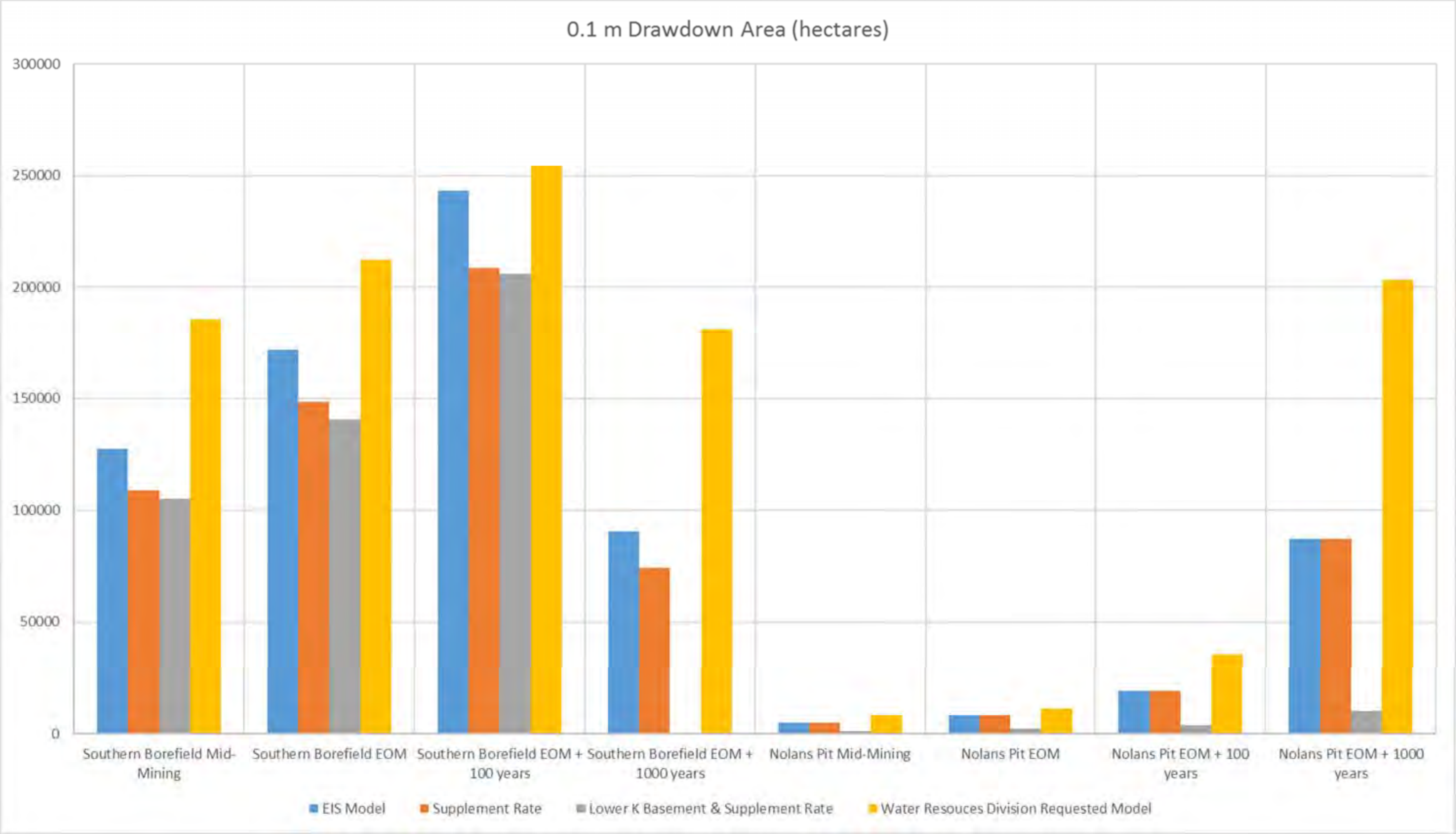


Figure 4-15 0.1 m drawdown area calculations

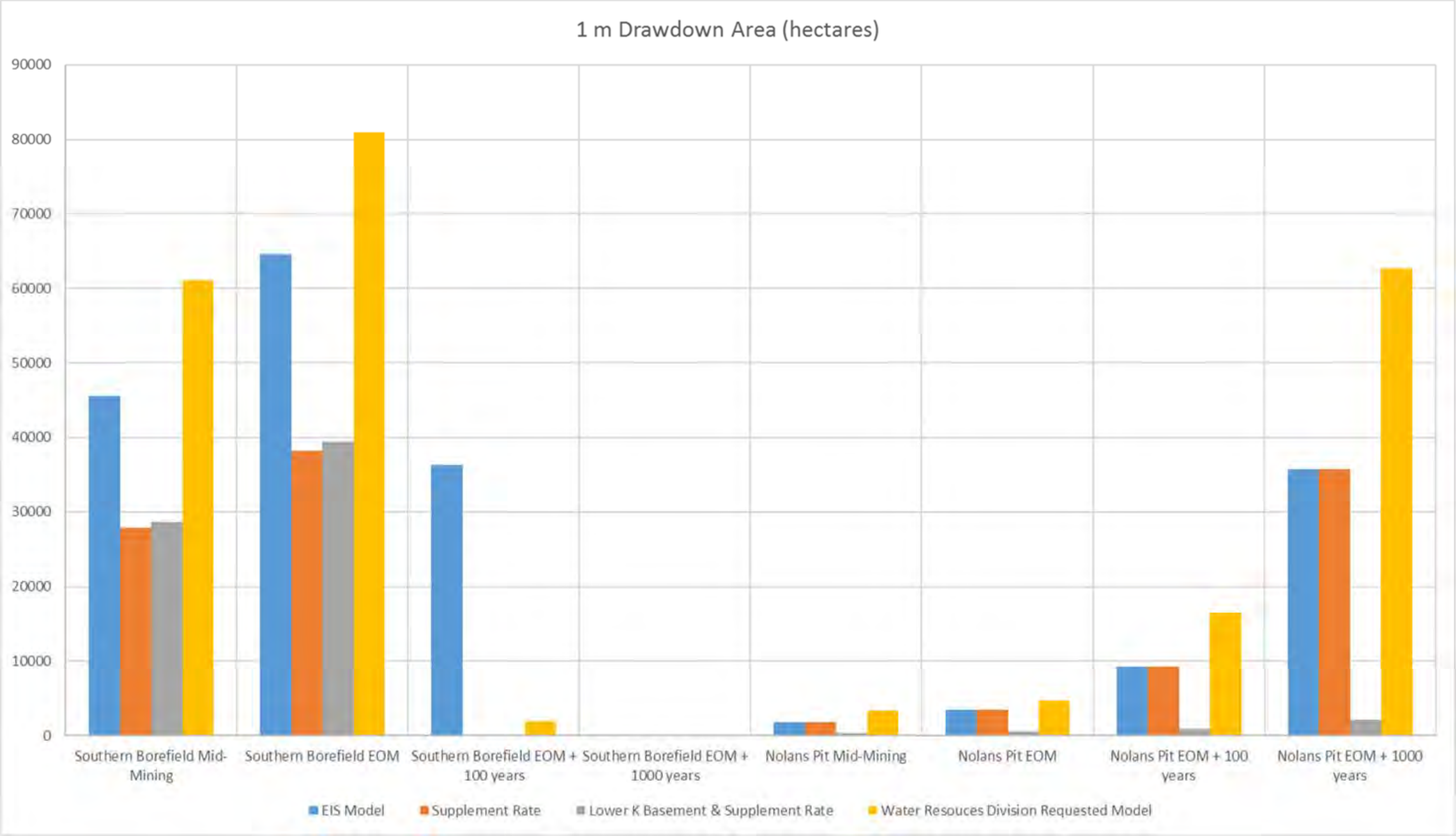


Figure 4-16 1 m drawdown area calculations

Table 4-8 Recharge quantifications

	Description	Type	Areas	Rate mm/year	Percentage of Direct Average Rainfall	Total Volume per year	% of total recharge
Regional Basement Outcrop	Fractured rocks of the ranges and hills	Diffuse	1640864217	0.8	0.3%	1319	6%
Regional Basin Cover	Diffuse recharge from rainfall falling on for example sand dunes and plains country	Diffuse	14845996018	0.8	0.3%	11930	55%
Basin areas receiving runoff from Basement outcropping as hilly terrain. Large River and Creek Channels Small Terminal Creeks Floodout Areas	The alluvial fans and plains immediately adjacent to the ranges and hills where runoff infiltrates into the plains at a higher rate than diffuse recharge. Infiltration from Lake Lewis and the areas locally referred to as 'swamps' and 'clay pans' following inundation events.	Direct	2325315768	3.7	1.1%	8493	39%

4.5 Groundwater Dependant Vegetation

Vegetation communities associated with Day Creek have been mapped and are provided in Figure 3-3. The vegetation that is most likely to be reliant on groundwater are river red gums, bloodwoods and bean trees (O'Grady et al. 2009; Santini et al. 2016). Ghost gums may also access groundwater resources, but this has not been examined in central Australia.

Most studies suggest a threshold depth of around 8 to 10 m for reliance on groundwater by vegetation. While some plants may extend roots much deeper than this, water tables at such depth are unlikely to support GDEs. At depths of over 20 m the probability of groundwater use is low (Froend and Zencich 2001), given that stands of river red gum and bean tree have a basal area of around 8m^2 per hectare (as observed along Day Creek), and increasing root depth to the water table places additional stress on the tree's internal water transport system equivalent to increasing tree height.

Water table level observations at Day Creek are approximately 28 m below top of collar (RC00026 RN19038). Water table depths greater than 20 m are unlikely to support riparian woodland vegetation given tree response to water table depth elsewhere including in the adjacent Ti Tree Basin.

It seems more likely that trees along Day Creek are utilising water from a perched water supply in recent alluvial material of the creek channel, especially given the lack of tree species known to utilise groundwater away from the creek channel and immediate banks (except near the Reaphook Hills).

The anticipated groundwater drawdown and subsequent rebound at Day Creek (RC ID 26) over the next 1000 years is provided in Figure 4-17. No groundwater connectivity upwards has been determined or hypothesised; rather, Day Creek is more than likely to be a losing feature, thus any beneath drawdown would have no impact on its water balance or levels.

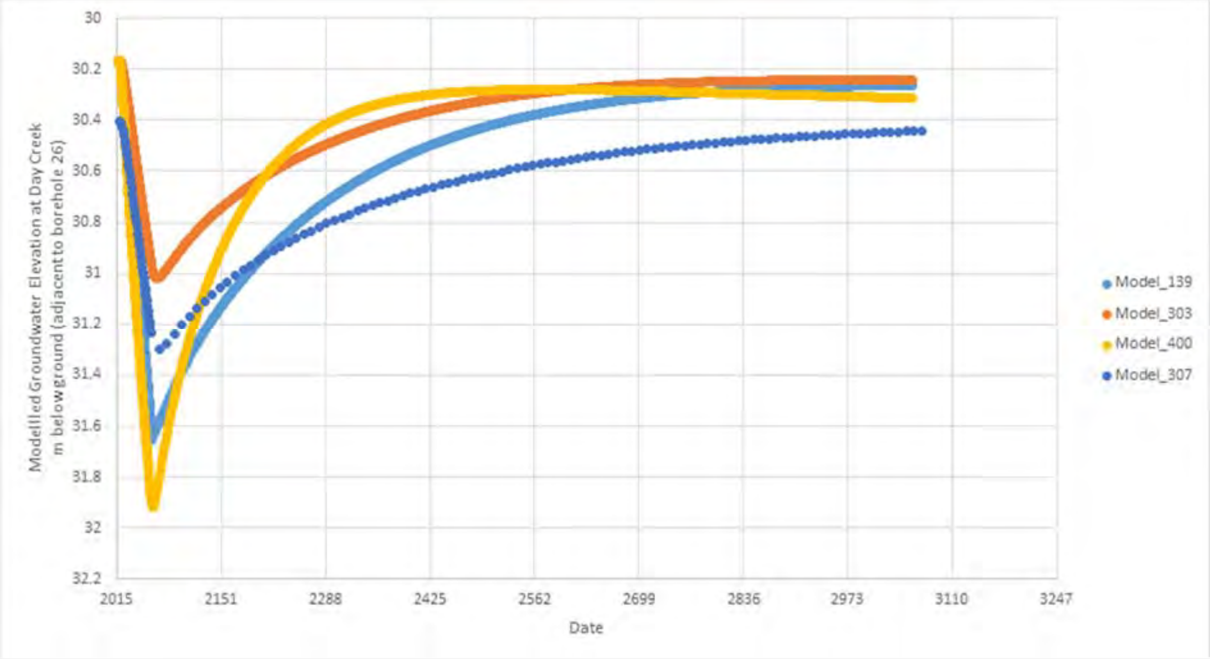


Figure 4-17 Anticipated groundwater drawdown and subsequent rebound at Day Creek

A whole-of-project risk assessment of potential impacts to groundwater dependant vegetation has resulted in a moderate value / moderate to high risk (Appendix 11). The impacts are considered moderate to high because reduction in "*groundwater level(s) would be beyond seasonal variation, resulting in temporary (or permanent loss) or alteration of a defined habitat type.*" A peer review of the risk assessment has also been completed to support the findings (Appendix 12).

Groundwater drawdown within the borefield area will create a situation in which some vegetation communities are likely to need to adjust to changes in soil moisture availability in the soil profile. It is difficult to predict whether these changes would impact tree condition with the limited data available. Short-term changes may be expected, particularly if pumping occurs in drought years when trees are more heavily reliant on groundwater as their water source, during which time ability of trees to access water may decrease and may result in a decline in tree condition (Appendix 12).

The period of potential impact to vegetation associated with Day Creek would be influenced by seasonal rainfall (e.g. above or below average years) but would likely exist for more than 100 years.

A monitoring program including monitoring of water table levels, water quality and tree condition will be implemented prior to water being sourced from the Southern Basins. Refer to the updated Water Management Plan (Appendix 4) for further information. Tree condition monitoring will occur in patches of living River Red Gum, Ghost Gum, Bean Tree, Desert Bloodwood and Coolabah, in areas where the groundwater is predicted to drop following borefield pumping. In addition, monitoring points will be established at control sites that are not expected to be affected by groundwater drawdown. Tree condition monitoring will be included in the Biodiversity Management Plan. This has been included as a commitment.

4.6 Other Groundwater Users

Groundwater users in the vicinity of the Mine are discussed in Section 3.2 of the Groundwater Report and potential impacts, as identified by the groundwater model, are described in the Section 6.4.2. It is noted that the Groundwater Report considers impacts associated with the extraction of 4.5 GL/year for a 43-year period. The 0.1 m and 1 m drawdown contours for the 2.7 GL/year scenario (Model 301 [303]) are presented as Figure 4-11 to Figure 4-14.

In summary, there are no drinking water users in the mine area and existing groundwater is not of a quality that drinking water could be a future beneficial use. The groundwater availability for users within the Ti-Tree Basin is highly unlikely to be measurably impacted.

This localised aquifer, largely confined to the orebody, will be totally dewatered during mine operations and in its place the pit void will be unsuitable for stock watering. Aileron Station water supplies near the pit location will be impacted by the proposed mine dewatering and remain impacted beyond mine closure. Beyond the pit and mining area it is conceivable that local resources in the basement aquifers and adjacent materials may be impacted due to the pit void limiting flowthrough beyond closure relative to the pre-mining conditions.

Existing basement bores in the Alyuen Community and the Aileron Station Homestead and Aileron Roadhouse area, which may have previously been used for drinking water, may be impacted in the long term by mine drawdown. It should be noted that these waters are not currently considered to be of a quality to have a beneficial use as drinking water.

Aileron Station Homestead, Aileron Roadhouse and Alyuen Community is currently source drinking water from the Southern Basins. This source is beyond the reach of the impact of the mine pit.

Pine Hill Station also uses groundwater for stock water from bores as close as the Kerosene Well area, 8 km downstream of the mining lease (bores RN010759 and RN012624). The groundwater modelling indicates that this area is beyond the cone of depression during mining, however it is conceivable that these local resources may be impacted due to the pit void limiting flowthrough beyond closure, relative to the pre-mining conditions. The groundwater modelling predicts no impact at the Pine Hill Station Homestead and nearby outstation.

Groundwater drawdown could theoretically occur in the Laramba Aquifer as a result of Arafura’s extraction of groundwater from distant bore fields but is unlikely. Impact is unlikely due to the characteristics of the Laramba Aquifer; i.e. recharge is principally from flows in Day Creek, it is a shallow aquifer unlike the Reaphook Palaeochannel, which is a very deep aquifer; and its groundwater quality is quite different.

4.7 Aquifer recharge

4.7.1 Recharge description

The EIS (Appendix K) states:

"Recharge was applied in five broad region types across the model but in practice the final calibration approach only utilised two numbers (Table 9 and Figure 23). These are synonymous with the Water Studies (2001) and Knapton (2007) applied values, with one clear difference being the Allungra Creek area. Throughout our calibration it was difficult to justify the very high recharge values applied to this isolated area of the Ti-Tree Basin. One explanation is that these flows are in-part accounted for in our model by areas outside of the previous model area (i.e. the basin areas receiving runoff from the basement outcropping as hilly terrain higher in the catchment, and the smaller terminal creeks and broader flood-out areas). There remains scope for further refinement of these values, particularly following the acquisition of a temporal water level dataset."

Arafura have committed to acquiring a temporal water level dataset, undertaking ongoing validation of the recharge approach, and ongoing re-calibrating the groundwater model. Representing recharge, and replicating its influence on groundwater levels, would be a focus of such work.

4.7.2 Expanded description of the application of recharge

Recharge is commonly a challenging parameter to estimate, especially at the scale in the context of the GHD EIS study. Our study benefited from numerous previous studies (see Section 5.6.3) and application of recharge in the Ti-Tree Basin and these works formed the basis for our application of recharge in the EIS model (both in the Ti-Tree Basin and beyond). The previous work on recharge and its application (both in past and present studies) in the Ti-Tree Basin is summarised in Table 4-9. It should be recognised that each study has unique model areas and unique areas of recharge it is applied to (not always definitively documented). Table 4-9 compares (in yellow highlight) these in a meaningful manner (to an extent that is practicable). The comparisons demonstrate how the GHD applied values are similar (if not the same) to those applied previously in Knapton (2007), albeit they are applied to a much broader area including the areas of outcropping bedrock and the Southern Basins. The exception to this Allungra Creek and this is explained further below.

The calibrated steady state solution involves only two values being applied across the model, both values following on from the work by Knapton (2007). The first, a very low value ($2.2x10^{-6}$ m/day or 0.4 mm/year) is applied to diffuse recharge across broad areas of the model. This very low value is applied for example:

- Over outcropping bedrock.
- The broad Ti-Tree Basin away from run-off areas.
- The sand dunes and open country of the Southern Basins away from the run-off areas.

The second low value ($1x10^{-5}$ m/day or 3.7 mm/year) is applied as direct recharge and is uniformly applied to all areas of elevated runoff.

Steady state calibration of the groundwater model demonstrated model recharge could be applied in a number of non-unique solutions that were almost equally as valid statistically (similar RMS values) with various combinations of hydraulic conductivity applied. In the model calibration process, numerous approaches were applied before the end values were obtained. The starting point for recharge application was a situation synonymous with and as close as practicable to Knapton, (2007). This approach applies the elevated recharge of 1850 ML/day Allungra Creek based on Knapton (2007). The upper Napper Creek area was the only other area within the model where recharge was applied at this high rate. Day Creek was considered for this application, however, the calibration did not warrant it, nor did the water balance. In addition, it was determined that the application of higher recharges here would not represent a conservative predictive model (i.e. could/may mask some of the proposed borefield drawdown). Other than this, only key areas of elevated runoff receive the direct recharge of $1x10^{-5}$ m/day or 3.7 mm/year. Other areas received the very low value ($2.2x10^{-6}$ m/day or 0.4 mm/year) diffuse recharge value in the model. As an example, with the current hydraulic conductivity values applied, this approach returns an RMS values of 4.19 m (Model 503). Where only the Allungra Creek recharge is applied as a high recharge and all other recharges are applied as per the EIS model, the RMS is worse at 4.79 m (Model 505). At the manual calibration stage, the best result with high recharge in the Allungra Creek area gave an unacceptable RMS of approximately 10 m (Model 53). Such results indicated it was difficult to justify/apply a higher recharge to Allungra combined with our broader model scale approach (as is discussed in the EIS Appendix K). Thus, it was difficult to justify the high recharge applied by Knapton and Water Studies (1850 ML/day and 2120 ML/day respectively) when considering the inputs from the broader catchment areas that our model covered.

Like hydraulic conductivity PEST was used to alter recharge parameters, however the best results (or equally as good statistically) were achieved with the approach of two parameters (very low diffuse recharge and low direct recharge applied equally across everywhere in the model domain that appeared (based on aerial photography) to receive any surface water flow. This approach applies the principle of parsimony to try to keep the numbers of parameters in the model as low as possible which is consistent with the recommendations of the Australian groundwater modelling guidelines (Barnett et. al. 2012).

Table 4-9 Summary of recharge estimates and application (past and present) (highlighted values to be compared)

	Source	Type	Area Source	Area Applied to Calculations (m^2)	Estimated rate (mm/year)	Estimated rate (m/year)	Model input value (m/day)	Percentage of Average Annual Rainfall (at 318mm not accounting for runoff from up-gradient areas)	Total Volume ML/year
Ti-Tree Basin upper estimate of "natural through flow" - assumed groundwater inflow for calculation 1000 ML/year based on later estimates	Siedel, 1995	Diffuse and Direct	N/A	3658493967	0.8	0.0008			3000
Ti-Tree Basin upper estimate of "natural through flow" - assumed groundwater inflow for calculation 1000 ML/year based on later estimates	Siedel, 1995	Direct	N/A	3658493967	1.1	0.0011			4000
"Long term mean annual recharge to the freshwater groundwater resource of the Ti-Tree Basin"	Harrington et al., 1999	Direct	N/A		1.9	0.0019		1%	1140
"Other parts of the basin"	Harrington et al., 1999	Diffuse			0.2	0.0002		0.06%	980
Chloride estimate (upper)	Harrington et al., 1999		N/A		0.1			0.03%	
Chloride estimate (lower)	Harrington et al., 1999		N/A		2			1%	
Chloride estimate (mean)	Harrington et al., 1999		N/A		0.8			0.3%	
Radiocarbon estimate (upper)	Harrington et al., 1999		N/A		50			16%	

	Source	Type	Area Source	Area Applied to Calculations (m^2)	Estimated rate (mm/year)	Estimated rate (m/year)	Model input value (m/day)	Percentage of Average Annual Rainfall (at 318mm not accounting for runoff from up-gradient areas)	Total Volume ML/year
Radiocarbon estimate (mean)	Harrington et al., 1999		N/A		3.5			1%	
Ti-Tree Basin (environmental tracer techniques)	Harrington et. al., 1999 as stated in Water Studies, 2001			3658493967	0.7	0.0007			2400
Ti-Tree Basin (simplified catchment model)	DLPE, 2000 as stated in Water Studies, 2001			3658493967	2.7	0.0027			10000
Hanson River Floodout	Water Studies, 2001	Direct	Estimated from PDF of Model Grid	124968060	6.1	0.0061		2%	760
Allungra Creek Floodout	Water Studies, 2001	Direct	Estimated from PDF of Model Grid	45286600	46.8	0.0468		15%	2120
Woodforde River Floodout	Water Studies, 2001	Direct	Estimated from PDF of Model Grid	119338509	18.6	0.0186		6%	2220
Western Ti-Tree Basin	Water Studies, 2001	Diffuse	Not Defined						690

	Source	Type	Area Source	Area Applied to Calculations (m^2)	Estimated rate (mm/year)	Estimated rate (m/year)	Model input value (m/day)	Percentage of Average Annual Rainfall (at 318mm not accounting for runoff from up-gradient areas)	Total Volume ML/year
Central Ti-Tree Basin	Water Studies, 2001	Diffuse	Not Defined						1350
Eastern Ti-Tree Basin	Water Studies, 2001	Diffuse	Not Defined						1060
Northern Ti-Tree Basin	Water Studies, 2001	Diffuse	Not Defined						0
Ti-Tree Basin Diffuse Totals	Water Studies, 2001	Diffuse	Estimated from PDF of Model Grid	3368900797	0.9	0.0009		0.3%	3100
Ti-Tree Basin Total Average	Water Studies, 2001		Estimated from PDF of Model Grid	3658493967	2.2	0.0022		0.7%	8200
Ti-Tree Basin estimate of "outflow/discharge" - assumed groundwater inflow for calculation 1000 ML/year based on later estimates	Paul, 2002	Direct and Diffuse	N/A	3658493967	2.5	0.0025		1%	9000
Ti-Tree Basin	Reed and Tickell, 2007	Diffuse			2				

	Source	Type	Area Source	Area Applied to Calculations (m^2)	Estimated rate (mm/year)	Estimated rate (m/year)	Model input value (m/day)	Percentage of Average Annual Rainfall (at 318mm not accounting for runoff from up-gradient areas)	Total Volume ML/year
Allungra Creek	Knapton, 2007	Direct	Not defined (therefore assumed as above)	60334050	30.7	0.0307		10%	1850
Woodforde River	Knapton, 2007	Direct	Not defined (therefore assumed as above)	119338509	3.8	0.0038		1.2%	450
Other (Ti-Tree Basin)	Knapton, 2007	Diffuse	Not defined (assumed based on figure)	5456523389	0.8	0.0008		0.3%	2130
Ti-Tree Basin Total Average	Knapton, 2007	Diffuse and Direct	Not defined (assumed based on figure)	5636195948	1.19	0.0012		0.4%	4430
Regional Basement Outcrop	GHD, 2016	Diffuse	Model	1640864217	0.8	0.0008	1.0E-05	0.3%	1313
Assumed half of basement flowing to Ti-Tree Basin	GHD, 2016	Diffuse	Model	820432108	0.8	0.0008	1.0E-05	0.3%	656
Woodforde River Floodout	GHD, 2016	Direct	Model	244566184	3.7	0.0037	1.0E-05	1.2%	905
Allungra Creek Floodout	GHD, 2016	Direct	Model	60334050	3.7	0.0037	1.0E-05	1.2%	223
Ti-Tree Catchment (Other)	GHD, 2016	Diffuse	Model	5152451567	0.8	0.0008	2.2E-06	0.3%	4122

	Source	Type	Area Source	Area Applied to Calculations (m^2)	Estimated rate (mm/year)	Estimated rate (m/year)	Model input value (m/day)	Percentage of Average Annual Rainfall (at 318mm not accounting for runoff from up-gradient areas)	Total Volume ML/year
Basin areas receiving runoff from Basement outcropping as hilly terrain within the Ti-Tree catchment (high)	GHD, 2016	Direct	Model	174167430.3	3.7	0.0037	1.0E-05	1.2%	644
Basin areas receiving runoff from Basement outcropping as hilly terrain within the Ti-Tree catchment (low)	GHD, 2016	Direct	Model	281768150	3.7	0.0037	2.2E-06	1.2%	1043
Ti-Tree Basin Total Average	GHD, 2016	Diffuse and Direct	Model	6733719490	1.13	0.0011	N/A	0.4%	7593
Basement, Southern Basins and Ti-Tree Basin Total	GHD, 2016	Diffuse and Direct	Model	18812176003	1.16	0.0012	N/A	0.4%	21741

4.7.3 Recharge references

Water Studies (2001) and Knapton (2007) were referenced in the EIS (Appendix K). Knapton (2007) also references the recharge applied in the Water Studies (2001) model. Water Studies (2001) in turn referenced two studies estimates of recharge in the Ti-Tree Basin; Harrington et al. (1999) and DLPE (2000). In the EIS, GHD did not warrant referencing these works as they were already acknowledged in those works which were referenced, although it is now acknowledged that stakeholders are keenly interested in the history of these works.

Additional studies that GHD consulted as part of the EIS recharge assessment, which did not warrant additional referencing, but did provide validation and historical context to recharge values presented in those works that were referenced in the EIS included, for example, Seidel (1995), Harrington et al., (1999), Paul (2002), Reed and Tickell (2007), and Wischusen *et al.* (2012). Notably Harrington's (1999) thesis was not consulted as part of the EIS assessment. Of these, notably Wischusen et al. (2012) provided a detailed summary of the recharge assessments within the Ti-Tree Basin which is reproduced here for the benefit of the EIS reader.

"Quantifying recharge has been an ongoing focus in the hydrogeological interpretation of the Ti-Tree Basin. Early studies concentrated on quantifying the amount of recharge and the main hydrodynamic processes affecting the groundwater system (e.g., Edworthy, 1967; Ride, 1968). Later investigations were completed by Harrington (1999), Harrington et al. (2002) and Calf et al. (1991). The recharge component of the water balance at Ti-Tree has been controversial as the amount assumed determines predictions of sustainable extraction rates. Magee (2009) summarised some of this debate and the apparent inconsistencies of recharge estimates used by different researchers. The Alice Springs DLRM hydrogeologists working on the Ti-Tree area have recently favoured a more conservative estimate of recharge, more in keeping with the 2 mm-per-year estimation of Harrington et al. (1999) rather than the higher values used in the NT government-commissioned modelling studies (Water Studies, 2001, 2004) and some water policy documents (A. Knapton, 2009, pers. comm.).

Knapton (2007) has developed a new model of the Ti-Tree Basin incorporating:

- Transmissivity data similar to that determined from test pumping by McDonald (1990).
- Storage characteristics similar to those determined by Seidel (1995) and Read (2003).
- Recharge predominantly focused along the Woodforde and Allungra drainages (McDonald 1990; Harrington, 1999; Water Studies, 2004).

This model assumed diffuse discharge where the water table is less than 4 m from surface, i.e., mainly in the Wilora Palaeochannel. Calibration of this model confirmed the recharge rate of 2 mm per-year proposed by Harrington (1999), and also indicated that around 1,000 ML/yr flows north into the Wilora Palaeochannel. Analysis of the modelling indicates that current extraction levels should not affect groundwater dependent ecosystems in the area of the shallow water table to the north of the Ti-Tree Basin. The modelling work of Knapton (2007) has shown that hydrological characteristics matching observed data, rather than the high recharge rates used by Water Studies (2001, 2004), can best be used to simulate the Ti-Tree aquifer system.

Read and Tickell (2007) presented the following succinct summary of recharge: *'Due to the low average rainfall (318 mm/year) and its sporadic nature, the aquifer does not receive recharge every year. The abrupt rises in groundwater levels record recharge events, typically associated with heavy rainfall. An exceptionally large event occurred in the mid to late 1970's. Groundwater levels have still not fallen to pre-1970's levels over much of the basin. The long-term average recharge is estimated at 2 mm/year, a relatively small amount.'*

Since the late 1960s the Northern Territory Government has measured groundwater levels in the shallow aquifer, as have some groundwater users more recently. In the recently 'State of the Basin' reports (e.g., Knapton, 2005; 2006a) the water levels in over sixty monitoring bores have been assessed. Apart from the routinely monitored bores, new monitoring bores for other projects are also added periodically. For example, in 2007 three nested piezometers and a temporary riverbed monitoring bore were drilled and constructed near Arden Soak, 30 km south of Ti-Tree near the Woodforde River. Another bore was also installed near Tin Fish Well on the Wilora Palaeochannel. This drilling and construction of monitoring bores was part of a collaborative project by the NT Government, the CSIRO and the University of Tasmania to study recharge and discharge characteristics in the basin (Cook et al., 2008).

Table 4-10 Recharge quantifications as applied by polygon to the model

Recharge Area	Polygon Area (m^2)	Area (total m^2)	Diffuse recharge rate (m/day)	Diffuse Recharge (m^3/day)	Recharge Area	Area (m^2)	Area (subtotals m^2)	Area (total m^2)	Direct recharge rate (m/day)	m^3/day	
			0.0000022						0.0000100		
Basement	1640864217										
Basement TOTAL		1640864217		3610							
Broader Ti-Tree	98389841				Allungra Creek	60334050	60334050				
Broader Ti-Tree	495234043				Hanson River	334033953	334033953				
Broader Ti-Tree	3317002226				Woodforde River	244566184	244566184				
Broader Ti-Tree	17614800				Hills/Plain Int	254551250					
Broader Ti-Tree	27671800				Hills/Plain Int	27216900					
Broader Ti-Tree	1196538858				Hills/Plain Int TOTAL		281768150				
Broader Ti-Tree TOTAL		5152451567		11335				920702337		9207	
Southern Basin	1825196620				Hills/Plain Int	782425517	782425517				
Southern Basin	3395714798				Day Creek Floodouts	61598425					
Southern Basin	2691691956				Day Creek Floodouts	15338750					
Southern Basin	1205651680				Day Creek Floodouts	41902505					
Southern Basin	583965000				Day Creek Floodouts	53693200					
Polygon correction to boundary	-8675603				Day Creek Floodouts TOTAL		172532880				
					Napperby Creek Floodout	39221801					
					Napperby Creek Floodout	140388034					
					Napperby Creek Floodout	45273300					
					Napperby Creek Floodout	50640050					
					Napperby Creek Floodout	29222750					
					Napperby Ck Floodout TOTAL		304745935				
					Day Creek	37041084					
					Day Creek	7622270					
					Day Creek Total		44663354				
					Napperby Creek	29144845					
					Napperby Creek	11100750					
					Napperby Creek TOTAL		40245595				
					Gidyea Creek	60000150					
					Gidyea Creek TOTAL		60000150				
Southern Basin TOTAL		9693544451		21326				1404613430		14046	
All Diffuse Recharge		16486860235		36271							
All Direct Recharge								2325315768		23253	
Grand Total Recharge										59524	m^3/day
Average Recharge Rate									0.0000032		m/day
Average Recharge Rate									1.1		mm/year
Total Recharge									21741		ML/year

4.8 The Margins

The geometry of the system is such that the modelled groundwater gradients in the Ti-Tree Basin at no point, in the 1000 year closure model, reverse and flow towards the pit; and a significant groundwater divide is well maintained in all of the models presented/considered possible. Thus at no point does the pit draw on the Ti-Tree. This is due to the bedrock being, indisputably, orders of magnitude lower in hydraulic conductivity than the Ti-Tree Basin aquifer. Thus, regardless of the pit dewatering there will always be steep hydraulic gradients in the low hydraulic conductivity bedrock and relatively very flat hydraulic gradients in Ti-Tree Basin, significantly lower than groundwater elevations in within the surrounding bedrock. Figure 28 of Appendix K of the EIS demonstrates the magnitude of this for the EIS model and is reproduced here (Figure 4-18) as an example of the relatively small inwardly following area around the pit (m AHD).

Modelled groundwater divide elevations adjacent to the pits are at approximately 630 mAHD and are at approximately 560 mAHD in the adjacent Ti-Tree Basin. Thus, other than the relatively small area, which results in an inwardly flowing geometry towards the pit, the majority of the fractured rock-mass flowing towards the Ti-Tree Basin (and Southern Basins) is highly likely to behave analogously to how it behaves now.

The proposed pit dewatering does draw on (and physically mine out) the local aquifer associated with the mineralisation at Nolans. The pit dewatering also draws, primarily on a fractured rock-mass (basement). In previously documented assessments (i.e. Water Studies, 2001 and Knapton, 2007), this has been considered to provide no freshwater groundwater input to the Ti-Tree Basin or it has been considered so insignificant that it has not been included in the assessment. Assuming no freshwater groundwater input from such waters may be appropriate for such studies as groundwaters from the basement, primarily due to their age, are likely to be brackish, however, for the purpose of this study are considered part of the broader flow regime. It is also assumed that the water allocation planning use these previously documented water assessments, thus any minor decease in flows from these basement rocks would not impact on the freshwater allocation as they have not been accounted for in the allocations to date.

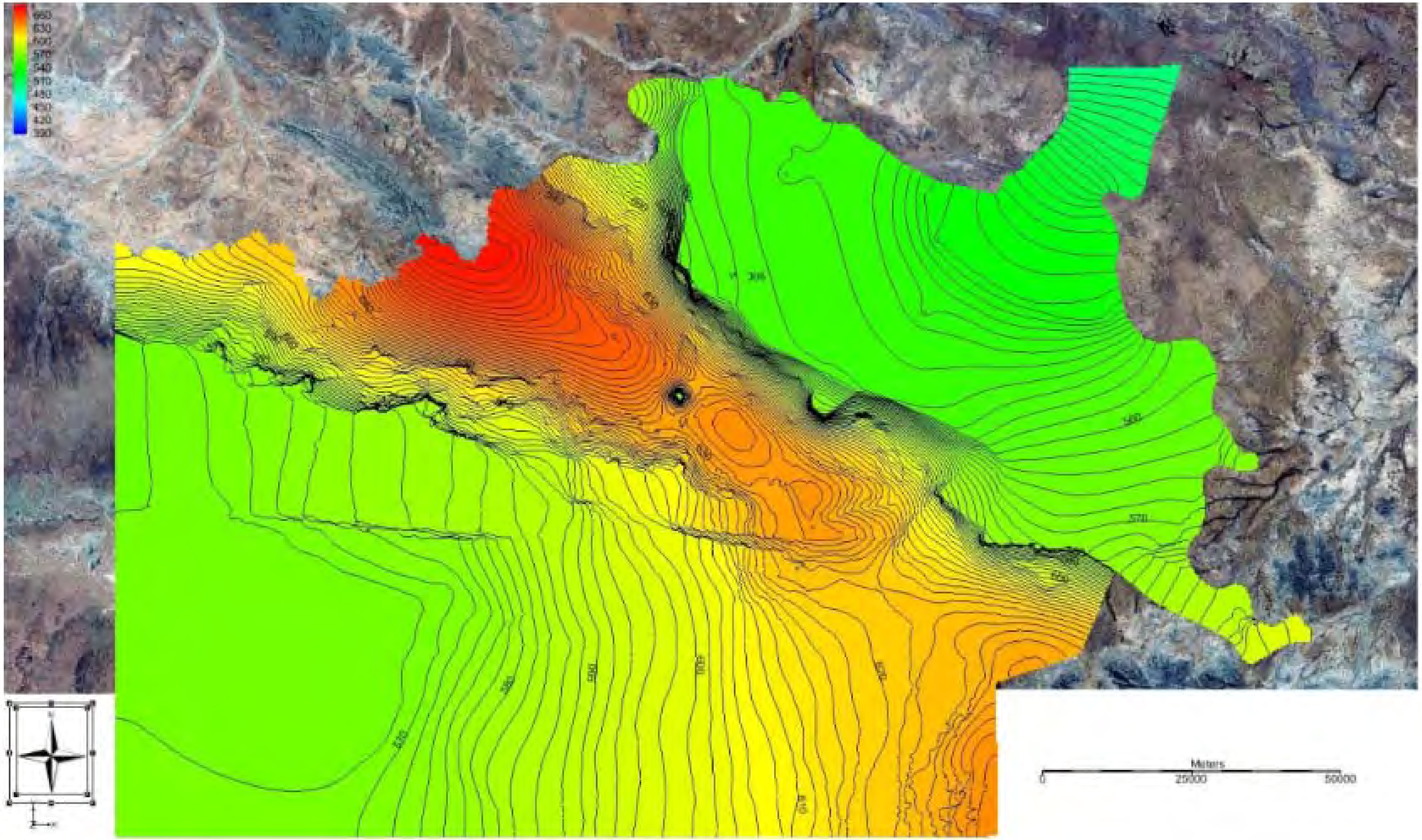


Figure 4-18 Modelled groundwater elevation 1000-years after end of mining 1/1/3060 (previously Figure 28 of Appendix K of the EIS reproduced here as an example of the relatively small inwardly flowing area around the pit)

4.9 Post-closure exposure scenarios

The closure goals for the project are to ensure that radiation levels are such that they are consistent with pre-operational levels. Therefore, it is expected that there will be no long term radiological impacts of the project following closure.

To consider future scenarios, Arafura conducted an assessment to identify potential failures of the TSF and RSF. The radiation exposures for the scenarios were then calculated.

The assessment utilised the FEPs methodology (IAEA 2011) which considers a range of features, events and processes that may affect the disposal facilities into the future. The method is widely used for assessing the long term safety of radioactive waste disposal facilities.

The design and closure characteristics of the TSF and RSF were assessed against a set of predefined criteria and potential failure scenarios are developed.

Radiological assessments of the possible exposure scenarios were conducted and a summary of the potential doses is shown in Table 4-11.

Note that the qualitative risk assessment indicated that it is highly unlikely that the identified failures could occur however the radiological assessment was conducted on the scenarios to determine the potential doses should the failure occur.

Table 4-11 Summary of Assessment on Potential Doses in Event of Future Failure

Failure Scenario	Radiological Impact	Comment
RSF liner failure leading to groundwater contamination	Ingestion of 1,000 litres per year of groundwater at Aileron gives an incremental annual dose of approximately 0.016 mSv/y.	Radiological impact is negligible
Large schist zones beneath RSF and liner failure leading to groundwater contamination	Ingestion of 1,000 litres per year of groundwater at Aileron gives an incremental annual dose of approximately 0.053 mSv/y.	Radiological impact is negligible
Erosion of TSF or RSF wall due to excessive rainfall leading to overtopping and loss of containment	Loss of containment will result in doses to flora and fauna exceeding the ERICA default screening level of 10uGy/h. Full time occupation may result in human doses up to 2.7 mSv/y.	Radiological impacts are likely to be minor compared to other impacts of a failure
Future drilling into TSF or RSF following closure while conducting exploration	Total occupational dose from gamma and dust for 1 year is estimated to be 4.1 mSv/y (for RSF drilling) and 3.2 mSv/y (for TSF drilling).	It is unlikely that exploratory drilling would continue for an extended period without workers becoming radiation workers and being monitored.
Occupation of rehabilitated RSF and TSF with following cover materials;		

Failure Scenario	Radiological Impact	Comment
- Regional surface material (natural background)	Human dose < 0.5 mSv/y	Considered to be consistent with existing natural background levels
- Mine waste rock and regional material (conservative average of 3Bq/g)	Human dose approximately 2mSv/y	Considered to be consistent with existing natural background levels

4.10 Water management system

The water management system at the Nolans Project would include separate water management areas for:

- **Clean water** – runoff generated by catchments areas outside of the mine affected areas.
- **Sediment water** – runoff generated by disturbed catchment areas, principally including waste rock dumps.
- **Ore contact** – runoff generated within the open pit. Stockpile and TSF areas.
- **Process water** – water utilised in the processing plant and water generated by and stored within infrastructure associated with the process plant.

This water management system concept is detailed in the Water Management Plan (Appendix 4).

Design standards for water management infrastructure is specific to each of these water management systems.

4.10.1 Clean water

The clean water system manages runoff generated by catchment areas outside of mine affected areas, and generally includes:

1. Natural watercourses and drainage lines outside of operational mining areas.
2. Flood protection levees and clean water diversions (including the proposed Kerosene Camp Creek diversion.

As detailed in the Water Management Plan, flow diversion banks will be installed across the Mine to divert clean water away from disturbed areas.

Clean water diversions and flood protection levees are generally designed to safely manage the 100 year ARI flood event, particularly above open cut mining areas. 100 year ARI flooding modelling indicates that a number of flood levees will be required to protect the open pit area from flooding. One of these levees is associated with the proposed Kerosene Camp Creek diversion as detailed in the Water Management Plan. Initial modelling indicates that a 1 m high flood protection bund is likely to be sufficient to separate the open cut pits from floodwater ingress during the 1000-year ARI flood event. Refer to Section 4.14.1 for further information on the flood modelling associated with the levee.

The regular inspection of the clean water diversions and flood protection levees should be included in the routine monitoring program, with repairs undertaken as necessary in accordance with a suitable response plan.

Culverts will be installed in roads to facilitate overland flow through the site and to facilitate diversion of flows (from within the catchment) into the Creek diversion.

4.10.2 Sediment water

The sediment water system manages runoff generated by areas disturbed by mining activities, but outside of the process water system. Dirty water generally includes runoff from haul roads and waste rock dumps.

Sediment water management infrastructure typically consists of dirty water catch drains and sediment basins. Dirty water catch drains intercept sediment-laden runoff and direct it to the sediment basins, where the suspended sediment can settle prior to the water being discharged off site or reused on site.

The sediment water management system would operate separately from the ore contact and process water management system, in order to minimise the potential contamination of water that could be discharged off site during large storm events.

4.10.2.1 Dirty water catch drains

Depending on the location, dirty water catch drains are typically sized to safely convey the flows generated by the 20 year ARI (approximately equivalent to the 5% AEP) critical duration design storm event.

Dirty water catch drains typically include a shallow excavated channel with an embankment along the downstream bank (Figure 4-19). Where possible longitudinal slopes should be about 1:100 (v:h).

Scour protection measures, including rip-rap and rock check dams (Figure 4-20), may be required to protect the dirty water catch drains from erosion and scour.

Regular inspection of the dirty water catch drains should be included in the routine monitoring program, with repairs undertaken as necessary in accordance with a suitable response plan.

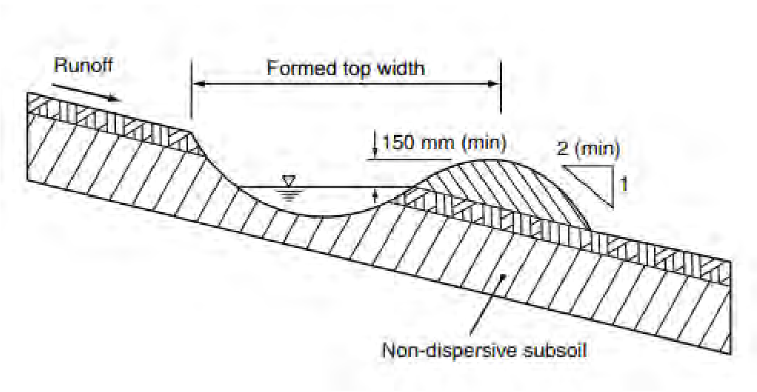


Figure 4-19 Typical catch drain, from Standard Drawing CD-01 (IECA 2008)

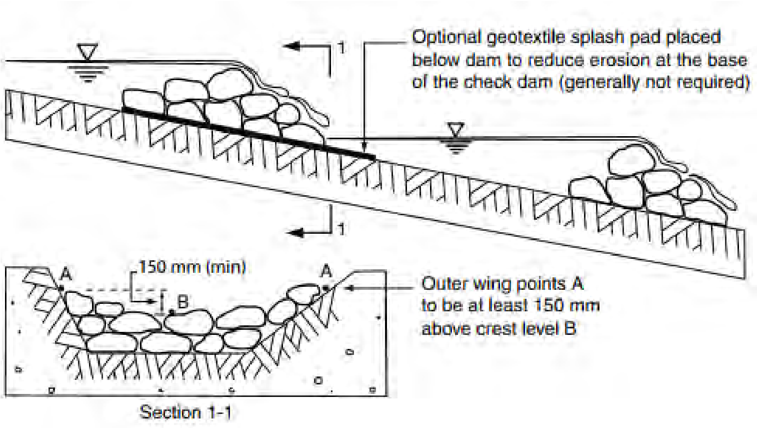


Figure 4-20 Typical check dam, from Standard Drawing RCD-01 (IECA 2008)

4.10.2.2 Sediment basins

Sediment basins consists of a *settling zone* and a *sediment zone* (Figure 4-21). The *settling zone* has a volume equivalent to the runoff generated by the 90th percentile 5-day rainfall event, whilst the *sediment zone* has a capacity of at least 50 percent of the *settling zone* (IECA 2008). Sediment basins designed to meet this criteria are expected to overtop on average five to seven times per year during larger rainfall events.

The *settling zone* is to be dewatered within 5 days of a rainfall, either by discharging offsite or transferring to a water storage dam for reuse on site.

If intercepted water is to be discharged offsite, flocculants and / or coagulants may be required to improve the removal of suspended sediments to achieve the target water quality prior to discharging. A *forebay* (Figure 4-21) may be used to simplify the dosing of flocculants and / or coagulants.

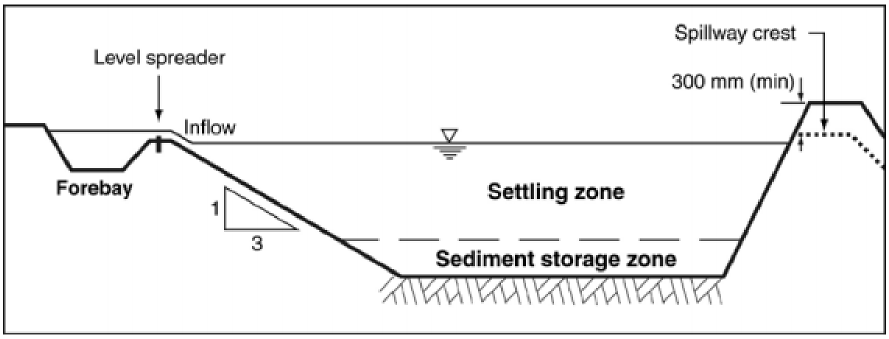


Figure 4-21 Typical Type D sediment basin (IECA 2008)

Sediment accumulates within the *sediment zone*, which will need to be cleaned at least twice per year.

Sediment basins are to include an emergency spillway designed to safely manage estimated overflows generated by the 1% AEP flood event (Figure 4-22). The emergency spillway is to include appropriate scour protection measures to minimise the failure.

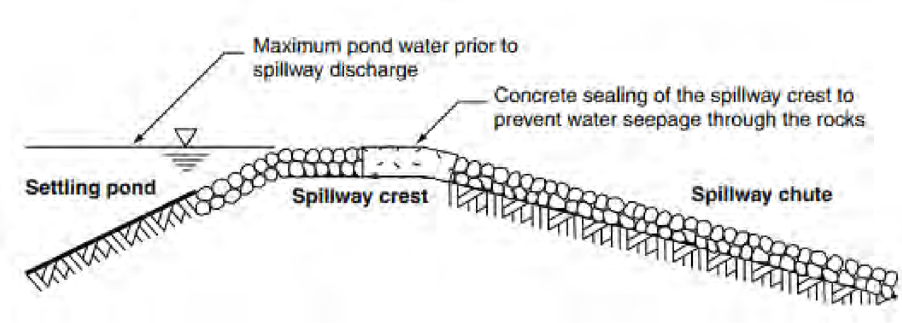


Figure 4-22 Typical emergency spillway, from Standard Drawing ES-1 (IECA 2008)

The concept dirty water management system indicates that about 14 sediment basins could be required to manage the sediment-laden runoff generated by the waste rock dump areas. Table 4-12 provides a summary of the estimated sediment basin capacities, based on the concept dirty water management system.

Table 4-12 Indicative sediment basin volumes

Sediment basin	Catchment area (ha)	Settling zone volume (m^3)	Sediment storage zone (m^3)	Total storage volume (m^3)
SB1	3.1	1030	520	1550
SB2	4.4	1460	730	2190
SB3	13.4	4440	2220	6660
SB4	0.9	300	150	450
SB5	3.4	1130	570	1700
SB6	2.4	790	400	1190
SB7	3.6	1190	600	1790
SB8	3.1	1030	520	1550
SB9	8.6	2850	1430	4280
SB10	1	330	170	500
SB11	4.4	1460	730	2190
SB12	2.8	930	470	1400
SB13	2.8	930	470	1400
SB14	3.6	1190	600	1790
Assumptions: 90th 5-day rainfall depth of 0.48 mm (Katherine) Runoff coefficient = 0.69				

Sediment basis are not typically lined and infiltration from the sediment basins can occur. As the water intercepted by the sediment basins is generally from non-mining areas, it is not expected to include elevated pollutants other than suspended sediment. Therefore the potential for the export of pollutants via infiltration from the sediment basins is considered to be low.

Regular inspection of the sediment basins should be included in the routine monitoring program, with repairs undertaken as necessary in accordance with a suitable response plan.

4.10.3 Ore contact water

The ore contact water system manages runoff water generated within the open pit, stockpile and TSF. As a result ore contact water typically includes elevated pollutant levels that should not be discharged into the downstream environment without suitable treatment.

To minimise the risk of uncontrolled discharges the TSFs are to be constructed as “turkeys nest” dams, and will be managed to maintain a minimum freeboard capacity equivalent to the inflows expected from the 100 year ARI (equivalent to the 1% AEP) 72 hour design storm event. During extreme rainfall events beyond this design limit, overflows from the TSF will be directed via an emergency overflow weir to the open pit to minimise the discharge of untreated mine water.

Within the open pit, a pit sump will be used to manage most runoff generated within the pit area. During periods of extended or extreme rainfall, it is expected that the pit sump will be overtopped, flooding the pit floor and potentially some lower benches. During these periods, mining operations will be moved to upper benches (if safe to do so) whilst the pit is dewatered.

Both the pit and TSFs will be dewatered by pumping the pit water to the process water dam for reuse in the processing plant or onto the evaporation ponds within the process water system.

4.10.4 Process water

The process water system manages water within the plant and RSF facilities. As a result process water typically includes elevated pollutant levels that should not be discharged into the downstream environment without suitable treatment.

To minimise the risk of uncontrolled discharges, process water storages and RSFs are typically constructed as “turkeys nest” dams. These storages will be managed to maintain a minimum freeboard capacity equivalent to the inflows expected from the 100 year ARI (equivalent to the 1% AEP) 72 hour design storm event.

The RSFs will be dewatered by pumping to the process water dam for reuse in the processing plant or disposed of via the evaporation ponds. If necessary, water treatment measures such as reverse osmosis may be utilised to allow for discharge of excess water.

4.11 Radioactivity

4.11.1 Radon

The assessment of the average pit radon and thoron concentrations was based on the assumption that air would be trapped within the pit void for a period of 2 hours. This was considered to be a realistic and conservative assessment of the potential long term average situation (see reasons why below).

The actual average air residency can be calculated using the formula provided by Thompson 1993 (Thompson, R.S. 1993). *Residence Time of Contaminants Released in Surface Coal Mines - a Wind-tunnel Study*. In: American Meteorological Society, 68–75.).

The formula is as follows:

- $T=33.8*(V/U.L.W)*(0.7\cos(x)+0.3)$
  - where T is the air residence time;
  - V is the pit volume;
  - U is the wind velocity;
  - L and W are the pit length and width; and
  - x is the angle between the pit axis and the wind velocity.

If it assumed that the pit is circular (for ease of calculation), then the term $(0.7 \cos(x)+0.3)$ will equal 1. The following are the pit dimensions;

- Volume is 160×10^6 m^3
- Pit length and width of 1520 m
- Pit depth of 225 m

A conservative average wind speed of 2 m/s was used (note that the average wind speed noted in the air quality appendix is approximately 2.8 m/s).

The calculation gives an air residency time of approximately 15 minutes, which is a factor of 8 less than the air residency time used in the dose assessment (of 2 hours).

The ventilation of the pit is controlled by the wind speed rather than the mechanically controlled ventilation rate. It has been suggested that a reduced ventilation rate in the pit may lead to prolonged elevated radon and thoron concentrations. This concern was considered from the following perspectives:

- The predicted average radon and thoron concentrations due to the pit emissions alone were calculated to be 7.2 and 40 Bq/m^3 for radon and thoron respectively (see Section 8.2 of Appendix P of the EIS). The equivalent decay product concentrations were then calculated to be very low. For radon, it was also assumed that the decay products were in equilibrium with radon. Therefore, even with a doubling or tripling of the radon and thoron concentrations, doses will continue to be low.
- The air quality report (Appendix Q of the EIS) indicates that winds remain relatively constant throughout the year, with minimal periods of calm conditions.
- There is a linear relationship between wind speed and residence time - halving the wind speed results in a doubling of the residence time.
- The dose assessment is for a full year, therefore using an average figure provides the balance between periods when there is both higher and lower wind speeds (and therefore air residence times).

It is therefore highly unlikely that workers will work in conditions greater than those predicted in the dose assessment and this will be verified through on going monitoring.

As noted, there is a logical reason for the relatively low radon and thoron concentrations and this is due to the very high volume of the pit which results directly in dilution of the emissions of radon and thoron from the ore areas very quickly resulting in low average concentrations.

4.11.2 Dose estimation method

The radiological impact to workers is assessed by estimating the potential doses that could be received. The following table provides a summary of the dose assessment methods for the different exposure pathways.

Table 4-13 Dose estimation methods

Dose Pathway	Miners	Surface Workers
Gamma Radiation	Estimation based on recognised conversion factors	Comparison with similar operations
Inhalation of radionuclides in dust	Estimation based on ore dust at concentration of 1 mg/m^3	Comparison with similar operations
Inhalation of RnDP and TnDP	Average radon and thoron concentration in pit calculated and then converted to a decay product concertation. Dose based on exposure to decay product concentrations for a full year (see later detail).	Comparison with similar operations
Ingestion of radionuclides	Not calculated – hygiene practices expected to ensure dose is negligible	Not calculated – hygiene practices expected to ensure dose is negligible

For the assessment of worker doses, the following general criteria were used:

Production Factors

- Average total mining rate – 10 mtpa (ore and waste rock)
- Average ore mining rate – 1 mtpa
- Average uranium grade of mined ore – 200 ppm
- Average uranium grade of waste rock – 80 ppm
- Average uranium grade of all material mined – 100 ppm (approximately and calculated as a weighted average)
- Average thorium grade of mined ore – 2,400 ppm
- Average thorium grade of waste rock – 240 ppm
- Average thorium grade of all material mined – 490 ppm (approximately and calculated as a weighted average)

Exposure Factors

- worker exposure hours (working year) – 2,000 h/y
- worker breathing rate – 1.2 m^3/h

Physical Property Factors:

- relationship between uranium grade and radionuclide activity is 1 ppm U = 12.3 mBq(U^{238})/g
- relationship between thorium grade and radionuclide activity is 1 ppm Th = 4 mBq(Th^{232})/g
- ore is in secular equilibrium when mined
- the majority of radionuclides report to tailings

Dose factors:

- The relationship between for radon and radon decay products (RnDP) is expressed by the following equation (UNSCEAR, 2000):
  - F = PAEC(nJ/m^3) / (5.56 x C(Rn222) (Bq/m^3)) where:

    F is Equilibrium Factor;

    PAEC is potential alpha energy concentration of the RnDPs

    C(Rn222) is the concentration of radon.
- The relationship between thoron and thoron decay products (TnDP) is expressed by the following equation (UNSCEAR, 2000):
  - F = PAEC(nJ/m^3) / (75.7 x C(Rn220) (Bq/m^3)) where:

    F is Equilibrium Factor

    PAEC is potential alpha energy concentration of the TnDPs

    C(Rn220) is the concentration of thoron.
- RnDP conversion factor 1.2mSv/mJ (workers) [ARPANSA 2005].
- TnDP conversion factor 0.48mSv/mJ (workers) [ARPANSA 2005].
- Note that a factor of 2.4 was applied to both the RnDP and TnDP to take account of the latest recommended dose factor by the ICRP.

- The dust inhalation dose conversion factor is derived from figures in ICRP (1995), using AMAD of 1 micron and most restrictive lung solubility class and assuming secular equilibrium for the decay chain radionuclides.

Key assumptions used in radon and thoron assessments

Radon and thoron sources from the proposed operation are described in Section 7.2 of Appendix P and were used for air quality modelling and for worker dose assessment. A summary of the figures are as follows:

- 1Bq/m^2/s (Rn) based on experimental assessment (for material containing approximately 500 ppmU).
- 200-500 Bq(Tn)/m^2/s (note that there was much experimental scatter) based on experimental assessment of material containing approximately 6,000 ppmTh).
- The resulting figures used in the assessments were.
    - 0.4Bq/m^2/s for radon (based on an average ore grade of 200 ppmU)
    - 300Bq/m^2/s for thoron (based on a conservative decision)
- Total Rn and Tn emissions calculated from areas as shown in Table 8.3 of Appendix P.

Gamma assessment – miners

- Gamma doserate = (0.3 uSv/h per BqU/g) + (0.45 uSv/h per Bq/g) (see Section 7.2 of Appendix P of the EIS).
- 200 ppmU is equivalent to 2.5 Bq/g U.
- 2,400 ppmTh is equivalent to 10 Bq/g Th.
- This gives a calculated doserate of approximately 5 uSv/h.
- For the gamma dose estimates, some anecdotal factors were applied based on many years' experience monitoring gamma radiation at other operations. These factors included:
    - Protection afforded to equipment operators from the shielding provided by the equipment, which has been experimentally shown to be more than 50%
    - The reduction in the average gamma dose rate due to the mining of both ore and non-mineralised material. In this case, a conservative 1:5 ore to waste rock ratio was used
- As part of the radiation management plan, real time monitoring would occur to verify the dose estimates.

Inhalation of radionuclides in dust – miners

The annual average airborne dust concentration was conservatively assumed to be 1 mg/m^3 in the pit. This is a conservative estimate of airborne dust concentration that has been used in other assessments and provides an indication of the maximum credible long term dust exposure scenario. In practice, the concentration would be considered to be “dusty” and would require active control. The estimates did not take into account any respiratory protection or protection provided by air conditioned equipment cabins.

Radiation assessment – metallurgical plant workers

For plant operators, it was assumed that the exposures from the exposure pathways would be similar to processing plant worker exposures received in other similar processing plants. For this assessment, the worker doses in the Ranger processing plant and the Olympic Dam processing plant were used. It was therefore concluded that processing plant worker doses would be approximately 1.5 mSv/y.

Verification of worker doses

A summary of the gamma doses estimated is provided in Table 9.1 of Appendix P.

As part of the operational radiation management plan, workplace radiation concentrations would be monitored with results being used for operational control and dose assessment.

4.11.3 Worker doses

It is noted that in the EIS, two dose conversion factors were used for assessment of doses from the decay products of radon. The existing ARPANSA recommended dose factor of 1.2Sv/J (ARPANSA 2005) is used for occupational doses assessments, while the recently newly recommended dose factor from the ICRP of 2.8Sv/J (ICRP 2015) is used for assessing member of the public doses. This inconsistency was an oversight, but is noted in the text of the radiation chapter.

If it is assumed that the increase in dose factor is appropriate for all isotopes of radon, (including thoron), the occupational doses can be recalculated using the new ICRP factor. The recalculated occupational doses can be seen in Table 4-14.

The conclusion in chapter 12 of the EIS therefore remains valid, which is that all worker doses are likely to be less than 4.9 mSv/y.

Table 4-14 Worker doses

Worker category	Gamma	Dust (LLa)	RnDP/ TnDP	Total (mSv/yr)
Mine on foot	1.0	0.3	0.5	1.8
Mine heavy equipment	1.0	0.3	0.5	1.8
Process plant operator	1.0	0.3	3.6	4.9

4.11.4 Background radiation levels

The locations in Figure 4-23 show that the sites are widespread and representative of the area. Furthermore it should be noted that it would have been remiss to omit a few higher spots as isolated higher spots up to 1000 m^2 or more occur in the region. This was explained in the regional geology and background section of Hussey in Appendix P EIS. These isolated spots are not mineralisation. They are natural concentrations in rocks and soils.

The attached figure shows the location of the environmental monitoring sites based on a calibrated high-resolution detailed low-level airborne radiometric image. This image shows the natural variations in radioactivity and the environmental dose rate across the project area. The image is a linear stretch of the data with all values of 500 nGy/hr or more all shown as red. Hence this image emphasises the variation in the lower values. The cooler colours on this image have lower natural background radioactivity. The warmer colours have higher natural background radioactivity. The images clearly shows that the selected sites are representative of the area.

Arafura completed several detailed grid-based surveys over the deposits area to determine the natural environmental radioactivity in the deposit area. These and the environmental monitoring sites were used to confirm the calibration of the airborne survey, see Hussey in Appendix P of EIS.

All environmental monitoring sites were originally selected based on knowledge of the region and Arafura's geoscientific data. However, the actual spots were sited once groundtruthing was completed by Arafura's Senior Field Supervisor at each location. The selection was primarily based on the vegetation and soil cover at or near each site. Some places were up to 100 m from the proposed target spot. The monitoring site locations were selected by finding a point near each target spot that was easy to access and that had sufficient soil and vegetation (grass/trees) for paired sampling. This was considered a very important factor in the site selection we believe the assessment of radioactive uptake is also an important factor to understand. Hence the actual monitoring spot was not biased in its selection based on measuring background radioactivity at each site. This measurement was taken after the fact.

Environmental monitoring sites within the pit were based on Arafura's geological knowledge however the location of vegetation governed the actual site selection. These sites are considered typical of the deposit. They are not the areas of known highest radioactivity within the deposit footprint.

The sites outside of the pit were selected as follows.

- ARA8001-ARA8004 inclusive are long-term dust monitoring sites outside of the deposit footprint area. These are upwind, downwind and orthogonal to the prevailing wind direction. It made sense to add these to the list of environmental radiation monitoring sites to enable long term collection of data.
- ARA8008 was selected as a low radioactivity area just outside of the pit. This site may be too close to the LOM pit but it will serve as a useful monitoring site for many years to come.

The other sites were targeted by considering the location of the pit and infrastructure together with the prevailing wind direction and distance from the ML or pit.

- A group of sites were selected at about 1 km from the ML. These are ARA8012, ARA8016, ARA8018 to the W, NW and N. Another group of sites were selected at about 5 km from the centre of the pit. These are ARA8014, ARA8015, ARA8017. These have variable but mostly low environmental radiation levels. Some of these are likely to form key additional downwind monitoring sites.
- ARA8013 and ARA8019 were selected as distal background sites. ARA8013 is significantly upwind while ARA8019 is orthogonal and significant distance from Nolans. ARA0871 has been used as a standard background biogeochemical (vegetation) sampling site for almost 10 years. It made sense to include this site as well as the most distal upwind site.
- ARA8011 was specifically targeted as example of an average outcrop of felsic granitic gneiss from this area. The radioactivity is slightly higher than its surrounds but it is similar to many other felsic gneiss outcrops in the region. Site ARA8012 would have similar radioactivity to ARA8011 if the soil was removed. This is also similar to some of the gneiss that hosts the deposit.
- ARA6460 was specifically targeted based on geological reconnaissance mapping of radiometric exploration targets. This general location is another felsic granitic gneiss outcrop with naturally elevated radioactivity although it contains an elongate pod of biotite schist with near this spot. The monitoring site is located within an area of high natural background radioactivity and is similar to that observed at Nolans Bore. ARA6460 is not sited on the highest radioactivity. A larger area of higher background activity occurs about 7.5 km E of ARA6460. This site is also similar to Nolans Bore but it has not been targeted.

Two sites were targeted within the processing site. The dose rate image clearly shows that the village site has similar of lower background radioactivity.

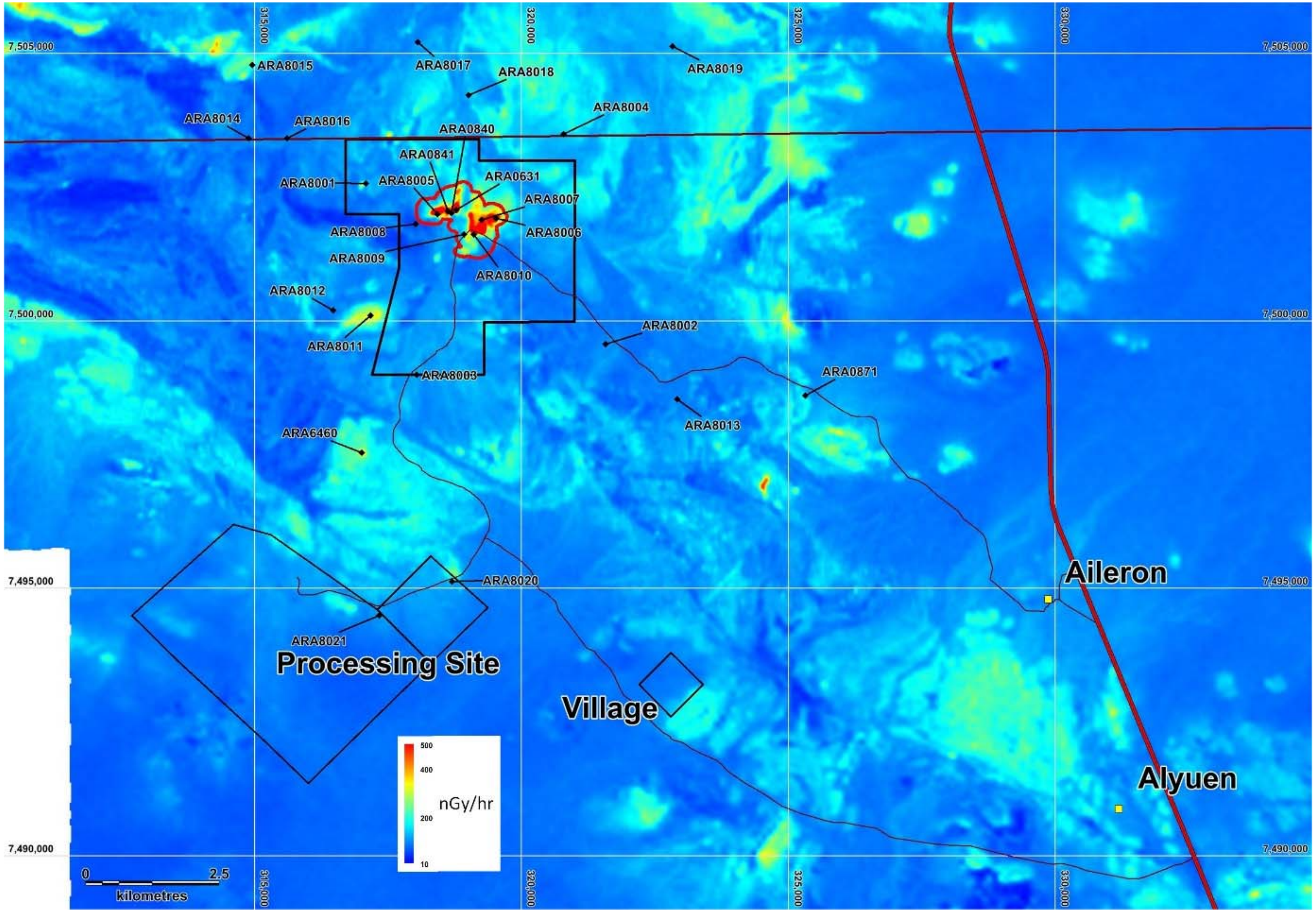


Figure 4-23 Baseline monitoring locations

4.12 TSF failure impacts

The proposed TSFs will be located within the Kerosene Camp Creek catchment, which meets the Woodforde River about 12 kilometres downstream of Nolans Project. The Woodforde River meets then meets Hanson River about 75 kilometres further downstream of Nolans Project.

A failure assessment was undertaken as part of the EIS (Appendix J). This assessment indicated that a failure of the TSF during a flood event is expected to increase downstream flood levels by about 0.1 metres, with no increase in the estimated population at risk and a resulting ANCOLD consequence category of “low”. Further assessment of failure impacts and mitigation through the application of a design framework is provided in Appendix 2.

‘Sunny day’ Dam Break Event

Model results for a ’sunny day’ dam break event indicates that the tailings dam could discharge into the Woodforde River, and the tailings water could reach a point some 27 km downstream. This failure is assumed to occur when there is no rainfall or other natural runoff. Therefore, clean-up would be restricted to Kerosene Camp Creek and Woodforde River stream beds, which are generally dry and ephemeral due to the low average rainfall (see Chapter 7 of the EIS).

Figure 4-24 TSF 'Sunny Day' dam break extent and inundation depth (Appendix 2)

Flood Failure Dam Break Event

The model results for a dam break event occurring during a flood event indicates that tailings water would continue past Ti Tree. The extent of flooding would depend on the rainfall event occurring at the same time as the dam break. The rainfall was modelled as a 0.01 AEP (or 1 in 100 yr AEP) rainfall event and simulated concurrently with the dam break release. It is expected that regional flood waters would mix with the tailings water and flow down the system. Tailings sediments would settle out, and the distance from the tailings dam would depend on the velocity of the flood waters and other factors.

It can be assumed that some tailings sediments would be carried to Ti Tree, which is based on the model results for flow velocities (see Appendix J of the Nolans EIS), and would be confined to the Kerosene Camp Creek and Woodforde River steam beds.

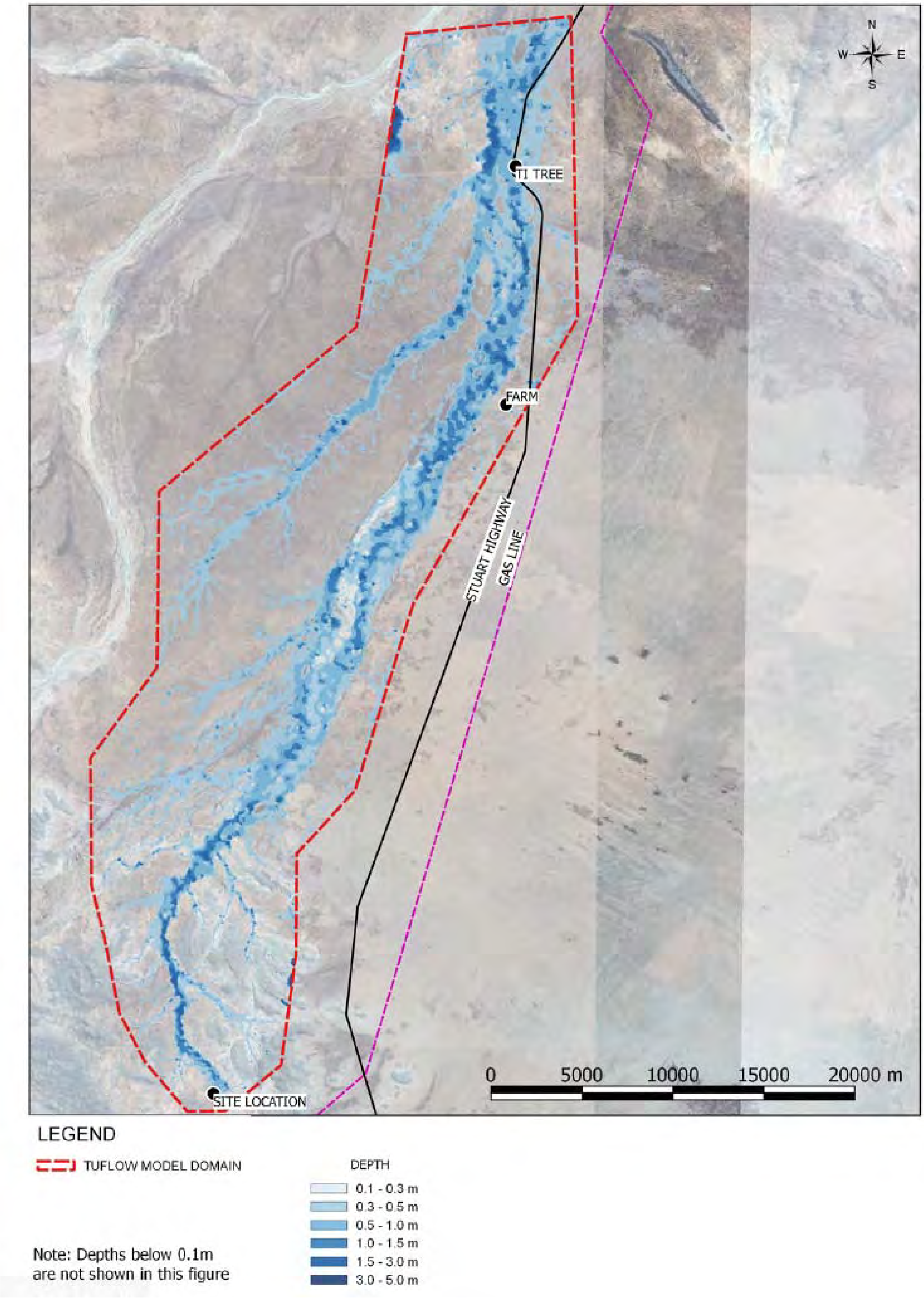


Figure 4-25 TSF flood failure dam break extent (Appendix J)

Given the relatively low flow velocities downstream of the Nolans Project (less than about 1 m/s for the 1000 year ARI flood event), accumulated sediments are expected to be mostly deposited within the reaches of Kerosene Camp Creek that are within or just downstream of the mine lease area. It is considered unlikely that these sediments would be transported to the Woodforde River, however the model did not consider sediment accumulation

Dissolved pollutants and some dispersive materials could be carried further downstream, depending on antecedent conditions. In a major flood event, it is expected that flows from the balance of the catchment would include similar dissolved and dispersive pollutants, meaning that pollutants from a TSF failure are expected to be generally consistent with the surrounding levels during such a large flood event.

Control Measures

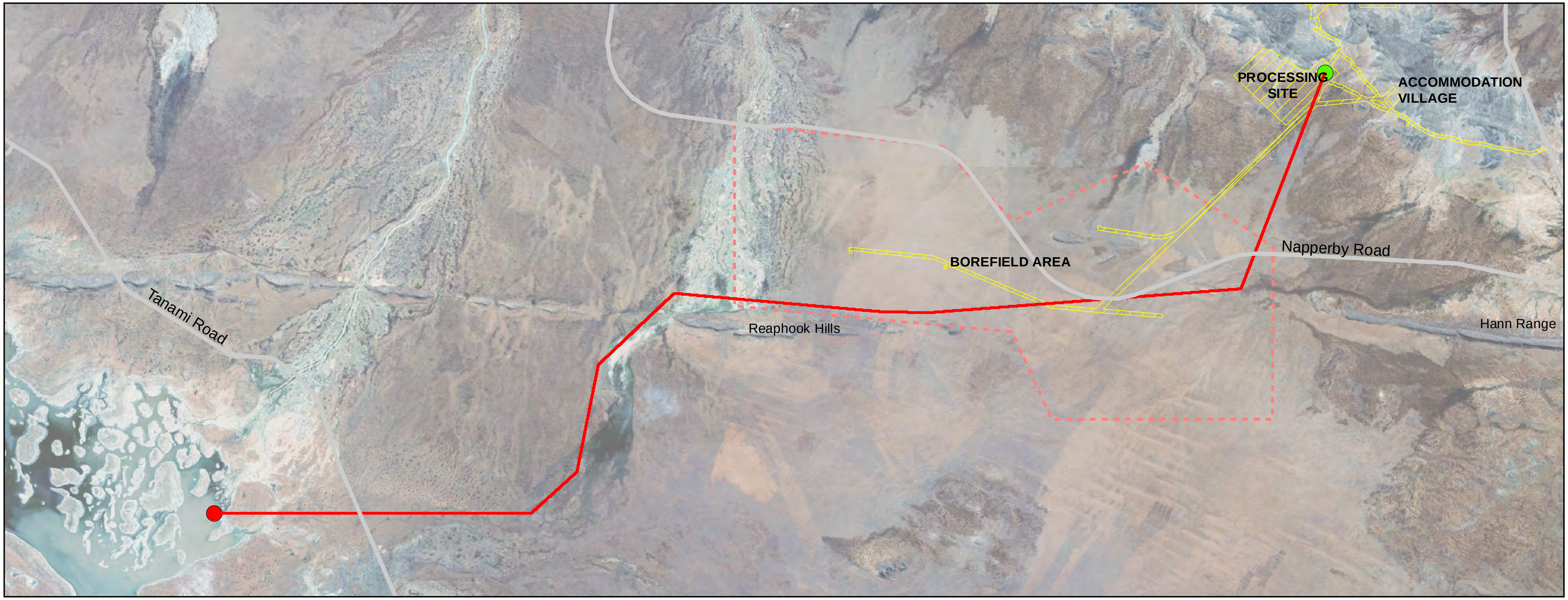
The impact from ’sunny day’ or flood failure dam break cases is expected to be confined to the Kerosene Camp Creek and Woodforde River stream beds. The clean-up from the ’sunny day’ dam break case will be less extensive than the flood failure dam break case. Therefore, Arafura is proposing a number of extra control measures to ensure a very low likelihood of a dam break event. These measures would include the following:

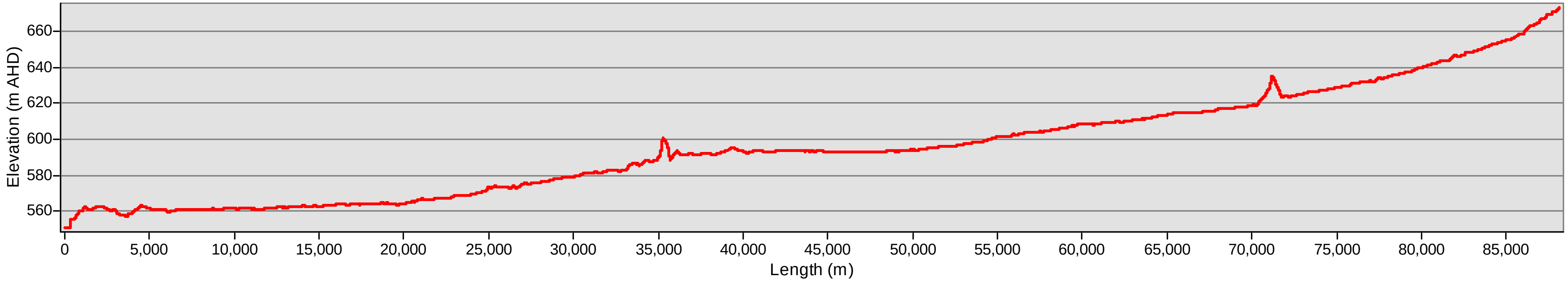
- Design – detail design of the tailings dam will be completed to limit the risk of structural failure or overtopping.
- Construction quality control – engineering supervision will be provided to ensure that the constructed tailings dam meets design intent.
- Management – management plans will be developed and implemented to ensure that the tailings dam is operated as per the design intent and that all relevant records are kept.
- Monitoring – daily inspections will be completed to inform the management of the tailings dam, and annual dam safety inspections will be completed by a suitably qualified person to inspect all the aspects of the dam, which includes the geotechnical stability of the dam and seepage.
- Emergency procedures – Arafura will develop emergency action plans to be implemented proactively to reduce the potential of an uncontrolled release or a dam failure, which will include options to pump-out the tailings water to the pit in extreme wet weather conditions.

4.13 RSF failure impacts

The RSFs are located south of the Yalyirimbi Range, therefore within the catchment area of Lake Lewis, located about 80 kilometres south west of the Nolans Project. There are no identified watercourse connecting the RSFs to Lake Lewis, which includes relatively flat terrain (Figure 4-26). The drainage lines downstream of the RSF consist of low gradient, poorly defined ephemeral creeks.

An estimate of the runout distance from the RSF in the event of a dam failure is illustrated in Figure 4-27. This assessment has been made based on the volume of residue contained within the RSF after 10 years of operation, the estimated outflow volume, and the local topography downstream of the RSF location. Refer to Appendix 2 for further information on the assessment.





1:350,000 @ A4

0 2.5 5 7.5 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

- 🟢 Start
- 🔴 End
- Existing Roads
- Long Section
- ▨ Study Area
- ⬚ Borefield Area

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Job Number	43-22529
Revision	0
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Process site to Lake Lewis

Figure 4-26

G:\43\22301\GIS\Maps\4322529_003.mxd

Level 7 24 Mitchell Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com

Data source: GA - Imagery, Roads, Waterways, Placenames (2015). ESRI - Shaded Relief (2009). ARL - Water Bores, Proposed Pipelines, Borefield Area, Proposed Mine Site, Treatment Plant and Accommodation Village (2015). Created by: CM

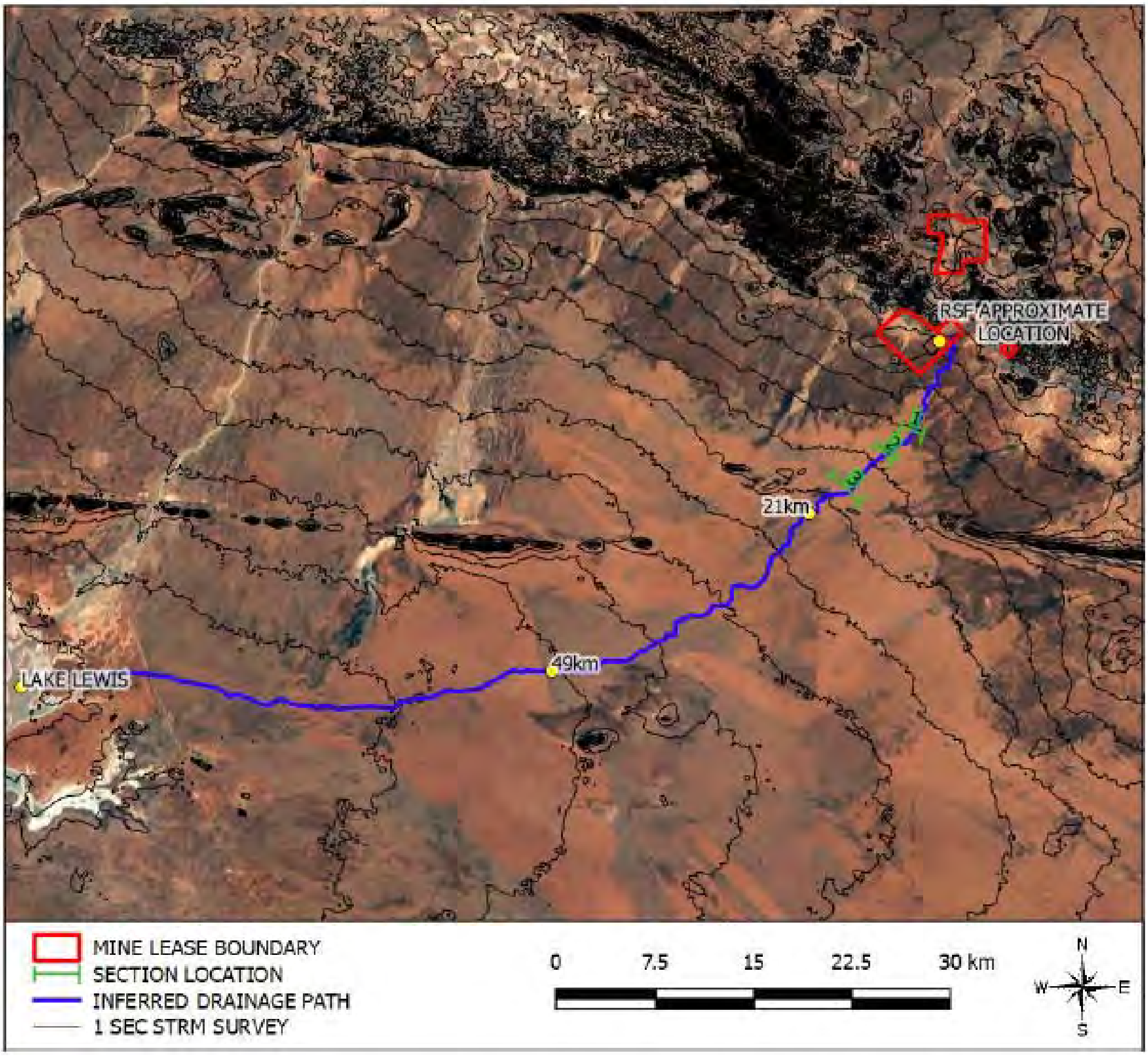


Figure 4-27 RSF Dam Break Runout Estimate (ATC 2017)

4.14 Flood model

4.14.1 Pit flooding

Section 8.5.5 of the EIS states that there is a risk that the contaminated water predicted to accumulate in the pit could be discharged if the pit filled above adjacent groundwater levels (i.e. as a result of flooding). Appendix K Section 7.1 states that to avoid this risk, the catchment design should be such that the water balance can demonstrate that the pit lake will remain a sink in events ‘far greater than any probable maximum flood’. The proposed mitigation to address this risk presented in Section 7.5.5 is a 1 m flood protection levee around the pit. Flood modelling presented in the EIS has been conducted for a 1 in 1 000 year ARI, although it does not appear to be explicitly stated where the height of the proposed 1 m pit levee would be in relation to this flood level.

In order to demonstrate that the risk of discharge of contaminated water from the pit as a result of flooding (i.e. fill and overflow) is mitigated adequately, the proponent should provide the following:

- Details of the probable maximum flood (PMF) and if this exceeds the 1 in 1000 year ARI, update flood modelling predictions accordingly.
- Clarification of whether the flood modelling undertaken takes into account the proposed Kerosene Creek stream diversion, including potential changes in channel morphology over time as a result of sediment deposition. If not, this modelling should be updated.
- Demonstrate that taking into account a PMF event, the proposed 1 m flood protection levee around the pit would be adequate.

PMF

The flood modelling undertaken includes the 100-year average recurrence interval (ARI) and the 1000-year ARI flood events (Figure 4-28 to Figure 4-35). By definition, the PMF event exceeds the 1000-year ARI flood event. Modelling of the PMF event is not typically required for developments of this type.

Kerosene Camp Creek diversion

The flood modelling undertaken includes the proposed Kerosene Camp Creek diversion and associated levee within the post-mining (developed) scenario (Figure 4-30 and Figure 4-31).

In this type of flood modelling it is not standard practice to include potential future changes to channel geometry within any watercourse.

The channel bed and banks is typically shaped by smaller, frequent storm events (e.g. 2-year ARI storm event). During major flood events, such as the 100-year ARI and 1000-year ARI flood events, flows are not generally contained within the defined channels, with most of the flood flows occurring within the floodplain. It is considered that channel geometry has minimal influence on the flood extents and depths during such larger flood events.

Therefore, additional flood modelling including potential changes to channel geometry is considered to be unnecessary as it would not result in an appreciable change to modelled flood depths and extents.

Levee

The proposed levee has an average height of about 1 metre. The finished level of the levee would be identified during detailed design, however it is proposed that the level of the levee be no lower than the maximum modelled 1000-year ARI flood level plus a 0.5 metre freeboard. Based on the flood modelling, it is estimated that the levee would have a finished level of about 665.75 RL (including a freeboard of 0.5 metres).

4.14.2 RSF flood modelling

Catchments upstream of the processing site are typically less than 1 km^2 in extent (Figure 4-10 and Figure 4-11 of the EIS). Due to their small catchment area, channels within the processing site tend to be ill-defined with runoff likely to be dispersed across the south facing hillslope before combining into distinct creeks or local drainage lines towards a sandy-floodplain area.

Depths for the processing site 100 year ARI and 1,000 ARI events (pre-mining) are provided in Figure 4-32 and Figure 4-33. Flood modelling has been undertaken for the processing site and is provided in 100 year ARI and 1,000 ARI events (post-mining) Figure 4-34 and Figure 4-35.

4.14.3 100 year flood modelling

The maximum modelled flood depths and velocities for the 100 year ARI design storm events are presented in Figure 4-28 and Figure 4-29, respectively. The maximum modelled flood depths and velocities for the 1000 year ARI design storm events are included in the EIS in the Surface Water Report (Appendix I - Figure 3-8 and 3-9 respectively).

Changes in flood depths (i.e. comparing Figure 3-8 and Figure 5-3) and flood velocities (i.e. comparing Figure 3-9 and Figure 5-4) as a result of mine development have also been assessed in the Surface Water Report. Potential impacts have been summarised for significant locations across the mine site, and reproduced in this Supplementary Report below in Table 4-15.

Table 4-15 Design flood characteristics – post-mining

Creek	Location	1 in 1,000-year ARI – 4.5 hr flood event [a]			
		Velocity (m/s)	Depth (m)	Velocity change (m/s) [b]	Afflux (m) [b]
Nolans	upstream of mine lease boundary	0.9	1.3	0.0	0.0
Nolans	downstream of mine lease boundary	0.6	1.4	0.0	0.0
Kerosene Camp	upstream of mine lease boundary	0.2	0.4	0.0	0.0
Kerosene Camp	Upstream of proposed diversion inlet	0.6	2.4	-0.2	+0.7
Kerosene Camp	downstream of mine lease boundary	0.6	1.2	-0.2	-0.5
Kerosene Camp	downstream of confluence of Kerosene Camp Creek and Nolans Creek	0.7	1.3	-0.2	-0.4

Notes: [a] storm duration corresponds to the time of concentration at mine site boundary

[b] change from pre-mining conditions

Nolans Creek flows along what will be the eastern boundary of the TSF and between the proposed locations for WRD 2 and 3. The location of Nolans Creek in close proximity to mine infrastructure creates the potential for flooding and erosion, however due to the shallow gradient of the creek and narrowing of the Nolans Creek floodplain due the WRDs, modelling suggests only a small flood level afflux of 0.1 m and no significant increase in flood flow velocity.

Kerosene Camp Creek and the connected floodplain enters the mine site between the proposed locations for WRD 4 and WRD 5 however gradients in this area are relatively shallow and mine development is predicted to cause a small flood level afflux upstream of the mine site boundary of about 0.1 m and an insignificant decrease in flood velocity of about 0.1 m/s.

The proposed diversion will intercept and convey surface and subsurface (alluvial) flows from upstream of the site and discharge into the downstream watercourse. The interception of the alluvial flows by the proposed creek diversion is expected to minimise the potential inflows into mining operations by way of shallow groundwater flows within paleo channels. Some shallow groundwater is still expected to be intercepted by mining operations from the sections of the paleo channels not intercepted (i.e. downslope) of the proposed diversion, however the volume of the intercepted shallow groundwater is expected to be minimal.

Modelling indicates that the proposed creek diversion will result in an increase in flow depth immediately upstream of the diversion inlet of about 1.7 m and a slowing of flood water flow by about 0.5 m/s during a 1 in 1,000-year ARI event. For more information, see the Diversion Report in the EIS at Appendix A of Appendix I. This will increase the potential for localised over-bank flooding and spillage from the diversion into the open pit and possibly sedimentation problems upstream of the diversion inlet.

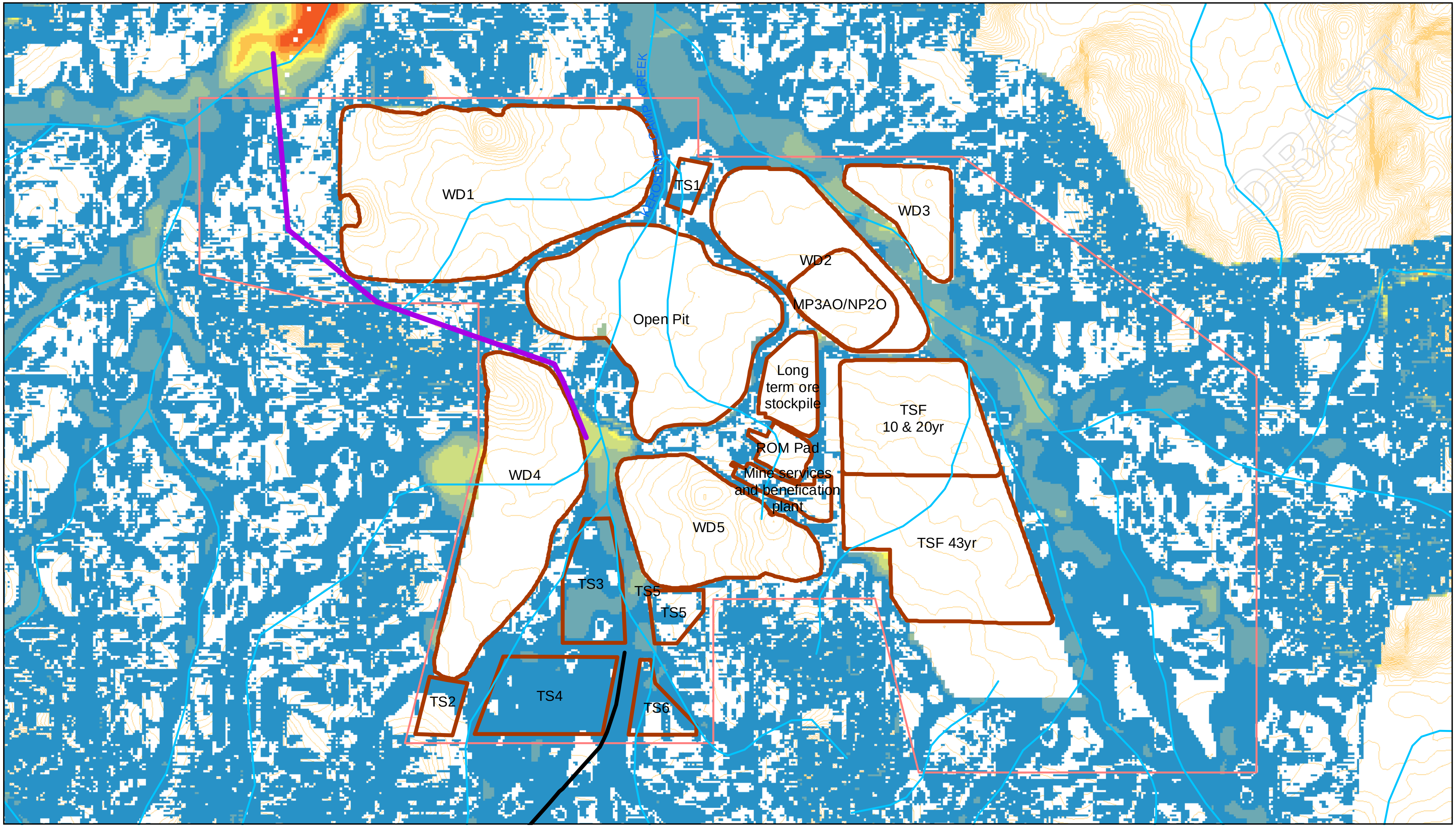
The proposed diversion is expected to result in increased depths within the unnamed tributary of Kerosene Camp Creek of up to about 2.2 m, with minor decreases in velocities. The modelled increases in flow depths are expected to be localised to the unnamed tributary of Kerosene Camp Creek, with little to no appreciable changes to flood depths within Kerosene Camp Creek downstream of the confluence with the unnamed tributary. The changes to flows depths (and minor decreases in flow velocities) have the potential to alter existing patterns of bed and bank erosion and accretion.

The positioning and design of mine infrastructure (incl. WRDs and TSF) will take account of the risk of flooding and erosion along existing watercourses and will either position infrastructure outside the 1 in 1,000-year ARI flood extent; or incorporate flood protection measures into flood prone areas. Flood protection measures will include:

- A flood protection levee constructed around the perimeter of the open pit rim to height equivalent to 0.5 metres above the maximum modelled 1,000 year ARI flood event.
- Provide rock protection or other scour protection measures (to be confirmed during detailed design) to the eastern external embankment of the TSF where flood velocities of to 0.5 m/s can be expected, and along the toe of WRDs adjacent to Nolans Creek (velocities of up to 1.5 m/s), and other drainage lines and soil storage areas (velocities of up to 2 m/s).
- Incorporate drains along the western toe of WRD 3, along the southern toe of WRDs 4 and 5, and around the northern, western and southern sides of the TSF, to prevent ingress of runoff from adjacent catchments.

The placement of erosion resistant rock protection can be completed as soon as the bottom layers of the WRD are constructed, to protect these areas.

Note: the design of WRDs presented in the EIS is not finalised and these will be the subject of further studies once waste rock is available to assess the physical characteristics. Design studies will continue after start of operations to confirm the concept design for the WRDs. Additionally, the site has experienced significant rainfall events over recent years and our site personnel have observed the natural flows at the site. This knowledge will be used to guide final design, to ensure surface water is appropriately managed.



1:35,000 @ A4

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

Creek re-alignment
Existing Creek Channels
Proposed Haul Roads
2m Contours
Proposed infrastructure

Flood Depth - Post-mining (Metres)

0 - 0.5
0.5 - 1
1.0 - 1.5
1.5 - 2
2.0 - 2.5
2.5 - 3
3.0 - 3.5
3.5 - 4

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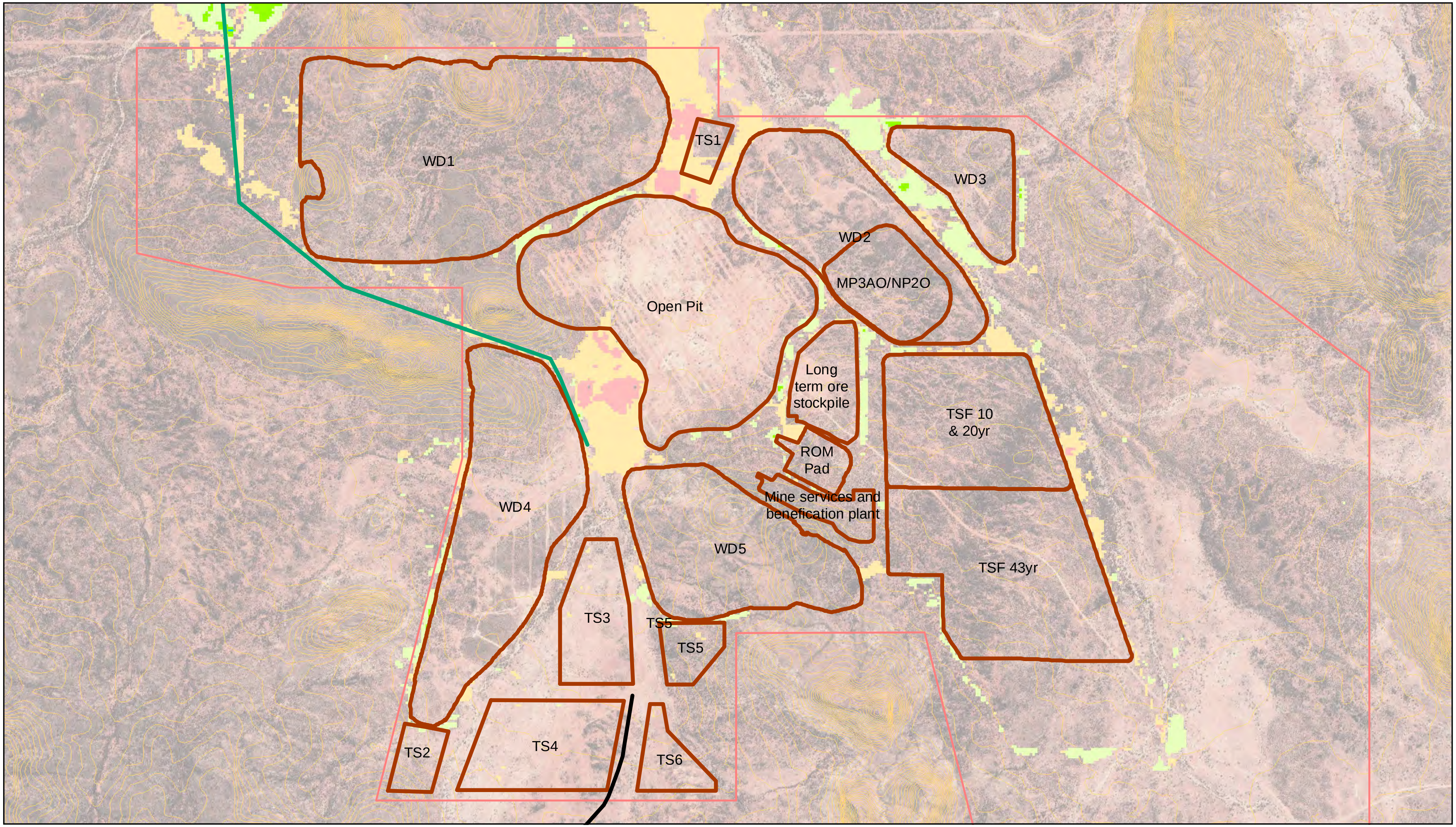
Flood depth for 100 year ARI event - post-mining

Figure **4-28**

G:\43\22301\GIS\Maps\4322301_467_FloodDepthPostMine.mxd

Data source: Google Earth Pro - Imagery (Date extracted: 29/04/2015). ARL - Proposed Haul Roads, Existing Creek Channels, Proposed Infrastructure (2015). CSIRO - 2m Contours (derived from SRTM) (2015). Created by: CM



1:30,000 @ A4

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

━	Proposed Diversion
━	Proposed Haul Roads
─	2m Contours
▭	Proposed infrastructure
▭	Mine Site Boundary

Post-Mining Change in Flood Velocity (m/s)

⬜	-1.5 - -1.0
🟥	-1.0 - -0.5
🟨	-0.5 - 0.0
⬜	0.0 - 0.5
🟩	0.5 - 1.0
🟦	1.0 - 1.5

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Revision	0
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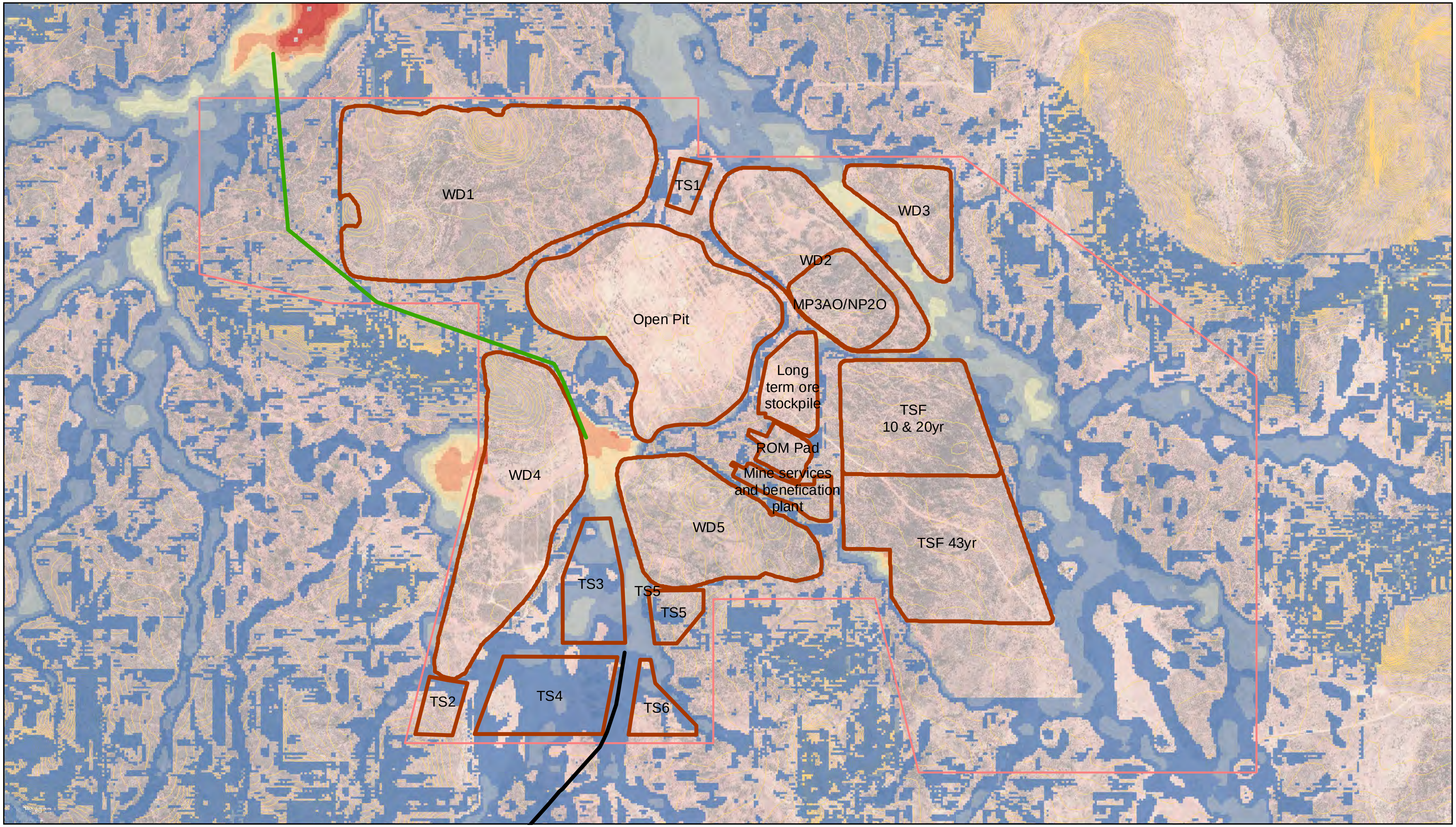
Change in flood velocity for 100-year ARI event - post-mining

Figure **4-29**

G:\43\22301\GIS\Maps\4322301_580_FloodChVel.mxd

Level 5 66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 29/04/2015). ARL - Proposed Haul Roads, Existing Creek Channels, Proposed Infrastructure (2015). CSIRO - 2m Contours (derived from SRTM) (2015). Created by: CM



1:35,000 @ A4

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

Proposed Diversion

Proposed Haul Roads

2m Contours

Proposed infrastructure

Mine Site Boundary

Post-Mining Flood Velocity (m/s)

0.0 - 0.5	2.0 - 2.5
0.5 - 1.0	2.5 - 3.0
1.0 - 1.5	3.0 - 3.5
1.5 - 2.0	3.5 - 4.0

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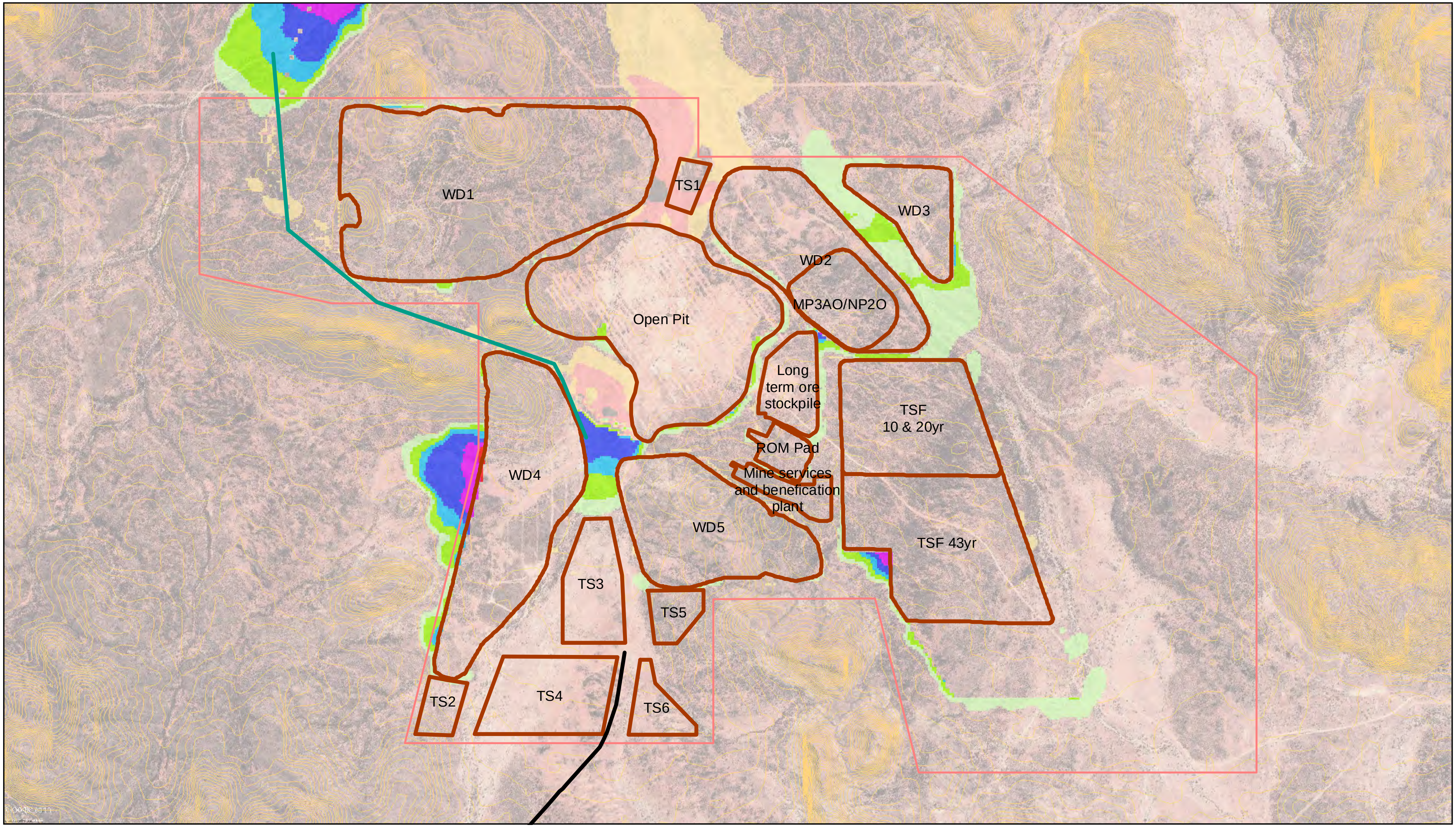
Flood depth for 1000 year ARI event - post-mining

Figure 4-30

G:\43\22301\GIS\Maps\4322301_568_FloodDepthPostMine.mxd

Level 7 24 Mitchell Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 29/04/2015). ARL - Proposed Haul Roads, Existing Creek Channels, Proposed Infrastructure (2015). CSIRO - 2m Contours (derived from SRTM) (2015). GHD - Flood Data (2016). Created by: CM



1:35,000 @ A4

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

LEGEND

▬	Proposed Diversion
▬	Proposed Haul Roads
▬	2m Contours
▭	Proposed infrastructure
▭	Mine Site Boundary

Post-Mining Flood Afflux (m)

⬜	-1.5 - -1.0
⬜	-1.0 - -0.5
🟨	-0.5 - 0.0
🟩	0.0 - 0.5
🟩	0.5 - 1.0
🟦	1.0 - 1.5
🟦	1.5 - 2.0
🟪	2.0 - 2.5
🟥	2.5 - 3.0

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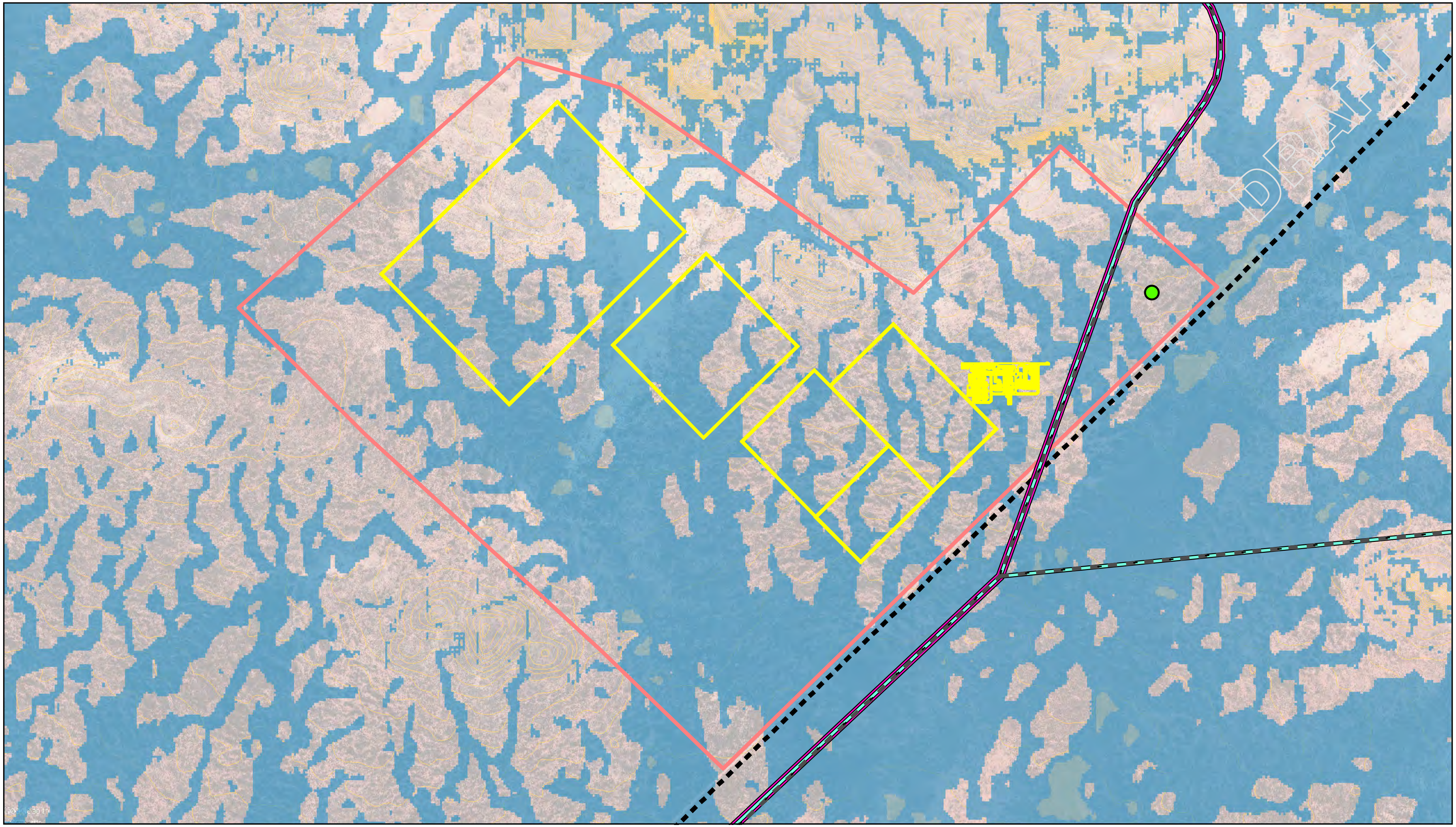
Change in flood depth (afflux) for 1000 year ARI event - post-mining Figure 4-31

G:\43\22301\GIS\Maps\4322301_570_FloodAfflux.mxd

Data source: Google Earth Pro - Imagery (Date extracted: 29/04/2015). ARL - Proposed Haul Roads, Existing Creek Channels, Proposed Infrastructure (2015). CSIRO - 2m Contours (derived from SRTM) (2015). GHD - Flood Data (2016). Created by: CM



1:35,000 @ A4

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

● Power Station

Residue storage facilities (RSFs) and evaporation ponds

Powerline

Potable Water Pipeline

Process Water Supply Pipeline

Existing Gas Pipeline

2m Contours

Processing Site Boundary

Flood Depth - Pre-mining (metres)

🟦	0.0 - 0.5
▨	0.5 - 1
🟩	1.0 - 1.5

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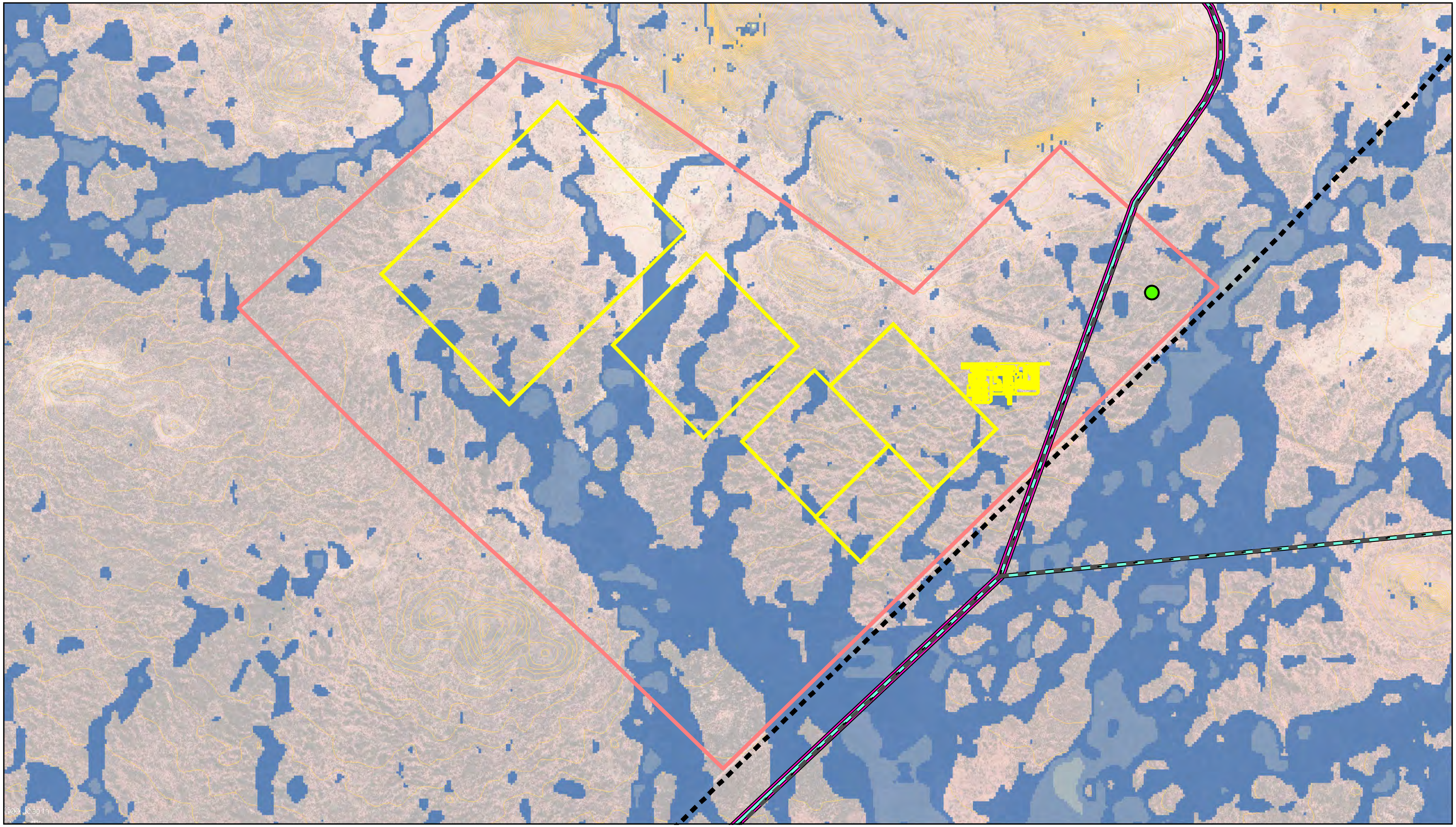
Flood depth for 100 year ARI event - pre-mining

Figure 4-32

G:\43\22301\GIS\Maps\4322529_011_FloodDepthProcessingPreMine.mxd

Data source: Google Earth Pro - Imagery (Date extracted: 29/04/2015). ARL - Proposed Haul Roads, Existing Creek Channels, Proposed Infrastructure (2015). CSIRO - 2m Contours (derived from SRTM) (2015). Created by: CM



1:35,000 @ A4

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

- ● Power Station
- Residue storage facilities (RSFs) and evaporation ponds
- Powerline
- Potable Water Pipeline
- Process Water Supply Pipeline
- Existing Gas Pipeline
- 2m Contours
- Processing Site Boundary

Pre-Mining Flood Depth (m)

- ▨ 0.0 - 0.5
- ▨ 0.5 - 1.0
- ▨ 1.0 - 1.5
- ▨ 1.5 - 2.0
- ▨ 2.0 - 2.5

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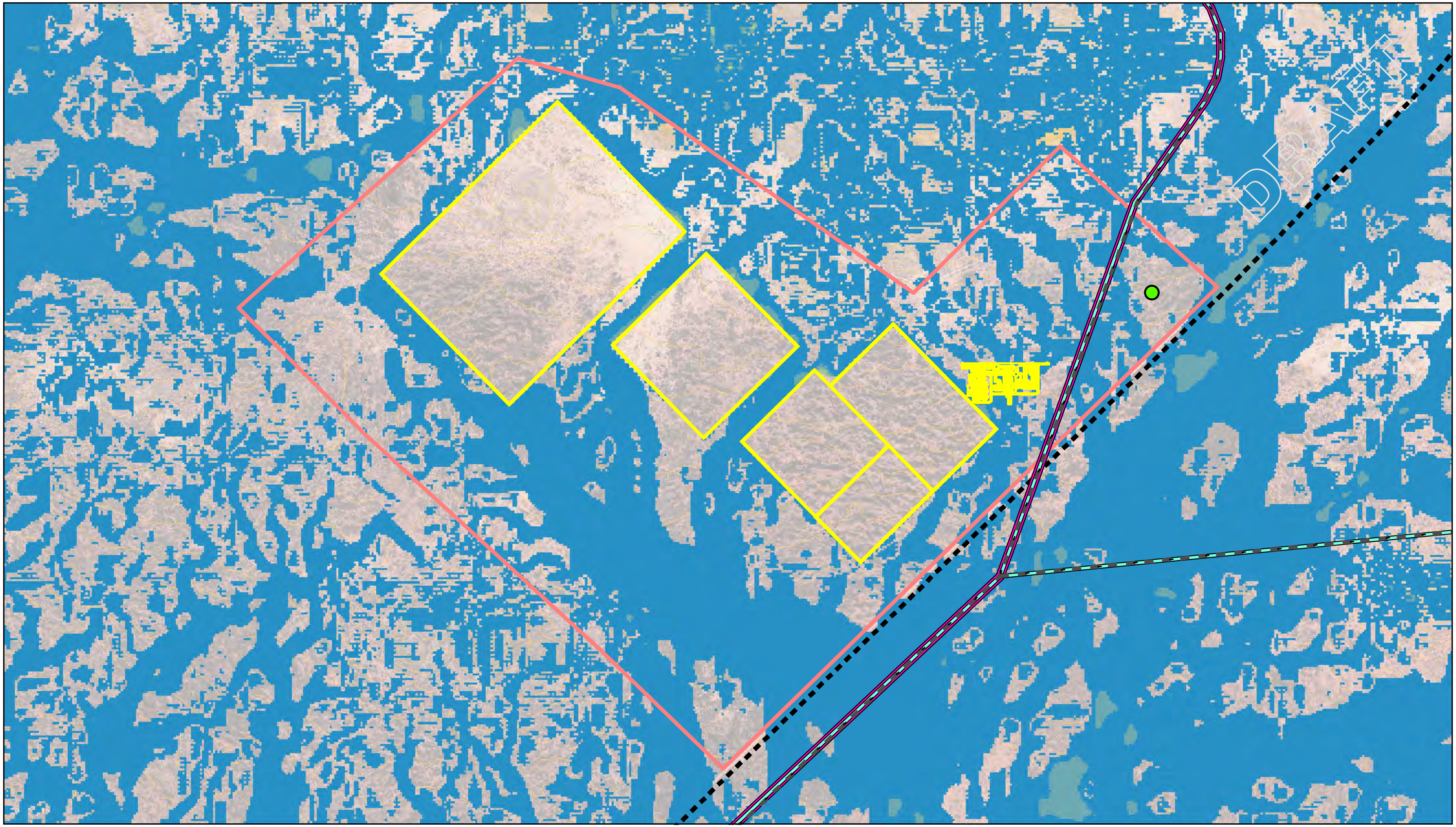
Flood depth for 1000 year ARI event - pre-mining

Figure 4-33

G:\43\22301\GIS\Maps\4322529_013_FloodDepthProcessingPreMine.mxd

Level 7 24 Mitchell Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 29/04/2015). ARL - Proposed Haul Roads, Existing Creek Channels, Proposed Infrastructure (2015). CSIRO - 2m Contours (derived from SRTM) (2015). GHD - Flood Data (2016). Created by: CM



1:35,000 @ A4

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

- ● Power Station
- Residue storage facilities (RSFs) and evaporation ponds
- Powerline
- Potable Water Pipeline
- Process Water Supply Pipeline
- Existing Gas Pipeline
- 2m Contours
- Processing Site Boundary

Flood Depth - Post-mining (Metres)

- 0 - 0.5
- 0.5 - 1
- 1.0 - 1.5
- 1.5 - 2

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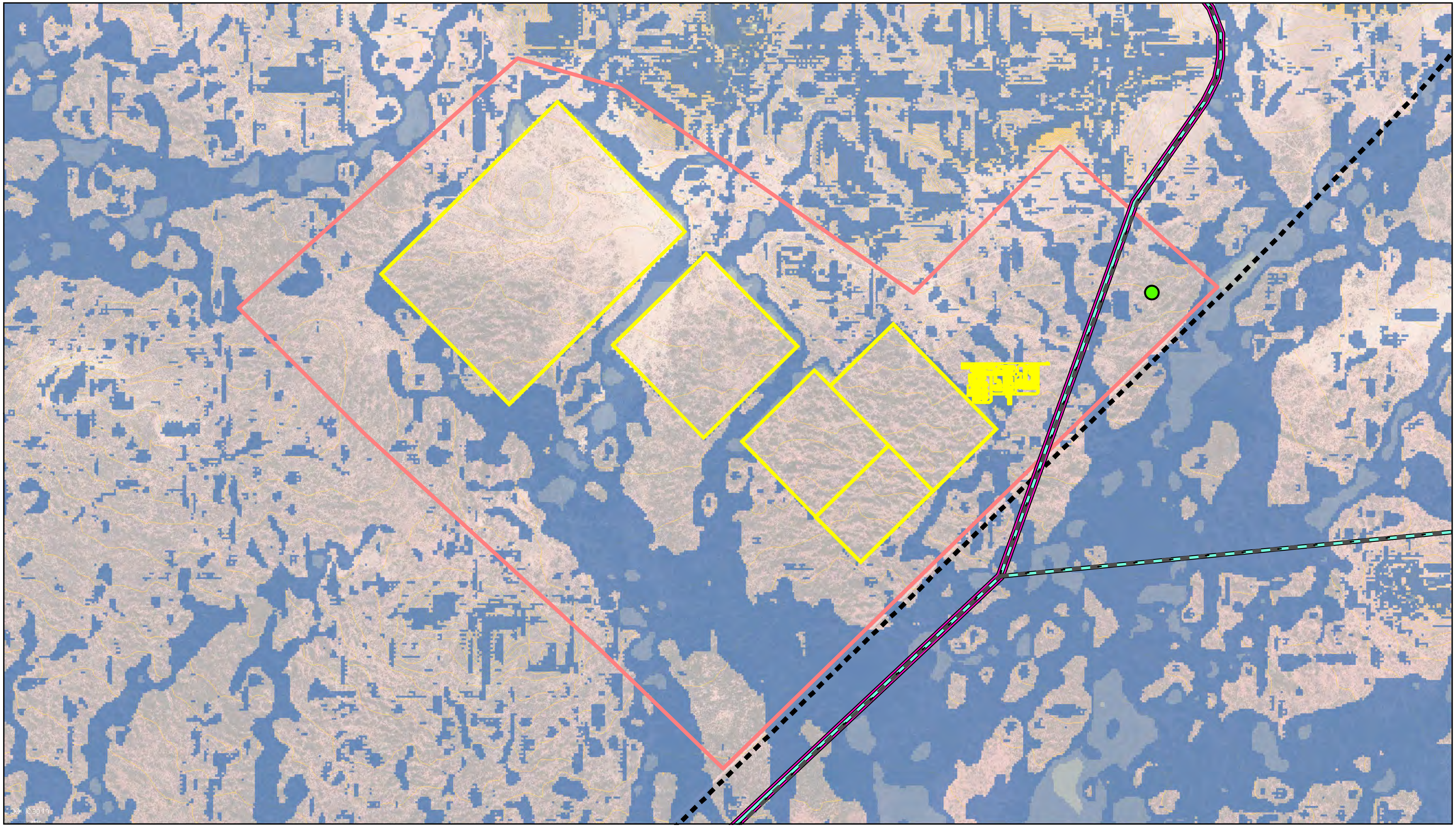
Flood depth for 100 year ARI event - post-mining

Figure 4-34

G:\43\22301\GIS\Maps\4322529_012_FloodDepthProcessingPostMine.mxd

Data source: Google Earth Pro - Imagery (Date extracted: 29/04/2015). ARL - Proposed Haul Roads, Existing Creek Channels, Proposed Infrastructure (2015). CSIRO - 2m Contours (derived from SRTM) (2015). Created by: CM



1:35,000 @ A4

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

● Power Station

Residue storage facilities (RSFs) and evaporation ponds

Powerline

Potable Water Pipeline

Process Water Supply Pipeline

Existing Gas Pipeline

2m Contours

Processing Site Boundary

Post-Mining Flood Velocity (m/s)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0

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Nolans Project

Job Number	4322301
Revision	0
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Flood depth for 1000 year ARI event - post-mining

Figure 4-35

G:\43\22301\GIS\Maps\4322529_014_FloodDepthProcessingPostMine.mxd

Level 7 24 Mitchell Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 29/04/2015). ARL - Proposed Haul Roads, Existing Creek Channels, Proposed Infrastructure (2015). CSIRO - 2m Contours (derived from SRTM) (2015). GHD - Flood Data (2016). Created by: CM

4.15 Kerosene Camp Creek

4.15.1 Diversion design

Due to the proposed location of the open pit on the natural flow path of Kerosene Camp Creek, it will be necessary to divert the Creek to the west of the Mine site to discharge natural flows into the western tributary of Kerosene Camp Creek.

Seven scenarios have been considered as part of the feasibility study investigating the management options for Kerosene Camp Creek. Each scenario was assessed against the following risk categories:

- Safety
- Operational
- Environmental

The study determined that the diversion along the proposed alignment was considered to minimise the risk of contaminating creek flows, without significantly effecting the proposed mining operations.

The previously provided concept diversion alignment (Appendix A of the Surface Water Report of the EIS) has been revised to consider existing drainage paths that could be retained or modified. This is intended to maintain, as far as practical, the existing flow paths. The updated alignment is presented in Appendix 13.

A design for the Creek diversion has been prepared by cutting the cross-section (Figure 4-36) into a DEM of the existing conditions. The cross-section for the proposed diversion was developed to allow:

- An inset channel with 1V to 1.5H banks, approximately of 2 metres deep with a 4 metre base width that mimics the dimensions of the existing channel.
- A steep sided channel with 3V to 1H batters to minimise both excavation volumes and the top footprint width of the diversion.
- Benches, each approximately 2 metres wide, on either side of the inset channel to provide an opportunity for vegetation to establish in proximity to the channel.

Further information on the cross-section is provided in the EIS, Appendix A of the Surface Water Report (Appendix I of the EIS).

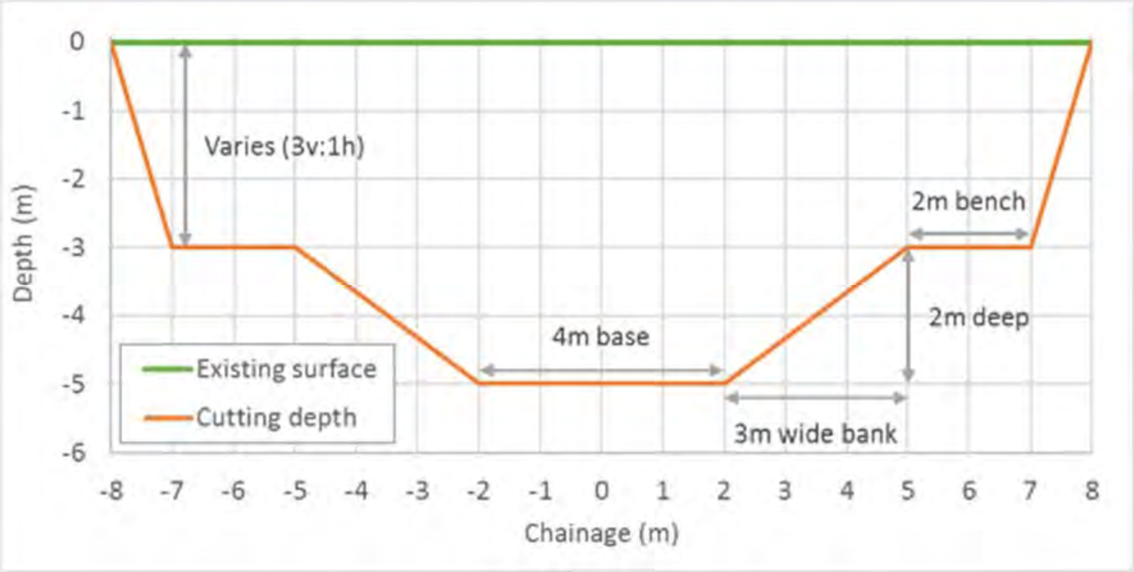


Figure 4-36 Diversion design cross-section

The diversion design assumes that the cross-section will be replicated the entire length of diversion. The design details:

- Alignment (i.e. horizontal alignment)
- Depth from surface to base
- Vertical alignment of the base
- In-channel benching
- Width of the channel at surface.

Three typical cross-sections have been produced to further to illustrate the application of the design. Example cross-sections have been produced for a channel:

- Less than 3 m deep
- More than 3 m deep
- Maximum depth

4.15.2 Hydraulic modelling

The previously prepared hydraulic model (HEC-RAS) has been updated to reflect the updated diversion design. This allowed for the maximum modelled flood depths, velocities and bed shear stresses to be estimated along the length of the proposed diversion, and thus the potential upstream and downstream impacts.

The modelling indicates that for more frequent storm events (e.g. the 2 year ARI storm event), the diversion is expected to generally maintain the maximum modelled flow depth upstream and downstream of the diversion, with flow depths within the diversion within the low flow channel (Figure 4-37). The maximum modelled shear stresses within the diversion indicate that fine gravels are likely to be transported along the length of the diversion, which is considered to be consistent with other watercourses within the region.

For larger flood events (e.g. the 10-year ARI flood event and 100-year ARI flood event: Figure 4-38 and Figure 4-39 respectively), the modelling indicates that the diversion would likely increase flood levels upstream of the diversion, whilst generally maintaining levels downstream. Within the diversion, shear stresses increase so that during the 100-year ARI flood event, larger (25 mm) gravels are expected to become mobilised. Movement of this material during large flood events is considered to be consistent with other watercourses within the region.

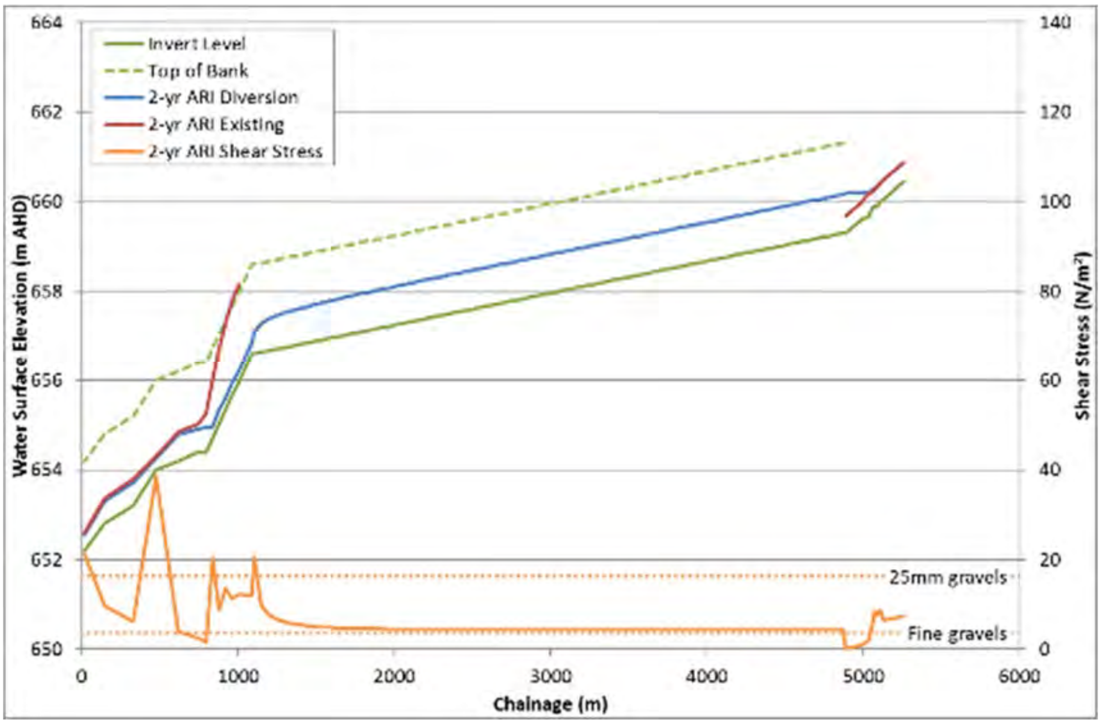


Figure 4-37 Hydraulic results - 2 year ARI event

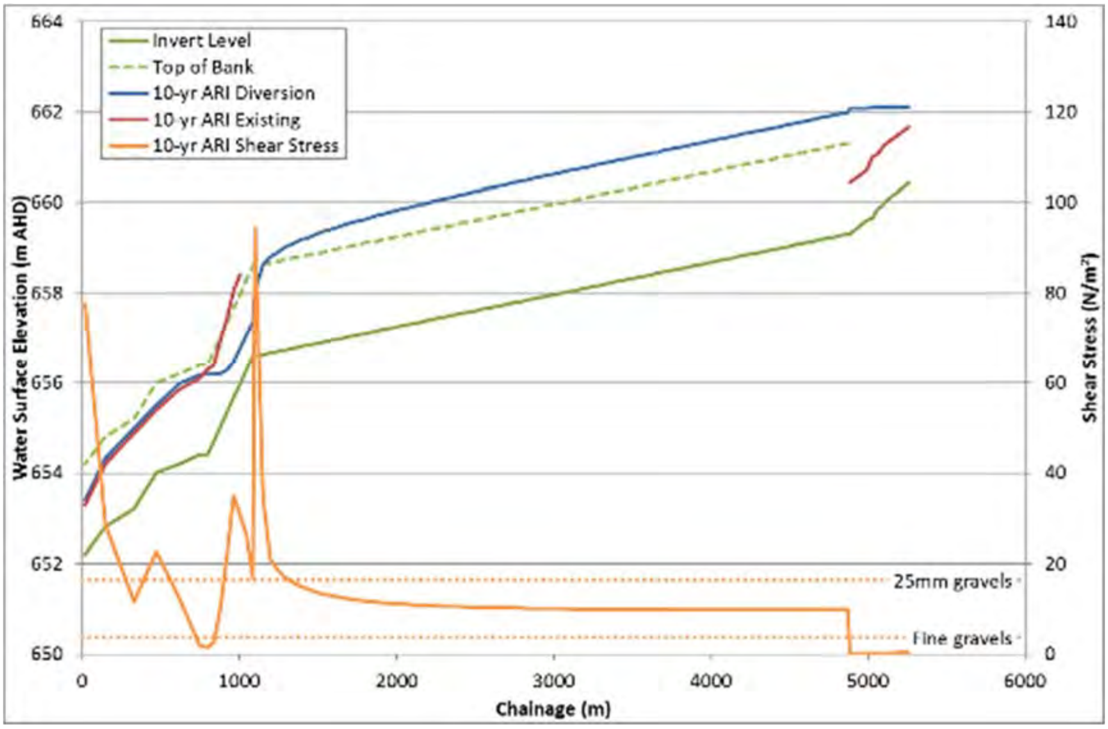


Figure 4-38 Hydraulic results - 10 year ARI event

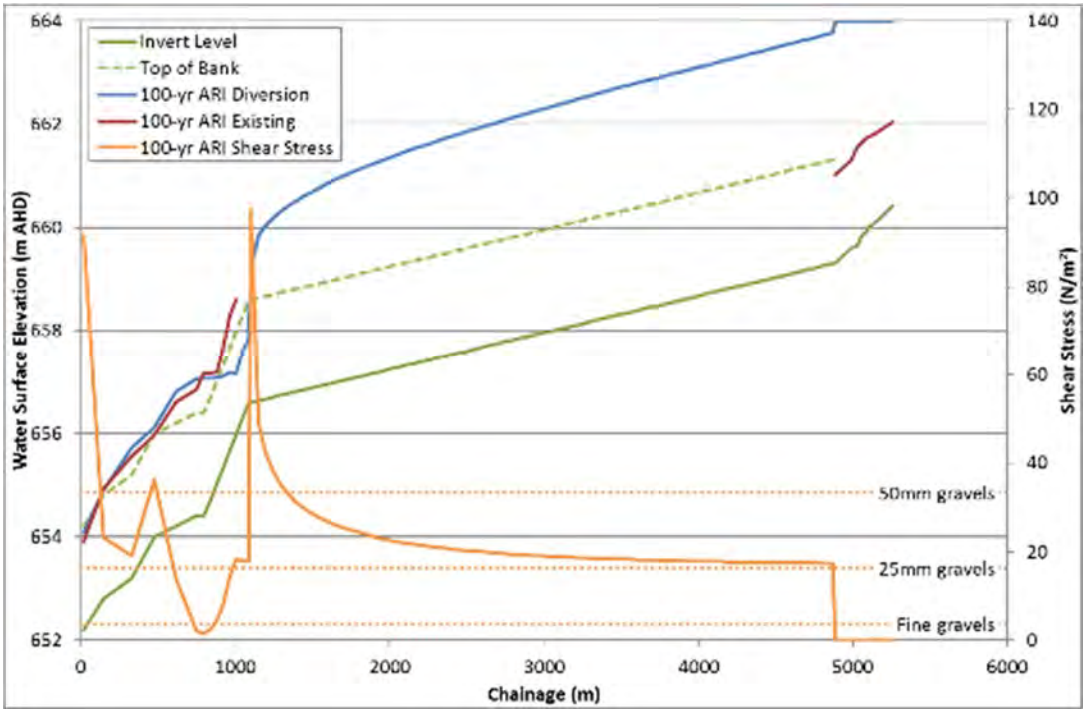


Figure 4-39 Hydraulic results - 100 year ARI event

4.15.3 Construction

The proposed creek diversion includes a section of deep (up to about 16 m) excavation through rock, principally quartzite, schist, gneiss and colluvium. Further geotechnical analysis will be undertaken to identify the suitability of these materials to achieve of 3:1 batter. Should it be determined that a lower batter ratio is required then this will be incorporated into the design. This has been included as a commitment.

The implementation of the design would require the excavation of about 520,000 m^3 of top soil, subsoil and rock.

Excavated top soil (and subsoil) would be stored within the topsoil stockpile areas for reuse around the site, including in the rehabilitation of the diversion bed and banks.

Where suitable, the excavated rock would be reused on site as:

- Scour protection (rip rap) within diversions and dam spillways
- Access and haul roads and elevated pad areas
- Flood protection levees

The remaining excavated material would be placed within the WRDs.

4.15.4 Impact assessment

Ecological functionality

The Creek diversion will essentially take the form of a confined, bedrock-dominated channel due to the terrain of the proposed alignment. The existing Creek, by comparison is an alluvial system with the channel bounded by floodplains. Although the character of the creek morphology through the diverted section will be altered to a confined, gorge like creek system, these characteristics are present within the Yalyirimbi Ranges.

The land disturbed by diversion works will be rehabilitated in three stages.

- Stage one will include:
    - Spreading of topsoil and the establishment of a cover crop (grasses) to stabilise exposed surfaces and minimise sediment generation during rainfall events;
    - Direct seeding of native vegetation within defined vegetation zones;
- Stage two will include:
    - Ongoing removal of weeds and supplemental seeding where necessary;
    - Identification and undertaking of remedial actions (if any); and
- Stage three will include:
    - An evaluation of the revegetation, with stage two repeated as necessary.

Where practical, diversions will be revegetated with suitable native species, with a preference for:

- Local species.
- Fast growing species that allow for rapid soil cover and erosion protection.

Further information on the management of the diversion is detailed in the Diversion Management Plan (Appendix 14) and includes monitoring requirements and performance criteria.

Catchment hydrology

Post mining flood characteristics modelling indicates that the proposed creek will result in an increase in flow depth immediately upstream of the diversion inlet of about 1.7 m and a slowing of flood water flow by about 0.5 m/s during a 1 in 1,000-year ARI event. For more information, see the Diversion Report in the EIS at Appendix A of Appendix I. This will increase the potential for localised overbank flooding and spillage from the diversion into the open pit and possibly sedimentation problems upstream of the diversion inlet.

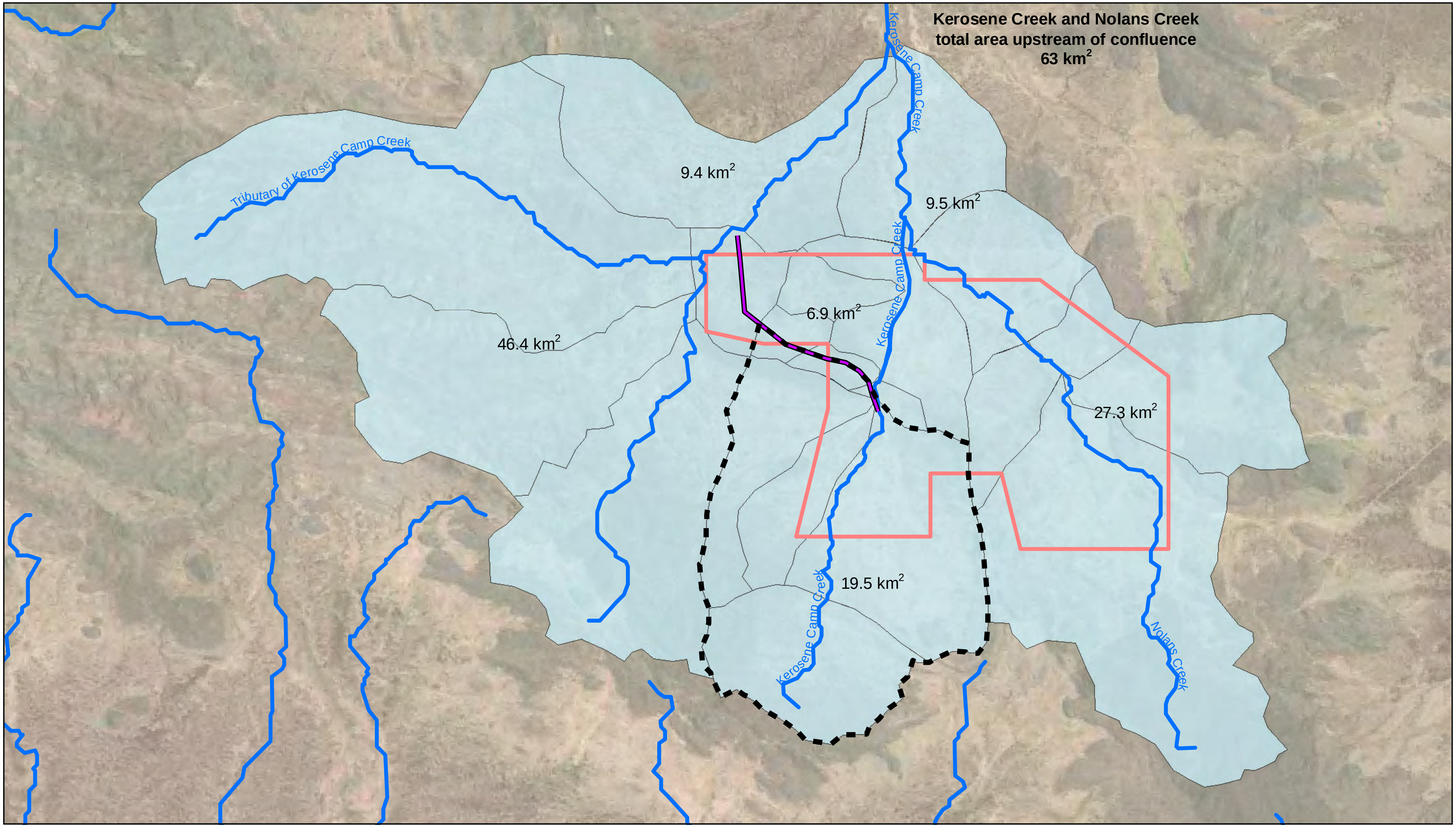
The catchment of the Creek diversion, and consequencely, the additional catchment to the western tributary of Kerosene Camp Creek equates to 19.5 km^2. The extent of the catchment is illustrated in Figure 4-40. This increases the catchment area of the western tributary by approximately 30 percent (modelled increase).

The modelling undertaken suggests that the diverted flow will have flow energies and erosion and sediment transport potential similar to existing conditions in the receiving channel (with an afflux during a 100-year ARI flow event of 0.2 m). As a result, the additional flow discharge from the diversion is not expected to have a significant impact on the morphology, and therefore the local ecology, of the receiving channel (Appendix A of the Surface Water Report).

The proposed diversion is expected to result in increased depths within the unnamed tributary of Kerosene Camp Creek of up to about 2.0 m, with minor decreases in velocities. The modelled increases in flow depths are expected to be localised to the unnamed tributary of Kerosene Camp Creek, with little to no appreciable changes to flood depths within Kerosene Camp Creek downstream of the confluence with the unnamed tributary. The changes to flows depths (and minor decreases in flow velocities) have the potential to alter existing patterns of bed and bank erosion and accretion.

The western tributary, when compared to Kerosene Camp Creek, has a larger catchment, larger creek flows, higher velocities, is incised into the bedrock without the broad shallow flood channels of Kerosene Camp Creek. The flood channels in the western tributary are up to 300 metres wide compared to Kerosene Camp Creek channels less than 100 metres wide.

The modelled increases in flow depths are expected to be localised to the western tributary, with little to no appreciable changes to flood depths within Kerosene Camp Creek downstream of the confluence with the tributary.



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

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LEGEND

- Diversion Channel
- Waterways
- ▭ Mine Site Boundary
- ▭ Existing Catchment Areas
- Diverted Catchment

Arafura Resources Limited
Nolans Project
Environmental Impact Statement

Job Number	4322301
Revision	0
Date	12 Oct 2017

Kerosene Camp Creek diversion catchments

Figure 4-40

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Data source: Google Earth Pro - Imagery (Date extracted: 29/04/2015). ARL - Proposed Pipelines, Proposed Mine Site, Proposed Diversion Channel Options, Tailings Storage Facility (2015). Created by: CM

Water quality

The risk of water quality impacts as a result of the excavation through rock is considered low as these rocks display the same characteristics as those associated with the ore body. Further geochemical characterisation work will be undertaken to confirm this as part as the detailed design phase of the project.

A baseline water quality dataset will be developed prior to the commencement of operations, as per the Water Management Plan. Monitoring points will be established upstream and downstream of the diversion outlet as well as within the diversion to monitor water quality.

4.15.5 Diversion Management Plan

A Diversion Management Plan has been developed to outline planning, implementation, monitoring and performance requirements of the Creek diversion (Appendix 14).

Performance criteria have been developed for:

- Water quality
- Ecology
- Geomorphology

This Plan will be reviewed:

- Every three years
- Following an independent environmental audit, with findings relevant to this Plan
- Following an environmental incident or community complaint relevant to the control measures outlined in this Plan
- Following relevant outcomes from a risk assessment or change management process.

If any significant modifications to the Plan are required as an outcome of the review, relevant government agencies will be consulted regarding the changes and the revised Plan will be submitted to the regulator for approval.

4.16 Springs

There are no permanent bodies of surface water in the region. The ephmeral water bodies in are Nolans project area, as defined in Table 4-16, are shown in Figure 4-41.

Red circles indicate rockholes (and natural depressions) with semi-permanent to ephemeral water bodies that are recharged by rainfall only. Blue circles indicate riverine refuges. These are semi-permanent to ephemeral water bodies in riverine sediments which are recharged by rainfall the interaction with semi-permanent shallow aquifers within the riverine system. The green circles highlight interflow discharge sites. These are ephemeral discharges due to rainfall that has infiltrated into and moves laterally through soil, sediment and or rock and has with no interaction with the water table or aquifer. An east-west section along the light blue line is shown in Figure 4-42.

The "spring after rain" to the east of Nolans Bore is classified as an interflow discharge site occurs at the base of a small hill to the east of the mine. Other interflow discharge sites are also suspected in this region. A number of rockholes (natural depression in the drainage) are shown on this section as well. The nearest example is Anna's Reservoir which is clearly a separated by hills, is within the Southern basins water catchment and above the groundwater level at Nolans Bore.

These springs are distant from the project, the nearest being Anna's Reservoir which is about 10 km west of the mine and Bluebush swamp which is about 8 km south east of the plant site. Neither of these are permanent, and being derived from rock fractures, they are reliant on rainfall events to recharge the fracture zones within the surrounding hills. Both are distant and up gradient from the project and will not be impacted by activities associated with the project (Figure 4-41).

The heritage site 10 km from Nolans Bore is Anna's Reservoir. This is a semi-permanent rock hole that is well known to dry up in drought periods. (*e.g*. *pers comm*. Chris Day, NT DENR Alice Springs). Anna's is separated from Nolans by hills and is also up gradient of the water table at Nolans Bore.

Table 4-16 Definitions of waterbodies

Type	Definition and mechanism	Known examples in the area
Spring	A permanent or semi-permanent discharge site for groundwater from an aquifer, either permanently or seasonally when water tables are elevated.	None
Interflow discharge sites	Interflow is part of precipitation that infiltrates into and moves laterally through the upper layers of soil, sediment and/or fractured rock and returns to the surface at some distance away from the point of entry into the ground (i.e. no interaction with the water table or an aquifer).	Widespread and associated to both bedrock and calcrete outcrops in the mine area
Riverine Refuges	A permanent or semi-permanent water body in riverine sediments that is recharged by rainfall and interaction with a permanent or semi-permanent shallow aquifer within the riverine system. These may be above the deep groundwater water table or may be connected to deep groundwaters.	20 Mile Waterhole
Rockhole	A permanent or semi-permanent water body in bedrock that is recharged by rainfall only. These features are permanent above the deep groundwater water table and have no or limited interaction with (i.e. they may provide recharge to) the deep groundwaters.	Anna's Reservoir

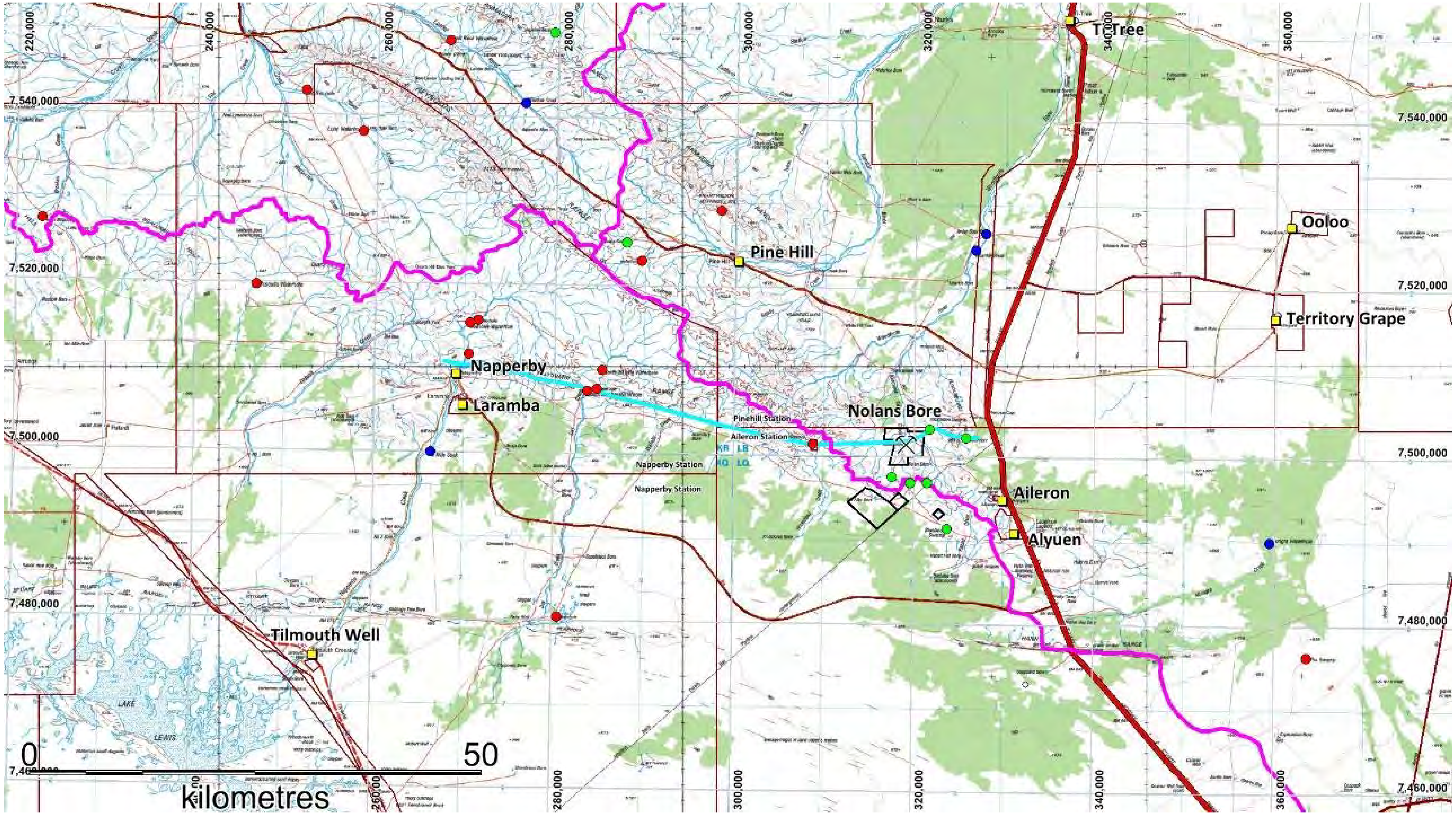

Figure 4-41 Natural water bodies in the Nolans project region and surrounds classified according to guidelines provided by GHD (Appendix 16)

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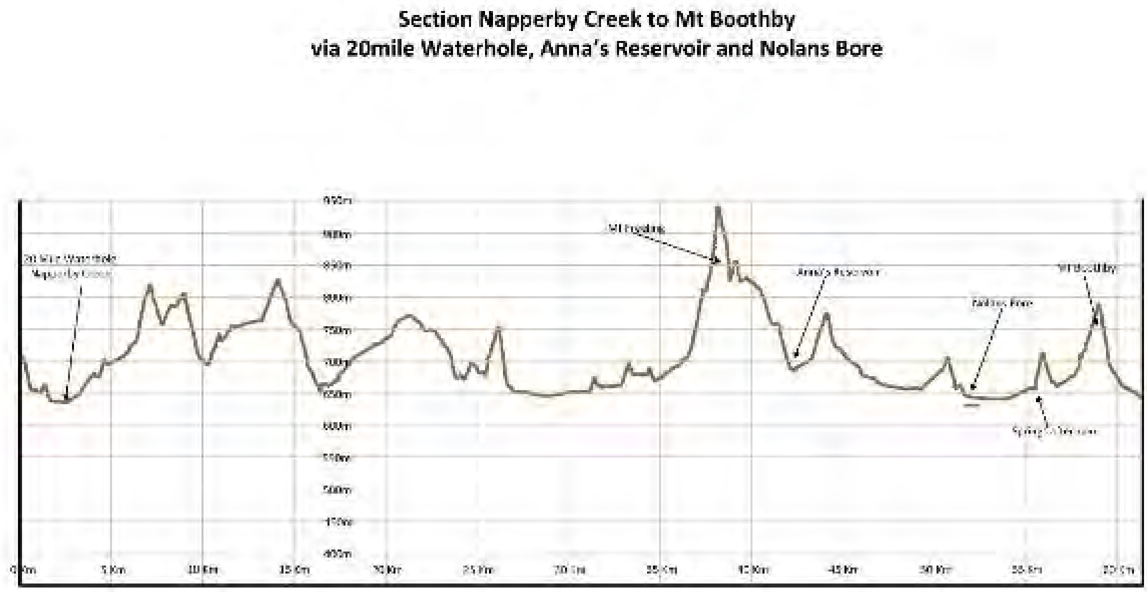


Figure 4-42 Cross section showing the relationship between elevation along the ranges, natural water bodies and the water level at Nolans Bore (Arafura 2017)

4.17 Palaeochannel

The dark blue areas in Figure 4-17 below shows the areas of thickest alluvial cover on top of basement rock. The dark blue includes all active sandy drainage features and all known older palaeochannels. The light blue indicates calcrete. The remainder of the area is outcrop or thin skeletal soil on top of outcrop where the cover is less than about a metre, and mostly 0.2 m-0.5 m or less.

Exploration has demonstrated that the calcrete bodies are thin disconnected superficial units. Drilling indicates calcrete bodies are 1-6 m thick and are well above the current water table. Exploration drilling demonstrates that the calcrete body in the south is the thickest while those near the deposit are only 1-3 m thick. The calcrete bodies form local topographic highs and all are actively being eroded and incised. They are best described as topographically inverted perched mounds, 1-6 m above the current surrounding land surface. The calcrete bodies sit above the floor, or are at the same level as the adjacent palaeochannel; geologically the calcretes are cemented alluvial sediments and they are related to the consolidated palaeochannel sediments. The active drainage systems are topographically lower and are incised into the calcretes and older palaeochannels. Hence underflow in the calcrete and the older consolidated palaeochannels are highly unlikely; although the calcretes may hold limited amounts of water in solution cavities until the evaporate.

Drilling and exploration mapping demonstrates unconsolidated sandy bases are likely only within the larger active drainage features within the dark blue shaded areas, where depths to the bedrock range from 1-5 m maximum. The remainder of the unshaded area has thin skeletal soils and rocky outcrops. Most drainages in these areas are directly incised into bedrock and underflow is therefore not possible.

The large shaded area south east of the ML has >2.5 m of unconsolidated sandy cover, based on four widely spaced trenches dug north of the station track. Most of this material is on the banks of the creek and 1-3m above current bed of the creek. This material has been identified as a potential borrow site for topsoil/growth media at closure. Further northwest along this feature in the NE corner of the ML, drilling indicates the unconsolidated sandy cover is 1-3 m thick on either side of the creek bank. This feature might have small underflows outside of the active creek bed however most underflow will be restricted to the existing creek bed which is topographically lower. Most of this unconsolidated material on the creek banks in the north west of the ML sits above the active creek bed that runs through it. Arafura plans to excavate and stockpile the unconsolidated sandy material (soil) in the north east of the ML prior to placing infrastructure in this area.

The dark blue shaded area that enters the ML from the south west is mostly a consolidated (cemented) sandy soil, indicating it is a relict palaeochannel with a granite outcrop “island” in the middle. This palaeochannel also has a very thin veneer of an active channel. This palaeochannel is likely to be 1-3 m thick based on exposures and limited drilling within the ML, however given that most of this is consolidated, underflow is unlikely in this area, only surface flows.

Hence only the active creeks within the blue areas are likely to have any underflow at the bedrock contact, although underflow is ponded by the rock bars and clearly periodic in this desert environment.

Detailed drilling to assess of the depth of regolith cover in the processing area has not been done yet. Preliminary geological mapping (Table 4-18) indicates most areas are likely to have very shallow cover of colluvial sheet flow sand over basement units. Hence underflow is considered unlikely in most of the ML.

A deeper alluvial channel may occur near the alluvial deposits in the middle of the processing site and this will need to be assessed before infrastructure is placed here.

The infrastructure design plan presented in the EIS is preliminary and drafted by our consultants (AMC) without reference to the underlying substrate/regolith. Additional planned sterilization and geotechnical drilling will be conducted to ensure infrastructure is not placed on concealed mineralisation or palaeochannel. This has been included as a commitment.

The processing site ML area is considered large enough to allow for infrastructure to be sited in optimal locations.

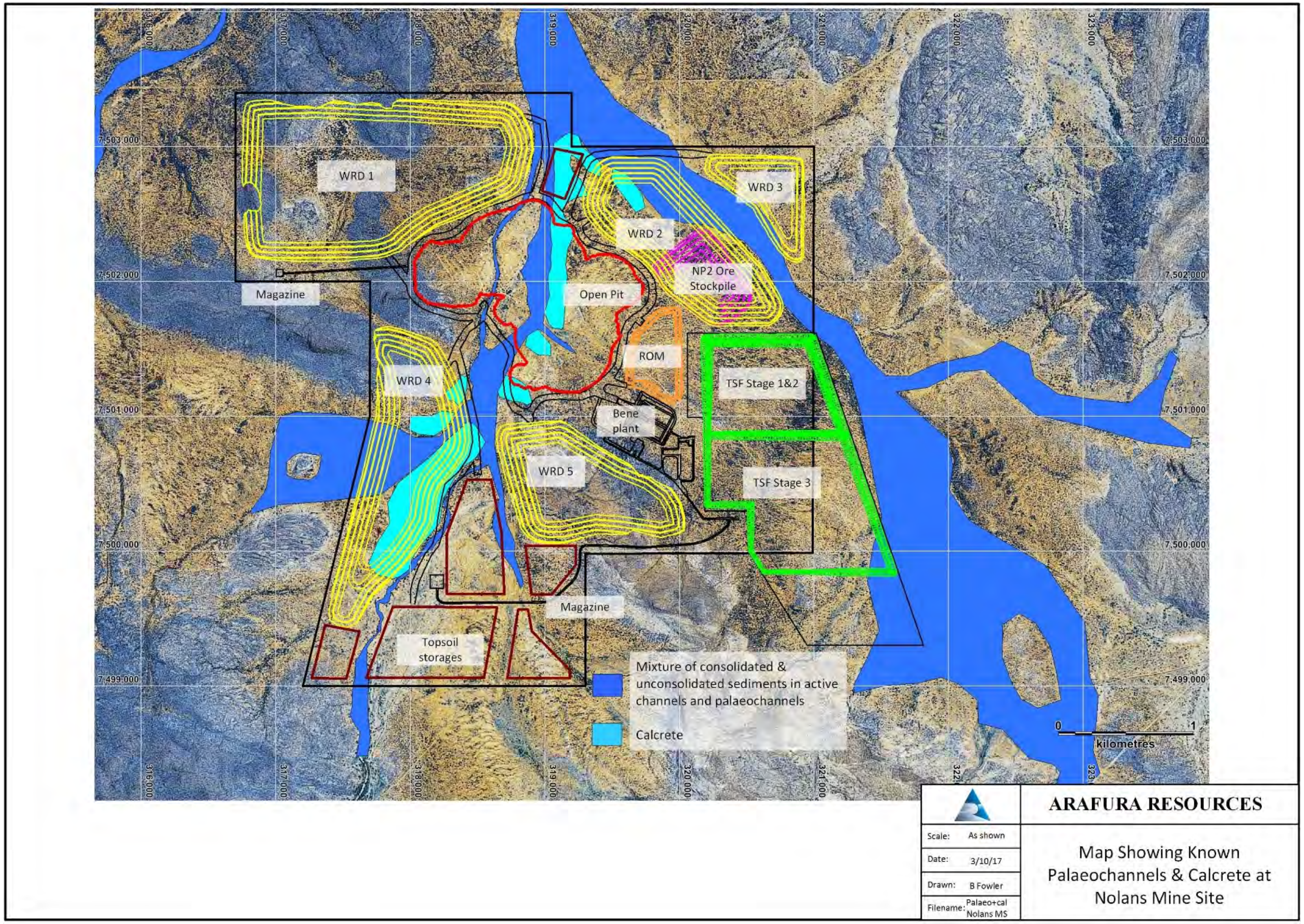


Table 4-17 Map indicating the type of drainage and areas of subsurface flow (Appendix 16)

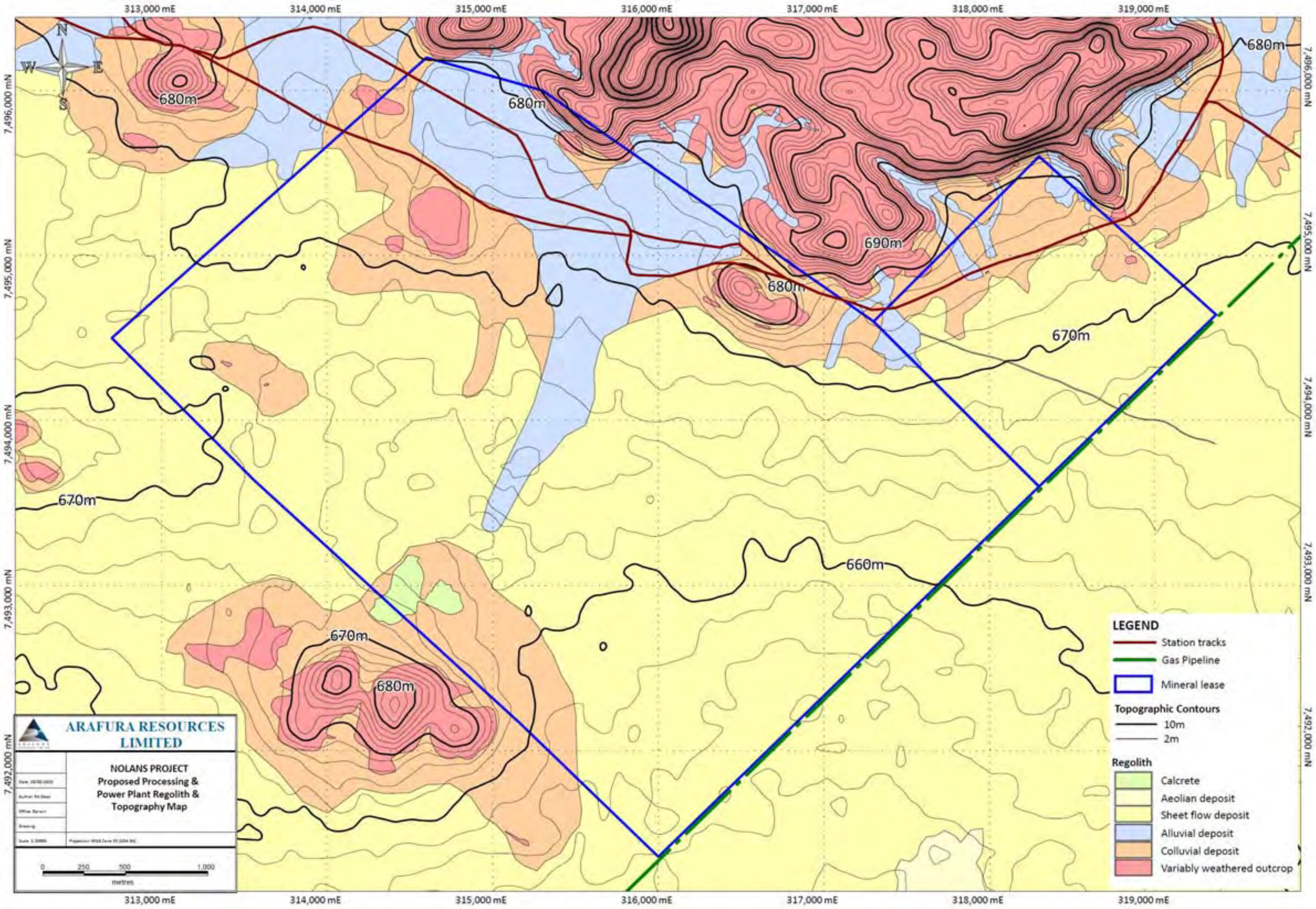


Table 4-18 Geology of the processing and RSF sites

4.18 Species for Rehabilitation

Where possible, pre-disturbance seed collection will be undertaken for listed flora species within the Mine site. It should be noted however, that for the majority of these species, only a small number of individuals were observed and it may not be feasible to a) relocate these individuals and b) to collect seed from them.

The rehabilitation program will collect and utilise seeds from more common species characteristic of vegetation types present within the site. Where possible, the species detailed in Table 4-19 and Table 4-20 would also be collected prior to disturbance and propagated for use in site rehabilitation.

Nationally and Territory significant flora

Three flora species that are listed as near threatened and three species listed as data deficient under the TPWC Act were recorded within the Study area. These species area listed in the table below and a description of their distribution provided in Appendix M of the Project EIS.

Table 4-19 Near threatened and data deficient species recorded within the study area

Species name	Common name	Status under TPWC Act
Abutilon lepidum	-	Near threatened
Acacia aneura var. conifera	Christmas Tree Mulga	Data deficient
Digitaria hystrichoides	Curly Umbrella Grass	Near threatened
Euphorbia ferdinandii	Caustic Weed	Data deficient
Eragrostis lanicaulis	-	Data deficient
Vittadinia obovata	-	Near threatened

Regionally significant flora

In addition to the species listed above eleven species listed as having bioregional conservation significance were recorded within the Mine. These species have conservation significance due to them being either at the limit of their range or being rare in the bioregion. These species and their regional conservation codes are listed in Table 4-20.

Table 4-20 Species with bioregional significance recorded within the study area

Species Name	Common Name	Regional Conservation Code DLRM 2015) BRT = Burt Plains bioregion
Maireana aphylla	Cottonbush, Leafless Bluebush	BRT (northern range limit)
Maireana scleroptera		BRT (northern range limit)
Convolvulus remotus		BRT (apparently rare)
Swainsona phacoides s.lat.	Dwarf Swainsona, Woodland Swainsona	BRT (northern range limit)
Prostanthera striatiflora	Striped Mint-bush	BRT (northern range limit)
Acacia murrayana	Colony Wattle, Murrays Wattle	BRT (northern range limit)
Aristida arida		BRT (northern range limit)
Aristida hygrometrica	Northern Kerosene Grass, Corkscrew Grass	BRT (apparently rare, disjunct)
Thyridolepis mitchelliana	Window Mulga Grass, Mulga Mitchell Grass, Mulga Grass	BRT (northern range limit)
Oldenlandia mitrasacmoides subsp. mitrasacmoides		BRT (southern range limit)

Species Name	Common Name	Regional Conservation Code DLRM 2015) BRT = Burt Plains bioregion
Spartothamnella teucriiflora	Mulga Stick-plant	BRT (northern range limit)

4.19 Fauna and Waterbodies

The tolerance of fauna to drinking at the TSF and RSF is unknown. The project will define limits of toxicity for threatened species and apply a quantitative commitment to keeping the water quality below these limits.

The water storage ponds (i.e. turkeys nests) at site will contain ‘raw’ water from either the borefield, pit water (i.e. groundwater) or rainfall capture. These ponds will likely be saline but will not contain any reagents or chemicals from the mining process, and thus present very little risk to fauna.

The TSF and RSF are not attractive environments to most fauna, but could still attract either waterbirds or waders. Experience at other operations in similar environs is that these species only stay for short periods because of human activity and the fact that there is no food source in the ponds. Ponds are generally maintained only around the decant facility so they are limited in area.

The facilities will be designed so to reduce the attractiveness of the facilities to avian fauna including:

- Reduce the pond surface area
- Create steep dam walls
- Remove vegetation on dam walls
- Avoid creating islands within the dam

Standard stock fencing will be installed around the TSF, RSF and ponds to prevent stock and other larger fauna entering the area, and therefore to limit opportunity to drink the pond contents.

It is considered rare that threatened fauna including the Black-footed Rock-wallaby, Great Desert Skink, Brush-tailed Mulgara and Great Bilby would utilise water in these facilities due to the distance from their preferred habitat, difficulty accessing the ponds and/or human activity in the area.

A water trough will be installed outside perimeter fencing at the water storage pond at the borefield to provide water for wildlife, and reduce the likelihood of fauna breaking the fence. There are also numerous watering points for stock, which are currently used by native fauna, which are located across the project area.

The results of ongoing fauna monitoring will further guide deterrence protocols. Best practice guidelines (i.e. WA DMP Environment Note – Fauna Egress Matting and Ramps) will be considered in the development of additional controls. The implementation of design controls and ongoing monitoring has been included as a commitment.

4.20 Black-footed Rock-wallaby

It is acknowledged that camera trapping is an effective approach for monitoring populations of Black-footed Rock-wallaby once populations are known (e.g. *Survey Guidelines for Australia's Threatened Mammals* DSEWPC 2011), however, the method employed for the targeted survey in July 21st to 26th 2015 was based on that developed by the Warru Recovery Team 2008. This method was used in the APY Lands of north-western SA to search for Warru (Black-footed Rock-wallaby) in the Tomkinson and Musgrave Ranges and was co-developed and recommended by Dr John Read who was also involved in the targeted surveys for the Nolans Project.

The method focussed on the identification of BFRW scat (age, size, abundance) and the presence/absence of known BFRW food plants. The method focusses on:

- Locate/define region where informants or habitat suggest current or prior BFRW occupancy and seek Traditional Owner approval, and ideally assistance, with the search.
- Visually assess the three most likely shelter/refuge sites for BFRW at each locality, with preference given to sites with multiple caves, crevasses or large boulder jumbles in proximity to BFRW forage and vegetative cover (especially figs, spearbush and grassy patches).
- Visit these three (or more) localities and search for scats in concealed locations. En route to these potential refuge sites search for scats on exposed rocks or adjacent to spearbushes/grasslands.
- Record GPS locality of all refuge sites visited (whether scats found or not) and the first 3 localities where fresh exposed scats are located.
- Collect up to 20 scats from at least one location from each search site with preference for fresh scats and label collection bag with locality and date. These should be deposited at the relevant state Museum (along with owl pellets etc). Ensure that a record of this collection is made on the relevant datasheet.
- Evidence (or lack of) on favoured forage species such as spearbush or Rumex in areas deemed inaccessible to Euro (*Macropus robustus*) should be noted.
- Observations of Euro, donkey, cattle, fox, cat, dingo, eagle, buffel grass, cave-dwelling bats, peregrine falcons etc. and also proximity to permanent or ephemeral water supplies and human habitations should be recorded.

Remote cameras are proposed to be included in any future monitoring, however the inaccessibility of much of the project site and size (150,000 ha) suggests that for effective monitoring of the population, which appears to be sparsely distributed across numerous rocky areas, a helicopter will be necessary for the proposed annual surveys in addition to remote cameras.

It is proposed that future monitoring for the Black-footed Rock-wallaby is based around the same survey effort (two days) and approach described in the Nolans EIS, with the same sites re-monitored annually and remote cameras used to supplement scat collection and habitat assessment. Monitoring will include:

- Surveys concentrated on rocky outcrops, crevices, caves and boulder piles where rock-wallabies typically shelter (Ward *et al*. 2011); and vegetated parts of hills and escarpments, particularly grassy areas, where rock-wallabies potentially forage (Ward *et al*. 2011).

- Collection of macropod scats for analysis. Low densities of Black-footed Rock-wallabies can be difficult to detect using ground-based diurnal or spotlighting surveys. Searching for scats is considered a reliable and repeatable technique for detecting low density populations (Sharp 1999). Scats are deposited in the vegetated zones where they forage, on exposed boulders or ledges where they 'bask' and particularly in crevasses, caves or under boulder piles adjacent to secure refuges (Sharman and Maynes 2002).
- Targeted surveys for Black-footed Rock-wallaby, to be undertaken by four ecologists (two teams of two) over two days. Survey sites (65) have been selected and surveyed in 2015 over a 650 km^2 area in the eastern end of the Reynolds Range, Hann Range, Reaphook Hills and many small outcrops in between, using aerial imagery to select sites containing potentially suitable habitat (i.e. rocky outcrops, steep slopes and site supporting key food plants – spearbush, figs, grasses and forbs).
- Obtaining permission from Traditional Owners to conduct surveys and to access certain areas, prior to surveys. Permission woul be obtained through consultation with the CLC and AAPA.
- Surveys conducted on foot, in teams of two, during daylight hours. Teams will be dropped into sites by helicopter. A habitat assessment will be completed at each site, including qualitative notes on presence/abundance, likely shelter/refuge sites (e.g. caves, crevasses or large boulder piles), proximity to forage and vegetative cover (especially figs, spearbush and grassy patches).
- The above approach could be further augmented by placing remote cameras out randomly at some of the above sites (e.g. 20 cameras) to provide additional information on recruitment, predators, and abundance, with cameras collected the following year and analysed.

Future monitoring of the Black-footed Rock-wallaby will consider:

- The incidence and extent of fire (remote sensing and rock-wallaby monitoring sites).
- Predator abundance/diversity as discussed in Biodiversity Management Plan using motion sensor remote cameras.
- The incidence and abundance of weeds with a focus on Buffel Grass (habitat assessments at rock-wallaby monitoring sites).
- Dust/noise/light levels at rock-wallaby monitoring sites to determine impacts to wallaby populations.

Predator abundance/diversity can be monitored via methods such as the use of remote cameras, scat/track analysis and direct observation; fire can monitored via habitat assessment at selected rock-wallaby monitoring locations (65 sites as described above) and remote sensing; weed abundance/diversity monitored via habitat assessment at selected monitoring sites.

4.21 Woodforde River lineament

Arafura assumes that the Woodforde River lineament mentioned above is the interpreted linear feature coinciding with the eastern margin of the Woodforde River drainage channel north of the Pinehill access road, and shown as a dashed white line in Figure 4-43 below. This lineament starts about 20 km NNE of the mine site and continues northwards, ceasing near the Ti Tree farms. This lineament is clearly at a high angle to the prominent regional geological fabric of the region and it is not coincident with any identifiable deep-seated basement structure (Figure 4-43).

This lineament feature could be a neotectonic structure as there is small change in elevation across the lineament along the Stuart Highway to Arden Soak access track (just north of the Pinehill access track shown in the map) which crosses this feature about 10 km north of the Pinehill access road. There is also a difference in the regolith units either side of the river channel. The eastern side of this lineament has a stabilised aeolian component with linear dunes overlying consolidated red sandy soils, but the stabilised aeolian dune component is largely missing or is very thin on west side of the creek. This suggests some erosion on the western side, possibly associated with minor neotectonic activity sometime in the past.

This lineament does not propagate southward into the outcropping Arunta basement rocks on satellite imagery, nor is the southern extension of it evident in Arafura's detailed low-level geophysical dataset (Figure 4-44).

If this is a real geological structure (*i.e*. neotectonic fault), it is likely restricted to the Cenozoic Ti Tree Basin because the magnetic data indicates the satellite lineament ceases at the northern edge of the NW-SE Pinehill Shear Zone (Figure).

The Woodforde River and its tributaries are all generally incised by similar amounts (2-4m) all the way from Ti Tree upstream into the headwaters in the Reynolds Ranges. There is no significant difference in the amount of incision coincident with the Woodforde lineament. The Woodforde drainage system actively erodes into carbonate-cemented hardpan soils and gravels which suggests the river system and associated palaeochannels have been in place for considerable geological time and migrated across the valley floor. There is also clear evidence in the satellite imagery for the capture and diversion of drainage features on the west side of this lineament.

Hence this lineament may be a neotectonic feature but the landscape has largely recovered and stabilised.

There is unlikely to be any hydrological or fluvial incision risk to the project area from a possible neotectonic feature that commences some 20 km to the NNE and therefore has not been captured in the risk assessment. Furthermore it is significantly down gradient of the mine site and it parallels the Woodforde River. The infrastructure for the Nolans project will be designed to ANCOLD guidelines re the potential seismicity risk of the area.

Figure 4-43 Satellite image showing the inferred location of Woodforde lineament

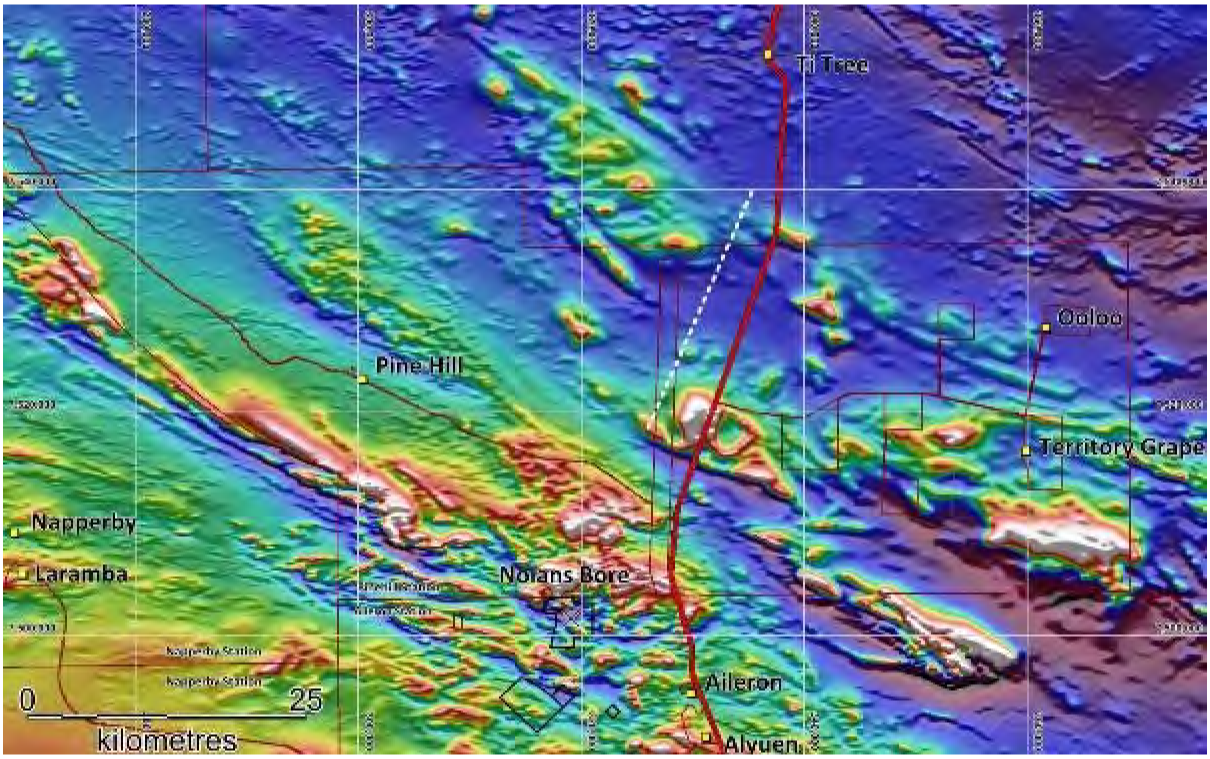


Figure 4-44 Magnetic image showing the location of the Woodforde lineament*

*Note this does not correspond to a basement feature. Most geological structures in this region trend north west.

4.22 Groundwater Model

Chapter 8 and, in particular, the Groundwater Report (Appendix K) of the EIS presented a groundwater model scenario referred to herein as:

1. the EIS model [Model 139].

This supplementary report introduces three new model scenarios as follows:

2. a scenario with reduced flow rates from the Southern Borefield [Model 301 (303)];
3. a scenario with reduced flow rates and reduced bedrock hydraulic conductivity (on request from Arafura) [Model 307]; and
4. a scenario with a reduced specific yield (from 0.10 used in the EIS model to 0.04, on request from the Water Resources Division, [i.e. Model 400]).

This supplementary report documents the changes to the EIS model only and therefore must be read in conjunction with the original Groundwater Report, and the limitations, assumptions and qualifications contained throughout the original Groundwater Report (Appendix K of EIS).

Model 301 [303]) are presented as Figure 4-11 to Figure 4-14. The other scenarios, EIS Model 139, Model 307 and Model 400, are presented in Appendix 10.

Limitations of New Models

The new scenario with reduced flow rates from the Southern Borefield (Model 301) has the following limitation:

- The pit size, mining rate and rebound characteristics remains the same as the EIS scenario which is not necessarily realistic but allows the comparison of the models.

The new scenario with reduced flow rates and reduced bedrock hydraulic conductivity (Model 307) has the following limitations:

- Information provided by Ride Consulting and others (including Government authorities);
- The root mean squared (RMS) residual with the lower basement hydraulic conductivity applied is higher at 4.23 m (less well calibrated) than the EIS model (which had a RMS of 2.83 m);
- Given the above the same PEST approach was re-applied with the exception being the recharge over basement was parameterised (and therefore lowered) to allow for the lower basement hydraulic conductivity. This resulted in a different set of automatically generated parameters which also resulted in a less well calibrated model (than the EIS model) with a RMS 3.27 m (model 307).

The parameters applied are presented below in Table 4-21. Further explanations of the application of PEST are expanded on in Section 4.22.2.

Model 400 uses the Model 301 scenario with the reduced specific yield from 0.10 to 0.04 and as such has the same limitations as described in the Groundwater Report (Appendix K).

Table 4-21 Horizontal hydraulic conductivity (m/day)

	Original	PEST	PEST _307	PEST vs PEST_307	Original vs PEST	Original vs PEST_307
Quaternary	1	7	4.70	67%	700%	470%
Napperby Formation Equivalent	2	0.2	0.26	129%	10%	13%
Napperby Fm Equiv Moderate	5	4	2.72	68%	80%	54%
Napperby Fm Equiv High	24	19	7.34	39%	79%	31%
Southern Basins Tertiary 2	2	3	2.09	70%	150%	104%
Southern Basins Tertiary 2 Moderate	5	0.8	9.93	1242%	16%	199%
Waite Formation Equivalent	1	2	2.22	111%	200%	222%
Hale Formation Equivalent	4	5	0.29	6%	125%	7%
Southern Basins Tertiary 1	4	28	22.54	80%	700%	563%
Palaeozoic Ngalia Basin	0.1	1	0.96	96%	1000%	960%
Proterozoic Basement Rocks	0.01	0.01	0.001	10%	100%	10%
Proterozoic Apatite	0.1	0.1	0.10	100%	100%	100%
Proterozoic Gneiss	0.01	0.01	0.001	10%	100%	10%
Mine Void	0.1	0.1	0.10	100%	100%	100%
Deep Proterozoic	0.01	0.01	0.001	10%	100%	10%

4.22.1 Model data

Groundwater data included those identified in the EIS in Appendix K, and key documents that have been provided as appendices to this document including:

- Open Pit Dewatering Investigation (EES, 2011)
- Pumping Tests Interpretation (GHD, 2015)
- Appendix 15 – Stygofauna Pilot Survey (GHD, 2011)
- Northern Burt Basin Groundwater Exploration Stage 1 (Summary Document Only) (Centreprise, 2013)
- Submission to the Northern Territory Government Groundwater Allocation from the Southern Basins (Ride, 2014)
- Groundwater Exploration and Investigation Report (Ride, 2016).

These reports (apart from GHD, 2011) have been consolidated in the Water Resource Assessment (Appendix 3).

In summary:

- 75 water bores were purpose drilled as part of this project.
- Additional data from regional water bores and mineral exploration were also considered.
- One-off water levels were available for 49 bores for steady state calibration.
- Pumping tests provided interpretations of aquifer parameters, and regional water bore testing results were also considered.
- Numerous studies on the Ti-Tree Basin provided data and insight into the local aquifer regime.
- AEM provided insight into the basin geometries when constrained/coupled with validation from the drilling discussed above.

In addition, a Digital Appendix demonstrating the model geometry and inputs has been provided to aid the EIS reader (refer Appendix 8).

4.22.2 PEST

The automated parameter estimation package (PEST) was used extensively to assist in modelling decisions and calibration. The PEST values used in the predictive modelling were not explicitly stated but this is the logical approach (given the lower RMS and therefore better ‘fit’) and the reason for undertaking the PEST calibration exercise.

The field tests used to inform all values were:

- Values obtained from the previous Ti-Tree Basin work.
- EES pumping and slug tests interpreted by EES (refer Appendix 3) and a summary of these (provided below).
- Airlifts and pumping tests and a summary of the GHD interpretation of the pumping tests in the Southern Basins (refer Appendix 3).

Other than the data that model geometry (which is discussed in the Appendix K report), the key data available to constrain the parameterisation of the hydraulic conductivity values were the 49 water levels and the Ti-Tree basin contours discussed in the Appendix K report of the EIS.

As a parsimonious starting point, hydraulic conductivity could be simplified as two hydrogeological units:

- Basin sediments and sedimentary rock, and
- Bedrock.

This approach applies the principle of parsimony to try to keep the numbers of parameters in the model as low as possible which is consistent with the recommendations of the Australian groundwater modelling guidelines (Barnett et. al. 2012). The model evolved (or regressed depending on opinion) from this starting point to include the complexity already detailed in the Ti-Tree Basin. Originally, this complexity was expected to be mirrored in the Southern Basins, however, the work undertaken by Arafura and Ride Consulting (pers. comm. Hussey and Ride, 2015) disputed this, and additional parameters were required to represent the materials in the Southern Basins. Likewise, a number of bedrock units were required to reflect differing conditions (increased permeability) observed at the mine site and bedrock deep within the Southern Basins. A future goal of the modelling will be to review and if possible consolidate the parameters in the model.

4.22.3 Specific yield

Storage refers the amount of extractable water within an aquifer (or water that can be drained from an aquifer). Storage has two relevant parameters applied in groundwater modelling, specific yield which is applicable for unconfined aquifers and specific storage (or storativity) which is applicable for confined aquifers. Storage is not a factor which applied to steady state modelling and has no bearing on the steady state modelling and calibration presented in the EIS. Where storage is applicable is in transient groundwater modelling which is why it is applicable to the predictive groundwater modelling presented in the EIS.

Local estimates of storage can be obtained from pumping tests and grain size analysis from drilled materials, but a long-term pumping stress is generally required to provide true aquifer scale estimates of specific yield and specific storage. Such long term pumping stresses exist in the Ti-Tree Basin but not in the Southern Basins or basement rock. Thus, storage represents the two parameters with the lowest confidence within the groundwater model.

Where there is little data to justify otherwise, the guiding principle of parsimony, as encouraged by the groundwater modelling guidelines (Barnett et al., 2012), is applied. The principle of parsimony is keeping a groundwater model as simple as can otherwise be justified and in this case resulted in us applying only one specific yield value (10%) and one specific storage value (0.00001 1/m) to all materials in the model. It is recognised storage values will be locally different between units and even within units.

The models have now been run based on two specific yield values: the original EIS model 0.10 (10%) and now 0.04 (4%). The driver for the 4% approach was consultation with the Water Resource Division, Department of Environment and Natural Resources and the Department of Primary Industry and Resources, based on the history that Knapton (2007) had adopted this value for specific yield. It should be noted that prior to and after Knapton's (2007) work, a variety of values, all within the same order of magnitude, have been applied to the Ti-Tree Basin aquifer for example:

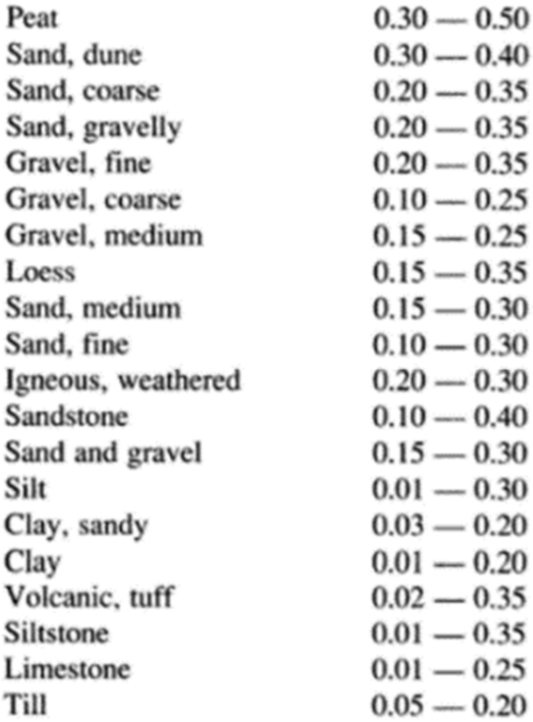
- 10% (Seidel, 1995)
- 4% to 10% (Water Studies, 2001)
- 7% (Water Studies, 2001)
- 10% (Paul, 2002)

- 7% (Read, 2003)
- 7% (Knapton, 2006)
- 10% (Wischusen, et al. 2012) and now
- 10% (GHD, 2016 - the EIS).

The Water Resource Assessment (Appendix 3) also presents a scenario at 1% which presents an ultra-conservative approach (an order of magnitude lower than the median of those presented above for the Ti-Tree Basin) to demonstrate that it is highly likely that there is ample groundwater within the aquifer for Arafura's requirements.

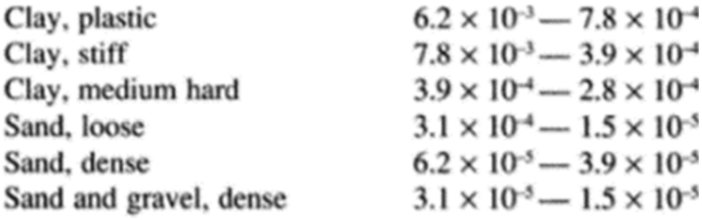
Storage values used in the EIS were estimated based on the above and are broadly supported by interpretations of pumping tests (GHD, 2015) and drilling results (Centreprise, 2013 and Ride 2014, 2016 and 2017) although it is recognised these data are variable and not conclusive without long term pumping as discussed above. In addition, storage values from the literature provided insight and are replicated here (Table 4-22) for the EIS reader (Walton, 1988) to demonstrate that value of 0.10 (10%) is well within the likely values for aquifers such as those modelled. Likewise Table 4-23 , presents the specific storage (storativity) values from Walton (1988) to demonstrate the value of 0.00001 1/m (1x10^{-5} 1/m) is well within the likely values for aquifers such as those modelled.

Table 4-22 Specific yield (Walton, 1988)



Peat	0.30 — 0.50
Sand, dune	0.30 — 0.40
Sand, coarse	0.20 — 0.35
Sand, gravelly	0.20 — 0.35
Gravel, fine	0.20 — 0.35
Gravel, coarse	0.10 — 0.25
Gravel, medium	0.15 — 0.25
Loess	0.15 — 0.35
Sand, medium	0.15 — 0.30
Sand, fine	0.10 — 0.30
Igneous, weathered	0.20 — 0.30
Sandstone	0.10 — 0.40
Sand and gravel	0.15 — 0.30
Silt	0.01 — 0.30
Clay, sandy	0.03 — 0.20
Clay	0.01 — 0.20
Volcanic, tuff	0.02 — 0.35
Siltstone	0.01 — 0.35
Limestone	0.01 — 0.25
Till	0.05 — 0.20

Table 4-23 Specific Storage 1/m (Walton, 1988)



Clay, plastic	6.2×10^{-3} — 7.8×10^{-4}
Clay, stiff	7.8×10^{-3} — 3.9×10^{-4}
Clay, medium hard	3.9×10^{-4} — 2.8×10^{-4}
Sand, loose	3.1×10^{-4} — 1.5×10^{-5}
Sand, dense	6.2×10^{-5} — 3.9×10^{-5}
Sand and gravel, dense	3.1×10^{-5} — 1.5×10^{-5}

As storage requires both stresses and monitoring of the responses to these stresses, further investigation of storage will be undertaken as part of the future groundwater calibration processes, once pumping (and mining) commences and groundwater level response is monitored. The result may be a refinement of the individual storage numbers applied across the model, or more likely, a discretisation of the model and multiple storage values applied across the model.

Undertaking the storage investigations, detailed above, has been included as a commitment.

4.22.4 Model assumptions

Assumptions and estimations used in setting up the numerical groundwater model are provided throughout Appendix K of the EIS, with particular reference to Section 5. The process of numerical model set-up includes an assumption that the validation process will continue as more data becomes available (refer Section 4.22.7).

4.22.5 Model Class

The EIS does not identify that “for a project of this magnitude, the modelling should be upgraded to a Class 2, where classes are defined in the Australian Groundwater Modelling Guidelines”; rather it identifies that if the modelling is to proceed to a Class 2 or 3 model, the key data gap at present is a temporal water level dataset. The EIS (Appendix K) states:

- “The key gap in data that would allow this model to move from a Class 1 model to a Class 2 or 3 model is temporal water level data.”.
- “Temporal monitoring of water levels (i.e. through the use of automatic loggers) will be essential for validation and the inevitable requirement for re-calibration of the groundwater model. These data are also required for developing the groundwater model to Class 2 or Class 3 according to the Australian Groundwater Modelling Guidelines (Barnett et al, 2012).”

The ongoing acquisition of temporal water level modelling to validate and ongoing re-calibration of the groundwater model (if required) has been included as a commitment.

Subsequent requests have indicated that a Class 2 model is required at the EIS stage and this has been discussed between Arafura, GHD, NT DME and NT DENR (Water Resources Division). GHD and Arafura presented that this request, developing a Class 2 model at EIS, is misguided and that a Class 2 model in the short term (under ten years) is not achievable or practicable for this project, primarily due to the setting, lack of previous detailed background groundwater studies or monitoring in the Southern Basins (unlike the Ti-Tree Basin) and the scale (volume and length of time) of the proposed abstraction. Table 4-24 to Table 4-29 presents the self-assessment in an attempt to document this against the Class 1 to Class 2 model distinctions as defined in the Australian Groundwater Modelling Guidelines (Barnett et al, 2012). Key consideration must also be given to the following aspects of Barnett et al. (2012):

- “A Class 1 model, for example, has relatively low confidence associated with any predictions and is therefore best suited for managing low-value resources (i.e. few groundwater users with few or low-value groundwater dependent ecosystems) for assessing impacts of low-risk developments or when the modelling objectives are relatively modest.”
- “Class 2 and 3 models are suitable for assessing higher risk developments in higher-value aquifers.”
- “If a model falls into a Class 1 classification for either the data, calibration or prediction sectors, it should be given a Class 1 model, irrespective of all other ratings.”

Table 4-24 Model Class Self Assessment - above or below Class 1 to Class 2 Threshold - Class 1 Key Indicators

Class 1 Key Indicators	Whole of model	Southern Basins	Reaphook Channel	Mine area (fractured rock aquifer)
Model is uncalibrated or key calibration statistics do not meet agreed targets.	Above	Above	Above	Above
Model predictive time frame is more than 10 times longer than transient calibration period.	Below, to get above requires 5 years of temporal data to replicate mine life pumping and mining, 100 years of data for the closure scenarios presented for Reaphook Channel rebound and mine drawdown	Below, to get above requires 5 years of temporal data to replicate mine life pumping, 100 years of data for the closure scenarios presented for Reaphook Channel rebound	Below, to get above requires 5 years of temporal data to replicate mine life pumping, 100 years of data for the closure scenarios presented for Reaphook Channel rebound	Below, to get above requires 5 years of temporal data to replicate mining, 100 years of data for the closure scenarios presented for mine drawdown
Stresses in predictions are more than 5 times higher than those in calibration.	Below, to get above requires test pumping of Reaphook Channel at 0.5GL/year (for 40 years) and mining of one fifth of the pit (over 50 years) to achieve required stresses	Below, to get above requires test pumping of Reaphook Channel at 0.5GL/year (for 40 years) to achieve required stresses	Below, to get above requires test pumping of Reaphook Channel at 0.5GL/year (for 40 years) to achieve required stresses	Below, to get above requires mining of one fifth of the pit (over 40 years) to achieve required stresses
Stress period or calculation interval is different from that used in calibration.	Below, to get above requires transient data	Below, to get above requires transient data	Below, to get above requires transient data	Below, to get above requires transient data
Transient predictions made but calibration in steady state only.	Below, to get above requires transient data	Below, to get above requires transient data	Below, to get above requires transient data	Below, to get above requires transient data
Cumulative mass-balance closure error exceeds 1% or exceeds 5% at any given calculation time.	Above	Above	Above	Above

Class 1 Key Indicators	Whole of model	Southern Basins	Reaphook Channel	Mine area (fractured rock aquifer)
Model parameters outside the range expected by the conceptualisation with no further justification.	Above	Above	Above	Above
Unsuitable spatial or temporal discretisation.	Above for spatial discretisation, below for temporal discretisation, to get above requires transient data to determine the suitability of temporal discretisation	Above for spatial discretisation, below for temporal discretisation, to get above requires transient data to determine the suitability of temporal discretisation	Above for spatial discretisation, below for temporal discretisation, to get above requires transient data to determine the suitability of temporal discretisation	Above for spatial discretisation, below for temporal discretisation, to get above requires transient data to determine the suitability of temporal discretisation
The model has not been reviewed.	Above, model reviewed by Rob Virtue as part of GHD QA/QC process and by Ride Consulting for Arafura and by EPA as part of the EIS process	Above, model reviewed by Rob Virtue as part of GHD QA/QC process and by Ride Consulting for Arafura and by EPA as part of the EIS process	Above, model reviewed by Rob Virtue as part of GHD QA/QC process and by Ride Consulting for Arafura and by EPA as part of the EIS process	Above, model reviewed by Rob Virtue as part of GHD QA/QC process and by Ride Consulting for Arafura and by EPA as part of the EIS process

Table 4-25 Model Class Self Assessment - Above or Below Class 1 to Class 2 Threshold - Class 2 Key Indicators

Class 2 Key Indicators	Whole of model	Southern Basins	Reaphook Channel	Mine area (fractured rock aquifer)
Key calibration statistics suggest poor calibration in parts of the model domain.	Above	Above	Above	Above
Model predictive time frame is between 3 and 10 times the duration of transient calibration.	Below	Below	Below	Below
Stresses are between 2 and 5 times greater than those included in calibration.	Below	Below	Below	Below
Temporal discretisation in predictive model is not the same as that used in calibration.	Below	Below	Below	Below
Mass balance closure error is less than 1% of total.	Above	Above	Above	Above
Not all model parameters consistent with conceptualisation.	Above	Above	Above	Above
Spatial refinement too coarse in key parts of the model domain.	Above	Above	Above	Above
The model has been reviewed and deemed fit for purpose by an independent hydrogeologist.	Above, model reviewed by Rob Virtue as part of GHD QA/QC process and by Ride Consulting for Arafura	Above, model reviewed by Rob Virtue as part of GHD QA/QC process and by Ride Consulting for Arafura	Above, model reviewed by Rob Virtue as part of GHD QA/QC process and by Ride Consulting for Arafura	Above, model reviewed by Rob Virtue as part of GHD QA/QC process and by Ride Consulting for Arafura

Table 4-26 Model Class Self Assessment - Above or Below Class 1 to Class 2 Threshold - Class 2 Data Requirements

Class 2 Data Requirements	Whole of model	Southern Basins	Reaphook Channel	Mine area (fractured rock aquifer)
Groundwater head observations and bore logs are available but may not provide adequate coverage throughout the model domain.	Above	Above	Above	Above
Metered groundwater-extraction data may be available but spatial and temporal coverage may not be extensive.	Above	Above	Above	Above
Streamflow data and baseflow estimates available at a few points.	Below, but we can assume it is zero outside of rain events	Below, but we can assume it is zero outside of rain events	Below, but we can assume it is zero outside of rain events	Below, but we can assume it is zero outside of rain events
Reliable irrigation-application data available in part of the area or for part of the model duration	Below, but we can assume it is zero outside of the Ti-tree Basin	Below, but we can assume it is zero outside of the Ti-tree Basin	Below, but we can assume it is zero outside of the Ti-tree Basin	Below, but we can assume it is zero outside of the Ti-tree Basin

Table 4-27 Model Class Self Assessment - Above or Below Class 1 to Class 2 Threshold - Class 2 Calibration Characterisation

Class 2 Calibration Characterisation	Whole of model	Southern Basins	Reaphook Channel	Mine area (fractured rock aquifer)
Transient calibration over a short time frame compared to that of prediction.	Below	Below	Below	Below
Temporal discretisation used in the predictive model is different from that used in transient calibration.	Below	Below	Below	Below
Level and type of stresses included in the predictive model are outside the range of those used in the transient calibration.	Below	Below	Below	Below
Validation* suggests relatively poor match to observations when calibration data is extended in time and/or space.	Above in terms of space, below in terms of time	Above in terms of space, below in terms of time	Above in terms of space, below in terms of time	Above in terms of space, below in terms of time

Table 4-28 Model Class Self Assessment – Class 1 Examples of Specific Use

Class 1 Examples of Specific Use	Whole of model	Southern Basins	Reaphook Channel	Mine area (fractured rock aquifer)
Design observation bore array for pumping tests.	N/A	N/A	N/A	N/A
Predicting long-term impacts of proposed developments in low-value aquifers.	Applicable	Applicable	Applicable	Applicable
Estimating impacts of low-risk developments.	Applicable	Applicable	Applicable	Applicable
Understanding groundwater flow processes under various hypothetical conditions.	Applicable	Applicable	Applicable	Applicable
Provide first-pass estimates of extraction volumes and rates required for mine dewatering.	Applicable	Applicable	Applicable	Applicable
Developing coarse relationships between groundwater extraction locations and rates and associated impacts.	Applicable	Applicable	Applicable	Applicable
As a starting point on which to develop higher class models as more data is collected and used.	Applicable	Applicable	Applicable	Applicable

Table 4-29 Model Class Self Assessment – Class 2 Examples of Specific Use

Class 2 Examples of Specific Use	Whole of model	Southern Basins	Reaphook Channel	Mine area (fractured rock aquifer)
Prediction of impacts of proposed developments in medium value aquifers.	N/A	N/A	N/A	N/A
Evaluation and management of medium risk impacts.	N/A	N/A	N/A	N/A
Providing estimates of dewatering requirements for mines and excavations and the associated impacts.	Applicable	Applicable	Applicable	Applicable
Designing groundwater management schemes such as managed aquifer recharge, salinity management schemes and infiltration basins.	N/A	N/A	N/A	N/A
Estimating distance of travel of contamination through particle-tracking methods. Defining water source protection zones	N/A	N/A	N/A	N/A

4.22.6 Validation of Model

The current numerical groundwater model is a Class 1 model. The current model follows best practice, and its main limitations are standard limitations when a numerical groundwater model is developed prior to significant extraction and monitoring the effects of this extraction on the groundwater system over an extended period.

A period of 5 years of monitoring significant extraction is considered to be a reasonable period to fully validate these models but they are still a very useful tool in assessing resources, potential impacts and identifying risk areas to be managed and monitored prior to extraction and during the early years of extraction. Arafura will run and update the models with baseline monitoring and other assessment data during:

- The current planning phase.
- The development phase as additional data becomes available from extraction of water for construction, groundwater and surface water monitoring.
- The initial operational phase and mine ramp up phases.
- Following commencement of the fully ramped up mine operational phase.

This has been included as a commitment.

4.22.7 Adaptive Management

4.22.7.1 Monitoring

The groundwater monitoring program, as detailed in the Water Management Plan (Appendix 4), outlines the proposed monitoring locations. These locations have been positioned based on the outputs of the groundwater model and the identification of potential groundwater impacts (i.e. seepage). The objective to monitor program is to monitor groundwater quality and depth.

The Water Management Plan will be reviewed annually (as part of the MMP review). The review will consider the results of monitoring and model validation (or progression to a Class 2 model). Should it be determined that groundwater is not behaving in the manner that was predicted then the monitoring program (location and frequency) will be updated to reflect this change. This has been included as a commitment.

4.22.7.2 Management

Should monitoring data or modelling indicate likely unacceptable impacts associated with planned extraction from the multiple bore fields in the Southern Basins, there are contingency measures that would be introduced to minimise that impact such as:

- Fully utilise water from the multiple bore fields to minimise the project potential impacts.
- Extract saline water from deep aquifers known to be present in the area.
- Expand the bore fields south and possibly further west. There are known brackish water supplies to the west in the Whitcherry Basin. From Airborne Electro Magnetic surveys there are believed to be other paleo channels to the south.
- Extract brackish water from the Ti Tree Basin either from deep paleo channels not currently utilised or a combination of use of these deep aquifers and other brackish groundwater known to exist based on NTG investigations e.g. in the southern sector of the NTG western Ti Tree Basin Water Management zone.

The application of these contingency measures will be dependent on the specific unacceptable impact.

4.23 Tailings and residues characterisation

There were four process stream samples subjected to leachate testing and analysis,

- A46422 CST Reserve
- 0488BH Barren Neutralised Slurry
- 0488BH DSP Barren neutralised water leach slurry
- A16422 Non-mag subs.

These samples were collected from previous metallurgical test work undertaken on a bulk sample of representative ore, which was processed through a SAPL pilot plant at ANSTO’s Sydney facility in 2011. The material was validated as representative ore of the first 7-10 years of mine production.

These representative samples, two from beneficiation and two from process residues come from various stages of the SAPL beneficiation process (tailings) and the hydrometallurgical processing stream (residues).

The samples are typical of the main orebody lithologies comprising fluorapatite, allanite and cheralite. Samples were predominantly derived from oxidised rock in the North Zone.

The original samples were a composite of large diameter core samples (700 mm diameter) drilled throughout the deposit and from various depths in the deposit to a maximum of around 80 m. The drill holes were sited to ensure they would represent the first 7-10 years of mining. The original composite bulk ore sample was selected from more than 30 large-diameter drill holes and was around 20 t. This sample was crushed, blended and then processed.

The composited samples tested were taken from the processing stream of materials used in SAPL flow sheet test work over a period of several days. The samples were also subjected to geochemical variability testing to ensure they were representative.

The PAPL flowsheet tailing and process residues are expected to be broadly similar as described in Section 2.7. It is intended to repeat similar test work on samples of these representative materials when they are available from the current PAPL piloting test work program. This has been included as a commitment.

Tailings samples are rarely available in large numbers at the EIS stage in any mining project. However, additional confidence in the beneficiation tailings can be derived from Stage 1 and Stage 2 samples of mineralised material, which will be the same as tailings but with lower rare-earth minerals.

4.24 Radionuclides in tailings

The chemistry of tailings and SAPL process residue, including total and leachable content, have been detailed in GHD’s July 2016 Supplementary Tailings and Residue Report (refer to EIS). Additional assessment of trial process residues held at the testing laboratory were similarly assessed, including detailed leachate analyses of as-received and neutralised residue, to inform on site management options, have been reported in GHD’s 2016 report *Arafura Leachate Analysis Process Residue*.

The tailings and residue samples discussed in the supplementary report are summarised in Table 4-30.

Table 4-30 Tailings and residue samples

Sample ID	Sample Type
A16422 Arafura Tails Blend	Flotation tailings slurry
A16422 CST Reserve	Magnetic separation solids
0488BH Barren Neutralised Slurry (BNS)	Neutralised slurry
0488BH DSP Barren neutralised water leached slurry	Neutralised and water-leached slurry
A16422 Non-Mag Subs	Residue solids

All U and Th concentrations, other than the water-leached neutralised slurry, were above the threshold equivalent Gross α + β for U and Th of 1 Bq/g of 80 ppm and 250 ppm respectively (DME QLD, 2008). The maximum concentration of U was 359 ppm (in 0488BH Barren Neutralised Slurry) and Th was 1900 ppm (in A46422 CST reserve) (GHD 2016a). The combined U+T equivalent ranged from 0.29 – 9.30 Bq/g, hence all materials, other than 0488BH DSP Barren neutralised water leached slurry, are classified as Naturally Occurring Radioactive Materials (NORMS).

Recent results of Arafura's beneficiation piloting program confirms radiation level as follows:

- Ore – 11.7 Bq/g
- Tailings are – 5.85 Bq/g dry and 4.6 Bq/g wet (water in tailings helps reduce activity). About 25% U and Th report to tailings during beneficiation.
- Residues are – 15.36 Bq/g dry and 11.5 Bq/g wet (water in tailings helps reduce activity). Note: this assumes that all remaining U and Th end up in residues and does not account for U that will go with the phosphoric acid.

None of the samples contained sulfide sulfur, as in all cases the sulfate sulfur was greater than the total sulfur, hence the wastes will not generate further acid on oxidisation. The leachate chemistry has been discussed in detail in the supplementary residue report and notes that leachate concentrations were less than 10 times the ADWG and FAE80% guidelines.

Based on the above, both tailings and non-water leached process residues are likely to be NAF, NORMS producing a neutral to alkaline leachate depending on the level of neutralisation of the residue.

4.25 Chemical and physical properties of WRD seepage

Given the general lack of sulfides with potential to oxidise over time and gradually release acid, metal and salts, the Australian Standard Leaching procedure (ASLP) testing provides an indication of first-flush water quality (refer Section 4.26.1).

The metal and metalloid toxicant and fluoride properties are discussed in Section 4.26.1. An indication of likely salinity can be obtained from the major ion analyses. The calculated total dissolved ions (TDI) ranged from 21 to 68 mg/L, indicating a very low salinity risk. A further indication can be obtained from the 1:5 EC testing undertaken as part of the NAG testing, which ranged from 45 to 412 uS/cm. This classifies the waste and ore as Very Low to Low salinity (DME, 1995).

Arid areas of the NT are known to have elevated nitrate levels in groundwater, derived from plant and microbiological activity in the soil. However, soils will be stockpiled separately; and given the local lithology, nitrate and other nitrogenous compounds are not expected to be present in significant concentrations in the waste rock or ore.

As with any mining or quarrying operation, there is potential for contamination by un-reacted blasting compounds such as ammonium nitrate. This can be reduced by ensuring efficient blasting or using alternative compounds in wet conditions, which also has a significant financial imperative to maximise blasting efficiency. Nitrate and ammonia will be monitored in groundwater and leachate/runoff and managed as required.

Although phosphate minerals are present in the ore and waste rock, they are not readily soluble and are highly unlikely to be present in significant dissolved concentration in leachate from runoff from the WRDs, ore pads or TSF areas.

Phosphorus may form more soluble compounds, such as phosphoric acid, in the acid-leached process residue. Consequently, the storage area will be designed and constructed accordingly.

In summary, the waste rock, ore pads and tailings leachate will have very low salinity and nutrient concentrations and relatively low toxicant concentrations, and appropriate management options have been proposed.

4.26 Leachate characterisation

4.26.1 Metal toxicant content

Results from an assessment of metal leachability carried out on raw and neutralised residue samples to assess on-site disposal options (GHD, 2016) demonstrated that fluoride and key metal solubilities were strongly pH-controlled, as illustrated in Figure 4-45 - Figure 4-50. If neutralised to a pH of around 8.5, the pH of a calcite-stabilised system, the residue is relatively benign. However, the RSF is being designed to contain highly metalliferous and acidic leachate as a precaution. The alteration to a phosphoric acid process is unlikely to make a significant difference, other than possibly to phosphorus concentrations, as the ore has high levels of phosphate minerals that react with sulfuric acid to form phosphoric acid.

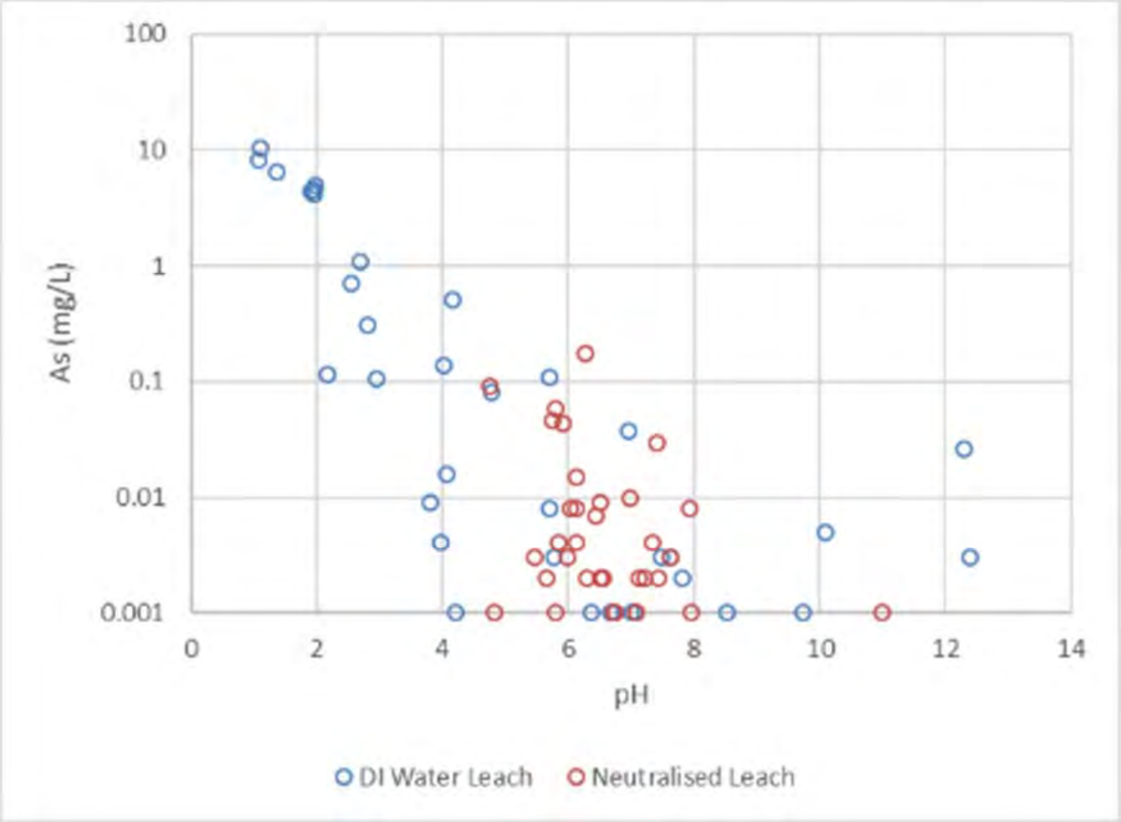


Figure 4-45 Leachable arsenic vs pH

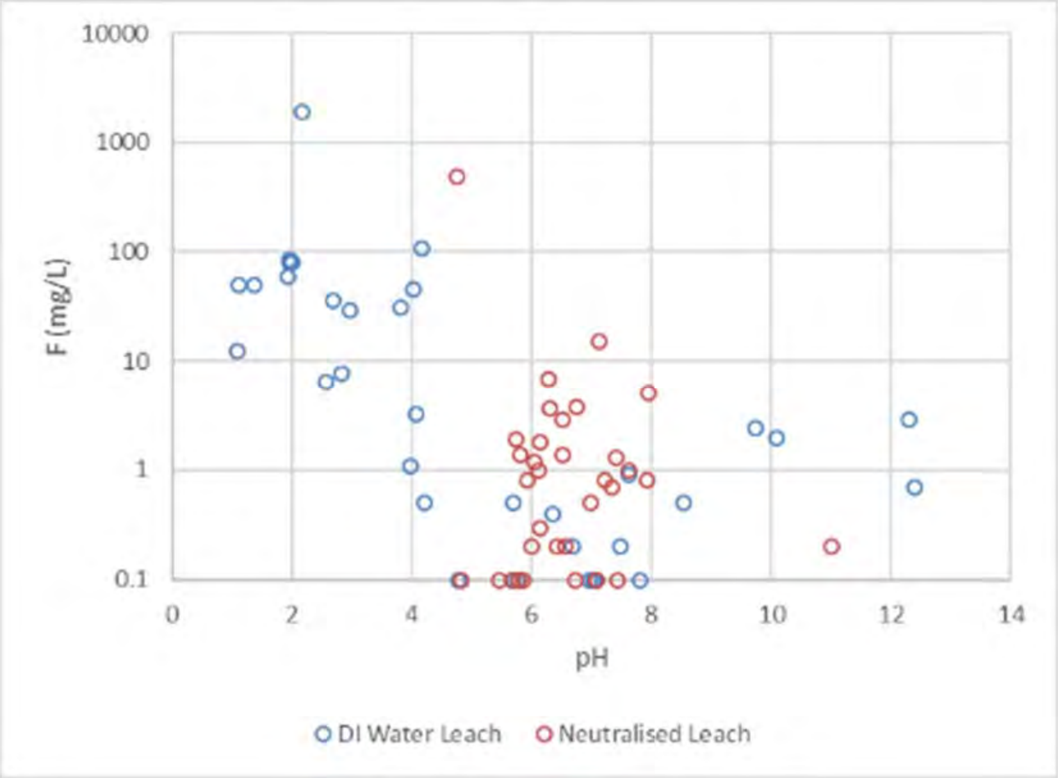


Figure 4-46 Leachable fluoride vs pH

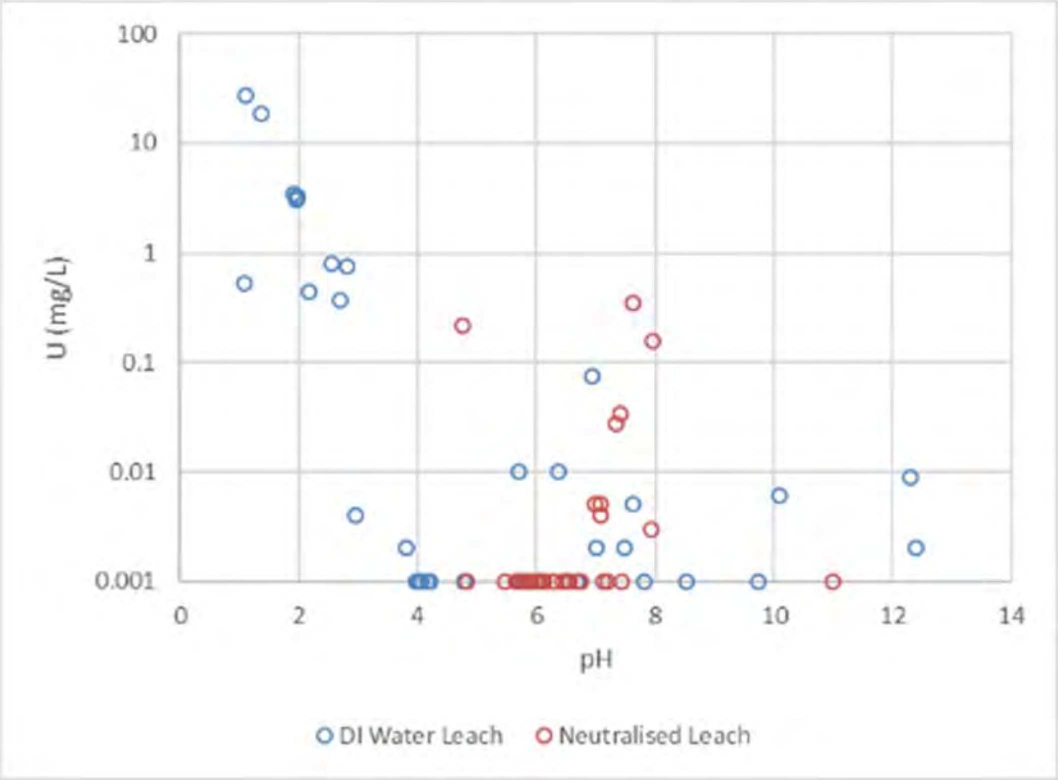


Figure 4-47 Leachable uranium vs pH

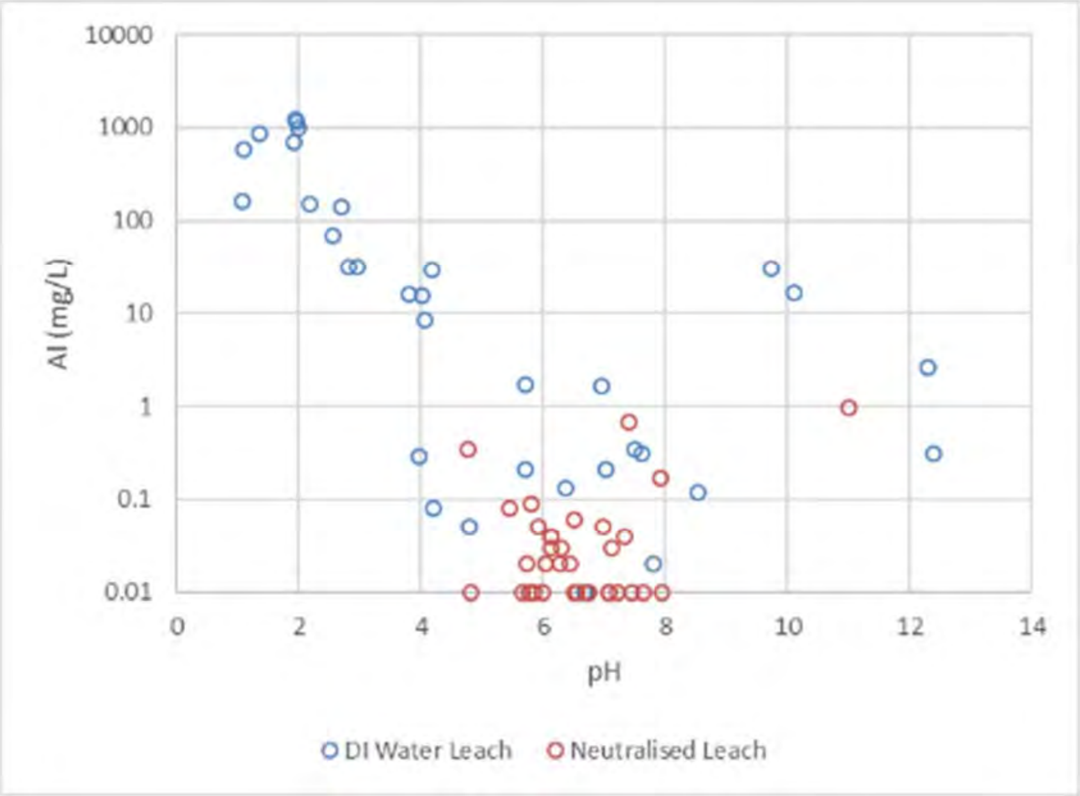


Figure 4-48 Leachable aluminium vs pH

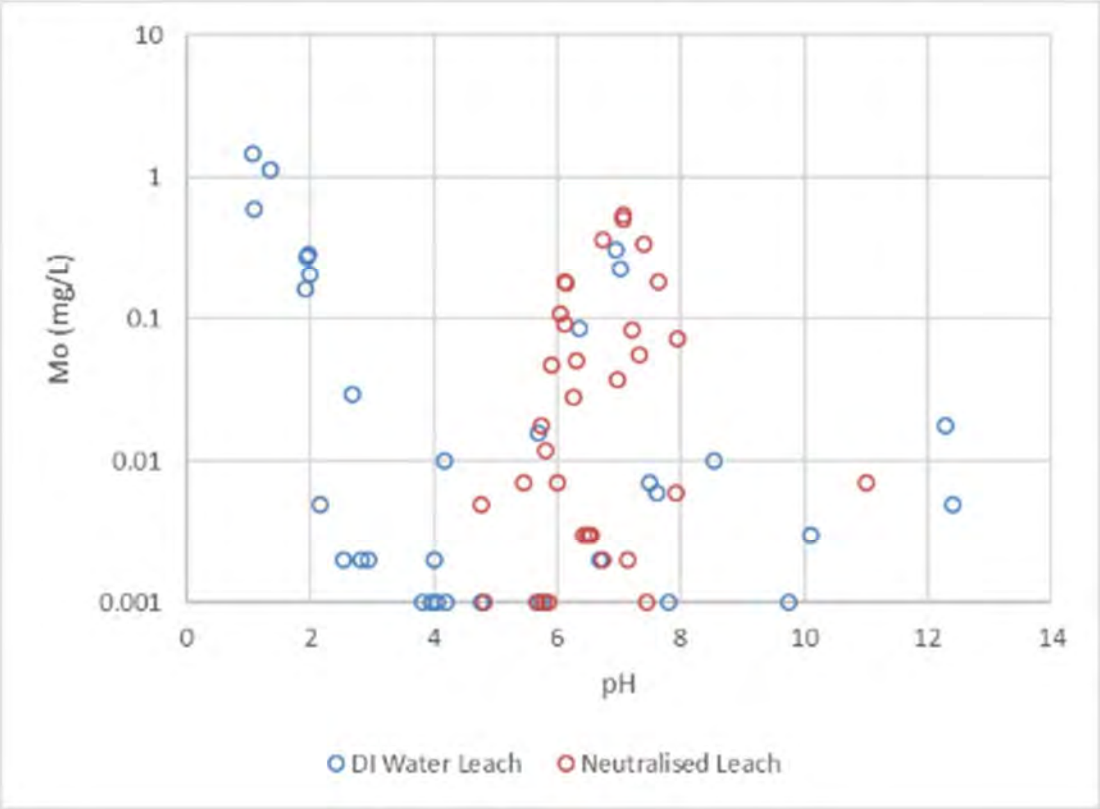


Figure 4-49 Leachable molybdenum vs pH

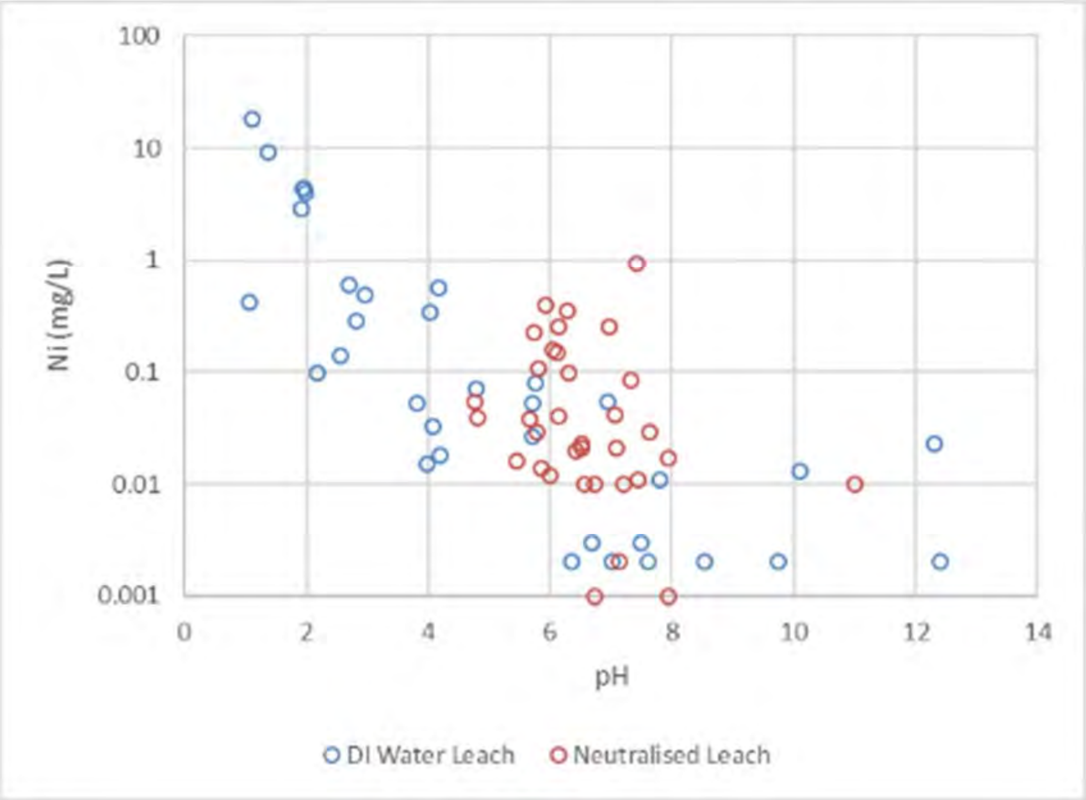


Figure 4-50 Leachable nickel vs pH

The mobility of metal toxicants was assessed using the ASLP, using distilled water, to simulate leaching of metals from non-acidic waste rock, by rainwater. A total of 24 samples of waste rock and ore distributed throughout the proposed pit area were tested. This test was selected given the generally low sulfide content of the ore and waste rock, and likely neutral drainage.

The leachate results were compared to a hierarchy of water quality guidelines. That hierarchy comprises:

- ANZECC & ARMCANZ (ANZECC & ARMCANZ, 2000) guidelines for protection of 80% of freshwater aquatic ecosystem species (FAE80%) selected based on the ephemeral nature of the arid area streams. The original submission referred to the 99% protection guidelines, but as noted in submissions, the 80% level is considered more appropriate given the ephemeral nature of surface water flow.
- Australian Drinking Water Guidelines 2011 (ADWG) (NHMRC, NRMMC, 2011)
- Northern Territory Environment Protection Authority (NTEPA) Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory (NT EPA, 2013), to assess appropriate liner designs. The composite liner guidelines allow a dilution factor of 100 and double-lined guidelines allow a factor of 400 in comparison to ADWG.
- Based on similar guidelines such as the WA *Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009)* (WADEC, 2009)leachate with ASLP concentrations less than 10 x ADWG or the appropriate receiving environment guideline are considered suitable for unlined landfill. This is consistent with the approach used in the NT landfill guidelines (NT EPA, 2013).

Leachate results above the trigger levels noted above do not definitively indicate unacceptable leachate will be generated, but they act as a screening tool and identify the need for additional testing that more closely mimics the storage environment should be carried out.

Leachate concentrations were below the Australian Drinking Water Guidelines (ADWG) (NHMRC, NRMMC, 2011) with the exception of a schist sample (2113728_2113729) which slightly exceeded the fluoride guideline of 1.5 mg/L at 1.8 mg/L, and a pegmatite sample (2133329) that exceeded the lead guideline of 0.01 mg/L at 0.058 mg/L, an exceedance factor of 5.8 (Table 4-31). The 99% upper confidence limits (99%UCL), with results less than the level of reporting set to half the level of reporting, ranged from 0.2 to 1.9 times the corresponding guideline. Consequently, all leachate results fall within the range acceptable for unlined on-site disposal, indicating relatively low risk of impact on human health.

When compared to ANZECC and ARMCANZ (2000) guidelines for the protection of freshwater aquatic ecosystems at the 80% protection level (Table 4-32), several samples exceeded guidelines for aluminium copper, lead and zinc. All concentrations were less than ten times the guideline (i.e. an exceedance factor of less than 10) with the exception of samples of schist and gneiss waste rock (2135832 and 2133727) with exceedance factors of 10.5 and 13.2.

The 99% upper confidence limits, with results less than the level of reporting set to half the level of reporting, ranged from 0.3 to 2.5 times the corresponding guideline.

This indicates that the various waste rock types have relatively low levels of leachable toxicants and are, overall, suitable for unlined disposal. However, runoff and leachate should be monitored, collected and prevented from discharging directly to surface water bodies unless adequate local dilution can be achieved.

All leachate U and Th concentrations, with maximums of 0.012 and 0.025mg/L respectively. were below the combined equivalent ADWG guideline 0.5 Bq/L Gross $\alpha + \beta$, based on the conversion factors of 0.08 and 0.25 Bq/mg/L (DME QLD, 2008) for uranium and thorium respectively.

Additional testing such as sequential, column and barrel leach tests have been recommended to be carried out and reviewed prior to operations, to confirm the ASLP-based leachate results.

Table 4-31 Waste rock ASLP ADWG exceedance summary

Parameters									Al		Fe Dissolved		Pb		F	
Units									(mg/L)		(mg/L)		(mg/L)		(mg/L)	
ADWG (2011) Health									-		-		0.01		1.5	
ADWG (2011) Aesthetic									0.2		0.3		-		-	
										Times exceed		Times exceed		Times exceed		Times exceed
Sample ID	Easting (MGA94)	Northing (MGA94)	Collar elev. (mAHD)	Sample Lithology	Oxidisation state	Location	From (m)	To (m)	**Results**	ADWG (A)	**Results**	ADWG (A)	**Results**	ADWG (H)	**Results**	ADWG (H)
2133119	7502183.762	318496.903	657.735	Mineralisation	T	NB0921	164.4	166.4	0.07	0.4	0.03	0.1	0.001	0.1	0.80	0.5
2134651	7502076.681	319403.828	659.212	Mineralisation	F	NB0854	226.4	228.3	0.10	0.5	0.03	0.1	0.002	0.2	0.20	0.1
2130694	7501776.876	319125.539	659.16	Mineralisation	T	NB0868	123.0	124.7	0.01	0.1	0.03	0.1	0.001	0.1	0.60	0.4
2133257	7502206.449	318579.937	656.599	Mineralisation	T	NB0922	155.3	157.2	0.05	0.3	0.03	0.1	0.001	0.1	0.30	0.2
2133528	7501761.111	319232.116	659.426	Mineralisation	T	NB0009	180.5	182.6	0.06	0.3	0.03	0.1	0.001	0.1	0.90	0.6
2133148	7502282.846	318616.464	656.024	Pegmatite	T	NB0209	112.3	114.1	0.73	3.7	0.09	0.3	0.004	0.4	0.70	0.5
2133886	7501869.007	319354.76	659.771	Pegmatite	T	NB0147	84.6	86.3	0.87	4.4	0.13	0.4	0.003	0.3	0.50	0.3
2133686	7502047.425	318984.188	656.9	Pegmatite	F	NB0087	188.4	190.1	1.00	5.0	0.21	0.7	0.008	0.8	0.40	0.3
2133329	7502099.855	318947.462	656.892	Pegmatite	T	NB0043	125.1	127.1	0.92	4.6	0.46	1.5	**0.058**	5.8	0.50	0.3
2130893	7502265.097	318927.812	657.011	Pegmatite	T	NB0287	248.5	250.0	0.72	3.6	0.08	0.3	0.005	0.5	0.40	0.3
2118644_2118645	7502384.844	319042.824	655.491	Schist	T	NB0977	18.0	20.0	0.82	4.1	0.27	0.9	0.001	0.1	0.50	0.3
2113728_2113729	7501397.609	319195.578	660.23	Schist	T	NB0960	14.0	16.0	0.95	4.8	0.76	2.5	0.001	0.1	**1.80**	1.2
2134104	7502050.837	319324.764	658.921	Schist	T	NB0279	118.2	120.2	0.34	1.7	0.11	0.4	0.002	0.2	0.50	0.3
2134341	7501882.787	319246.982	659.476	Schist	F	NB1028	176.0	178.0	0.54	2.7	0.20	0.7	0.002	0.2	0.60	0.4
2135832	7502099.11	319058.02	657.65	Schist	O	NB1086	34.3	36.3	1.57	7.9	1.22	4.1	0.006	0.6	0.90	0.6
2133727	7501957.93	319040.381	657.677	Gneiss	T	NB0012	71.0	73.0	1.98	9.9	1.94	6.5	0.005	0.5	0.60	0.4
2134187	7501947.939	318859.074	657.8	Gneiss	T	NB0891	165.6	167.2	0.52	2.6	0.06	0.2	0.003	0.3	0.40	0.3
2134887	7501947.406	319299.428	658.958	Gneiss	F	NB1036	180.0	182.0	0.24	1.2	0.07	0.2	0.002	0.2	0.40	0.3
2130745	7502261.431	318981.199	656.559	Gneiss	O	NB0286	144.0	145.8	0.91	4.6	0.68	2.3	0.004	0.4	0.60	0.4
2136002	7501953.943	318659.43	657.617	Gneiss	T	NB1024	182.7	184.7	1.06	5.3	0.19	0.6	0.004	0.4	0.50	0.3
2132125	7501944.097	319254.062	659.092	Gneiss	T	NB0939	136.9	138.9	0.87	4.4	0.17	0.6	0.004	0.4	0.70	0.5
2134597	7501985.763	318832.713	657.524	Gneiss	T	NB0892	225.0	227.0	0.37	1.9	0.07	0.2	0.002	0.2	0.30	0.2
2134886	7501947.406	319299.428	658.958	Gneiss	F	NB1036	179.0	180.0	0.53	2.7	0.15	0.5	0.002	0.2	1.00	0.7
2131103	7502216.786	318915.412	657.317	Gneiss	F	NB0914	178.2	180.2	0.93	4.7	0.19	0.6	0.003	0.3	0.80	0.5
Mean									0.65	3.3854	0.30	1.0	0.005	0.5	0.66	0.4
Median									0.72	3.65	0.15	0.5	0.003	0.3	0.60	0.4
99%UCL (Student's T dist)									0.36	1.9	0.33	1.2	0.008	0.9	0.27	0.2
Exceeds ADWG (Aesthetic)																
Exceeds ADWG (Health)																
🟩 Exceeds by 1-10 times																
Exceeds by between 10 -100 times																
🟥 Exceeds by <100																

Table 4-32 Waste rock ASLP FAE80% exceedance summary

Parameters									Al		Cu		Pb		Zn	
Units									(mg/L)		(mg/L)		(mg/L)		(mg/L)	
ANZECC & ARMCANZ (2000) FAE 80%									0.15		0.0025		0.0094		0.031	
										Times exceed		Times exceed		Times exceed		Times exceed
Sample ID	Easting (MGA94)	Northing (MGA94)	Collar elev. (mAHD)	Sample Lithology	Oxidisation state	Location	From (m)	To (m)	**Results**	FAE80%	**Results**	FAE80%	**Results**	FAE80%	**Results**	FAE80%
2133119	7502183.762	318496.903	657.735	Mineralisation	Transitional	NB0921	164.40	166.40	0.07	0.5	<0.001	<LOR	<0.001	<LOR	0.02	0.7
2134651	7502076.681	319403.828	659.212	Mineralisation	Fresh	NB0854	226.40	228.29	0.10	0.7	<0.001	<LOR	0.002	0.2	0.01	0.4
2130694	7501776.876	319125.539	659.160	Mineralisation	Transitional	NB0868	123.00	124.65	0.01	0.1	<0.001	<LOR	<0.001	<LOR	0.01	0.3
2133257	7502206.449	318579.937	656.599	Mineralisation	Transitional	NB0922	155.26	157.24	0.05	0.3	<0.001	<LOR	<0.001	<LOR	0.01	0.4
2133528	7501761.111	319232.116	659.426	Mineralisation	Transitional	NB0009	180.53	182.60	0.06	0.4	<0.001	<LOR	<0.001	<LOR	0.01	0.4
2133148	7502282.846	318616.464	656.024	Pegmatite	Transitional	NB0209	112.32	114.09	**0.73**	4.9	0.002	0.8	0.004	0.4	0.03	0.8
2133886	7501869.007	319354.760	659.771	Pegmatite	Transitional	NB0147	84.55	86.34	**0.87**	5.8	0.001	0.4	0.003	0.3	**0.04**	1.4
2133686	7502047.425	318984.188	656.900	Pegmatite	Fresh	NB0087	188.36	190.11	**1.00**	6.7	<0.001	<LOR	0.008	0.9	0.03	0.8
2133329	7502099.855	318947.462	656.892	Pegmatite	Transitional	NB0043	125.09	127.09	**0.92**	6.1	0.001	0.4	**0.058**	6.2	0.03	0.9
2130893	7502265.097	318927.812	657.011	Pegmatite	Transitional	NB0287	248.50	250.03	**0.72**	4.8	**0.003**	1.2	0.005	0.5	0.03	1.0
2118644 2118645	7502384.844	319042.824	655.491	Schist	Transitional	NB0977	18.00	20.00	**0.82**	5.5	0.002	0.8	<0.001	<LOR	**0.03**	1.1
2113728 2113729	7501397.609	319195.578	660.230	Schist	Transitional	NB0960	14.00	16.00	**0.95**	6.3	0.002	0.8	<0.001	<LOR	**0.04**	1.2
2134104	7502050.837	319324.764	658.921	Schist	Transitional	NB0279	118.24	120.24	**0.34**	2.3	0.001	0.4	0.002	0.2	**0.03**	1.0
2134341	7501882.787	319246.982	659.476	Schist	Fresh	NB1028	176.03	178.03	**0.54**	3.6	0.002	0.8	0.002	0.2	**0.04**	1.4
2135832	7502099.110	319058.020	657.650	Schist	Oxidised	NB1086	34.25	36.25	**1.57**	10.5	0.001	0.4	0.006	0.6	**0.06**	1.8
2133727	7501957.930	319040.381	657.677	Gneiss	Transitional	NB0012	71.00	73.00	**1.98**	13.2	**0.012**	4.8	0.005	0.5	**0.04**	1.1
2134187	7501947.939	318859.074	657.800	Gneiss	Transitional	NB0891	165.60	167.20	**0.52**	3.5	**0.008**	3.2	0.003	0.3	**0.05**	1.7
2134887	7501947.406	319299.428	658.958	Gneiss	Fresh	NB1036	180.00	182.00	**0.24**	1.6	0.001	0.4	0.002	0.2	**0.04**	1.3
2130745	7502261.431	318981.199	656.559	Gneiss	Oxidised	NB0286	144.00	145.80	**0.91**	6.1	<0.001	<LOR	0.004	0.4	**0.04**	1.2
2136002	7501953.943	318659.430	657.617	Gneiss	Transitional	NB1024	182.74	184.74	**1.06**	7.1	**0.003**	1.2	0.004	0.4	0.02	0.8
2132125	7501944.097	319254.062	659.092	Gneiss	Transitional	NB0939	136.93	138.93	**0.87**	5.8	**0.004**	1.6	0.004	0.4	0.03	1.0
2134597	7501985.763	318832.713	657.524	Gneiss	Transitional	NB0892	225.00	227.00	**0.37**	2.5	<0.001	<LOR	0.002	0.2	0.03	0.9
2134886	7501947.406	319299.428	658.958	Gneiss	Fresh	NB1036	179.00	180.00	**0.53**	3.5	<0.001	<LOR	0.002	0.2	**0.03**	1.0
2131103	7502216.786	318915.412	657.317	Gneiss	Fresh	NB0914	178.20	180.20	**0.93**	6.2	**0.010**	4.0	0.003	0.3	**0.04**	1.1
Mean									**0.67**	4.5	0.002	1.0	0.005	0.5	0.03	1.0
Median									**0.73**	4.8	0.001	0.4	0.003	0.3	**0.03**	1.0
99%UCL (Student's T dist)									**0.38**	2.5	0.002	1.0	0.009	0.9	0.01	0.3
Exceeds FAE80%																
Exceeds by 1-10 times																
Exceeds by between 10 -100 times																
Exceeds by >100																

4.26.2 ANZECC trigger values

ANZECC 99% trigger values were used as initially directed. Where appropriate, we corrected the concentrations for hardness, rather than the guidelines as that is a more practical option than moving guidelines for individual samples. It is agreed that 95 or 80 % would be better, however we have had contradictory advice from the NT Regulator with regard to this matter.

The hardness corrected Cu, Pb and Zn results are presented below (Table 4-33) with the corresponding exceedance factor of the FAE80% guidelines. The apparent exceedance has increased in some samples due to the leachates calculated hardness being below 30 mg/L, ranging from 3.3 mg/L for samples with no detectible Ca or Mg, to 35.7 mg/L. Although 3 of the 24 samples exceed FAE80% by more than a factor of 10, none of the mean or median exceedances are more than 10 times FAE80%, however the 99%UCL for lead is greater than 10 at 11.6, primarily due to one elevated sample.

Table 4-33 Hardness-corrected exceedance summary

Parameters	Hardness	Cu		Pb		Zn	
Units	(mg/L)	(mg/L)		(mg/L)		(mg/L)	
ANZECC (2000) FAE 80%		0.0025	Times exceed	0.0094	Times exceed	0.031	Times exceed
Sample ID		**Results**	FAE95%	**Results**	FAE95%	**Results**	FAE95%
2133119	16.6	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
2134651	35.7	<LOR	<LOR	<LOR	<LOR	0.011	0.4
2130694	19.5	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
2133257	19.1	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
2133528	25.7	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
2133148	12.0	**0.0043**	1.7	**0.0127**	1.4	**0.054**	1.8
2133886	12.0	<LOR	<LOR	**0.0096**	1.0	**0.096**	3.1
2133686	17.0	<LOR	<LOR	<LOR	<LOR	**0.042**	1.4
2133329	3.3	<LOR	<LOR	**0.9547**	101.6	**0.183**	5.9
2130893	19.5	<LOR	<LOR	0.0086	0.9	**0.045**	1.4
2118644_2118645	12.0	<LOR	<LOR	0.0016	0.2	<LOR	<LOR
2113728_2113729	3.3	<LOR	<LOR	0.0082	0.9	<LOR	<LOR
2134104	14.5	0.0019	0.7	0.0050	0.5	**0.059**	1.9
2134341	12.0	<LOR	<LOR	0.0064	0.7	**0.093**	3.0
2135832	3.3	**0.0065**	2.6	**0.0988**	10.5	**0.365**	11.8
2133727	3.3	**0.0782**	31.3	**0.0823**	8.8	**0.228**	7.4
2134187	17.0	<LOR	<LOR	0.0062	0.7	**0.086**	2.8
2134887	12.0	<LOR	<LOR	0.0064	0.7	**0.085**	2.7
2130745	3.3	<LOR	<LOR	<LOR	<LOR	**0.248**	8.0
2136002	12.0	<LOR	<LOR	**0.0127**	1.4	**0.052**	1.7
2132125	7.1	<LOR	<LOR	**0.0252**	2.7	**0.106**	3.4
2134597	14.5	<LOR	<LOR	<LOR	<LOR	**0.052**	1.7
2134886	12.0	<LOR	<LOR	<LOR	<LOR	**0.070**	2.2
2131103	14.5	<LOR	<LOR	0.0075	0.8	**0.065**	2.1
Mean	13.4	**0.0038**	1.5	**0.0519**	5.5	**0.081**	2.6
Median	12.0	0.0000	0.0	0.0063	0.7	**0.057**	1.8
99%UCL (Student's T dist)	4.3	**0.0089**	3.6	**0.1088**	11.6	**0.051**	1.7
Exceeds FAE80%							

Exceeds by 1-10 times

Exceeds by between 10 -100 times

Exceeds by >100

4.27 AMD

4.27.1 AMD sample number

Sulfur was added to the XRF assay suite for Arafura's material type re-classification program. These XRF results therefore provide additional information with respect to the samples selected for AMD studies that were reported in the EIS. The additional sulfur analyses also allowed Arafura to geologically and geochemically model the sulfur content, and therefore further enhance understanding of potential AMD material. There are now 3,473 sulfur assays at Nolans Bore. Note these sulfur results and the new model does not include Arafura's in-house pXRF data. The sulfur data is considered representative and meaningful with respect to the mineral resource, waste rock and the various weathering states. More detail on the sulfur analyses and block modelling are given in Appendix 16. Refer to Table 4-34 for a summary of geological test work completed to date.

The four samples analysed as tailings and process residues are representative of the first 7-10 years of mining and processing. These samples were derived from large diameter drilling (700mm) holes drilled to around 80 m throughout the orebody. The samples were composited and beneficiated and then sampled to form large composite sample of several tonnes to ensure they are representative. It is intended that further testing of tailings and residues will be routinely done during operations to confirm these results and adjust management practices accordingly.

As stated earlier, the design of facilities will be to a high standard and in accordance with ANCOLD guidelines irrespective of the test work results. Detailed design is not currently available but facilities will have liners, underdrainage systems, embankment piezometers, monitoring bores and systems in accordance with good engineering practice. They will be managed well and will be audited periodically by suitably qualified engineers to ensure they remain in compliance.

Based on the above, there are adequate analyses to inform the AMD risk and enable development of appropriate waste rock, tailings and process residue management plans and facility designs.

4.27.2 AMD calculations

The preliminary stoichiometric AMD calculation was only done on samples with Ca, Mg and S data. As the report stated, it is a low-reliability method and is largely irrelevant once acid-base accounting data are available. It was superseded by the subsequent AMD (NAG/NAPP and leachate) testing and was included only for completeness. Is has not been considered in the current design process. This testing was done on sample splits stored in Arafura's core shed, under dry but not refrigerated conditions, as is the norm for exploration and ore body delineation samples. Under these dry conditions, oxidisation of sulfides would be minimal and any acid produced would not be leached, hence although, in theory, initial acidity could be overestimated in the case of highly reactive sulfides, such as very fine grained pyrrhotite, the total acidity used in NAPP analyses and the NAG pH would not be affected.

The static NAG and NAPP tests can be used as an indicator of general classification, with an appropriate safety factor. Furthermore, the waste classification system proposed is based on total sulfur content and is therefore sufficiently conservative.

The leachability of metals and salts is discussed in Section 4.26

Table 4-34 Summary of test work completed to date.

	Test	Number of samples	Location	Summary
Geology and rock type characterisation	Rock assays	4,769	Throughout the deposit. Representative of all lithologies within the deposit.	Presented in Appendix 17-ARU Report 17_001. These are representative whole rock assays which are a combination of QAQC samples initially completed on a basis of about 1:20 (1296) for check analysis and subsequent additional analysis and reanalysis (3473) completed to inform the material types reclassification work on the resource.
Geology and rock type characterisation	XRF assay (excl. sulphur) for SAPL	3,473	Figure 27 in Appendix 16	Presented in EIS. Four key rock types characterised.
Geology and rock type characterisation	XRF assay (incl. sulphur) for PAPL	3,473	Figure 27 in Appendix 16. Re-assay of samples tested for SAPL.	Re-classification test work for the SAPL/PAPL change. Replaces test work completed for SAPL.
Geology and rock type characterisation	Conventional laboratory analyses (incl. sulphur)	200	Fifty representative samples of each rock type. Figure 30 – 33 in Appendix 16	Presented in Appendix L of EIS.
Geology and rock type characterisation	In-house pXRF (incl. sulphur)	679	? 0-50m, 50-175m and 175-250m drilling depth.	Samples were from various locations within the waste lithologies and at varying depths in the waste lithologies to ensure they are representative.
AMD – waste rock	Stoichiometric AMD calculations		Only done on samples with Ca, Mg and S data	Superseded by the subsequent Stage 1 /Stage 2AMD (NAG/NAPP and leachate) testing (was only included for completeness)
AMD – waste rock	Stage 1 static AMD testing (NAPP, NAG)	122	Figure 28 in Appendix 16. 25 samples of pegmatite, 34 samples of mineralisation, 25 samples of gneiss and 70 samples of schist.	The results of static NAG testing indicate that approximately 95% of the material is non-reactive and non-acid-forming (NAF). Refer to Appendix L of EIS. Note: 154 samples is referenced in report and is incorrect.
AMD – waste rock	Stage 2 kinetic AMD testing (KNAG, ABCC)	24	Figure 29 in Appendix 16. Samples showing highest risk of AMD from Stage 1 testing.	Kinetic NAG pH showed that single addition NAG pH is suitable for identifying PAF and that reaction times are relatively slow, with a very low risk of acid generation either during short-term storage of ore, or long-term storage of waste rock. Refer to Appendix L of EIS.

	Test	Number of samples	Location	Summary
AMD – waste rock	Leachate testing (ASLP)	24	Figure 29 in Appendix 16. Samples showing highest risk of AMD from Stage 1 testing.	Leachate testing indicated that most of the waste rock was non-sulfidic and relatively benign, with small amounts of material with slightly elevated sulfur, some of which is likely to be in the form of non-acid generating sulfate. Refer to Appendix L of EIS.
AMD – waste rock	Sequential, column and barrel leach tests	TBC	TBC	Will confirm the ASLP-based leachate results.
AMD – residues	AMD testing (NAPP, NAG, ASLP) of SAPL waste	4 Two from beneficiation and two from process residues for SAPL.	These samples were derived from large diameter drilling (700mm) holes drilled to around 80 m throughout the orebody. The samples were composited and beneficiated and then sampled to form large composite sample of several tonnes to ensure they are representative.	Presented in Supplementary Tailings and Residue Report of EIS. Representative ore of the first 7-10 years of mine production. The PAPL flowsheet tailing and process residues are expected to be broadly similar.
AMD – residues	AMD testing (NAPP, NAG, ASLP) of PAPL waste	TBC	TBC	PAPL test work currently underway.

4.27.3 NAPP values

The samples are of sulfuric acid leached then neutralised residue. Consequently, they contain high concentrations of sulfate (as calcium sulfate) but no sulfide. The lab-reported NAPP simply uses total sulfur on the assumption that all S is in the form of pyrite, hence it overestimates the acid risk and hence the need for analysis of sulfate sulfur, to subtract from total sulfur to get sulfide sulfur. As noted in in the report were-calculated the NAPP using sulfide S (total S minus sulfate S, truncated to minimum of 0). Some samples with very high levels of total and sulfate sulfur (040488BH Barren Neutralised Slurry water leach in Table 4-35) appear to have some remaining sulfide, however this is likely to be due to a discrepancy in the analyses at high concentrations. Due to the very high ANC, however, all residue NAPPS are negative, as reflected in the alkaline NAG pH (see Table 4-35).

Table 4-35 AMD test results

Sample ID	Lithology	Initial pH	EC (µS/cm)	NAG pH/ pHOX	NAG pH4.5 (kg/t H2SO4)	NAG pH7 (kg/t H2SO4)	ANC (kg/t H2SO4)	Total Sulfur (%S)	Sulfate Sulfur (%S)	Sulfide Sulfur (%S)	Calc sulfide MPA (kg/t H2SO4) (%Sulfide S*30.6)	Sulfide-based NAPP (kg/t H2SO4)	Total S Based NAPP (kg/t H2SO4)	NPR (ANC/ MPA)
LOR		0.1	1	0.1	0.1	0.1	0.10			0.010	0.1	0.1	0.1	0.1
A46422 CST	WASTE	9.5	250	8.0	0.1	0.1	25.00	0.03	0.013	0.017	0.5	-24.5	-24.1	49.1
040488BH Barren Neutralised Slurry	WASTE	12.5	10300	9.8	0.1	0.1	350.00	5.15	6.012	-0.862	0.0	-350.0	-192.0	35000.0
040488BH Barren Neutralised Slurry water leach	WASTE	10.2	2080	9.6	0.1	0.1	148.00	12.20	11.022	1.178	36.0	-112.0	225.0	4.1
A16422 Non-mags	WASTE	9.1	383	9.4	0.1	0.1	69.90	0.06	0.044	0.016	0.5	-69.4	-68.1	146.6

4.27.4 Risk from AMD

The risk of generation of acidic (or alkaline), saline or metalliferous leachate from waste rock or tailings, at a concentration or rate that would impact on surface water or groundwater, is very low. Notwithstanding this, XRF sulfur content, backed up by conventional laboratory sulfur analyses and static AMD testing, will be used for "AMD" grade control during operations; testing material to be blasted, including both waste rock and ore, at a similar density to pre-blasting ore grade control.

As noted above, additional kinetic leach testing is either underway or proposed prior to commencement of mining, to confirm the results of the previously completed conservative static testing leachate and NAG/NAPP testing.

4.27.5 Groundwater analysis

Raw leachate results are included in the report and the exceedance of each individual sample was discussed. Comparison with additional guidelines (FAE 95% and FAE 80%) are included in this response. ASLP is considered appropriate due to the generally low sulfur content and low acid-generating potential of the waste rock, ore and tailings. PAF material will be managed separately as noted in the EIS reports, which will address the potential for increased metal and salt content of leachate along with acidity.

It is considered aggressive due to the fine grinding, constant agitation and abrasion of minerals rather than just simple solubility. This is recognised in the various state landfill guidelines that base liner requirements on a multiplication factor of leachate results, with unlined landfills applicable for average concentrations up to 10 times the receiving environment guidelines (WADEC, 2009). This is discussed in more detail in Section 4.26.1 of this document.

ASLP testing is also more representative of first flush than long-term leaching. Additional testing will be done to confirm long-term behaviour. However, WRD design is based on conservative first flush results and will include containment and testing of runoff prior to release or re-use.

Deionised water has been used a leaching solution, as recommended in AS4439 (Standards Australia, 1997) for monofil disposal. Buffered acid solutions are appropriate where material is likely to be in contact with a buffered acid source such as; organic acids in putrescible waste landfills; from oxidisation of significant volumes of sulfide minerals; or from acid rain in industrialised areas, none of which are likely to occur at site. The exception is the minor volumes of PAF, which will be managed accordingly to neutralise or prevent oxidisation.

4.28 Leachates

Given that there is a general lack of sulfides, ASLP, with an appropriate dilution factor, is an appropriate indicator of leachate quality; and the results for waste rock and tailings have been discussed above (4.26.1).

Sequential and column leach tests will be performed prior to construction, to further refine the leachability properties of the rock types identified, and confirm the suitability of the storage facility designs.

Although samples of the currently proposed PAPL residue are not available and have therefore not been analysed, the overall residue chemistry is likely to be similar to the previously tested samples discussed in the supplementary reporting - phosphoric acid is produced from the sulfuric acid leaching of phosphate-bearing minerals. Residue testing, as noted above (4.26.1) showed that neutralisation of the residue significantly reduces the mobility of most metal and metalloids, however the RSF is designed to contain un-neutralised residue to allow for occasional imperfect neutralisation. The use of phosphoric acid may increase concentrations of reactive phosphate; however phosphoric acid is likely to be generated in sulfuric acid leach residue due reaction of the acid with naturally occurring phosphate minerals present in the ore. The current RSF design is suitable for such materials, even when un-neutralised; however, neutralisation significantly reduces the long-term risk of hazardous leachate generation and release in the event of liner failure.

The chemistry of the tailings will not change with the PAPL process as it is only applied to the concentrate. The PAPL process results in a net reduction in residues and relies on strict pH control, and as a result, the tailings and residues are expected to be neutral to alkaline. The Supplementary Tailings and Residue Report (GHD 2016a) was provided and demonstrates that the tailings and residues do not present long-term storage issues. It is acknowledged that this testing was conducted on limited materials but the waste tested in considered representative of the first 7-10 years of production.

Consistent with ANCOLD requirements and industry best practice, a spillway will be provided for the prevention of overtopping the embankment crest during extreme or unexpected events (Appendix 3). The likelihood of the dams overtopping is considered rare (Ref 25 in Risk Register). The design of the storage facilities will be in accordance with ANCOLD guidelines.

The embankments will also have piezometers and if required stability monitoring points. Dams will be periodically audited by suitably qualified technical experts to ensure these storages are performing in accordance with design expectations and are being operated appropriately. In addition to these design features, it is intended that monitoring bores will be installed at selected down-gradient locations to monitor for groundwater chemistry trends, which may indicate seepage. Should changes be noted then further investigations would be implemented and appropriate mitigations measures initiated.

A program of ongoing testing of waste rock, ore, tailings and residue will be included as part of the mining management system to continue to assess the performance of these tailings and residues. Final design for closure will be done once operation when appropriate testing and design can be done and assessed.

Analyses

The analyses carried out on the ore and waste rock, including large numbers of assays and both static and kinetic AMD and leachate testing, have been discussed above and in the EIS reports. A total of 859 samples were analysed. Two hundred samples were analysed using conventional laboratory analysis. The remaining 659 samples were checked by portable XRF with strict QA/QC controls in place to confirm the low geochemical content of the samples.

Potential leachate metal chemistry was assessed by subjecting a representative subset of 24 waste rock and ore samples from a range of lithologies. The results for metals and metalloids are discussed in Section 4.26.1 and their concentrations relative to freshwater aquatic ecosystem and drinking water guidelines summarised in Table 4-32 and Table 4-31. These indicate that the materials overall are suitable for unlined disposal, however the mine plan allows for the storage of PAF material, which is the most likely source of elevated metals, to be stored in appropriately engineered cells within the WRD.

A total of 122 samples have salinity and pH data derived from the NAG testing suite. Waste rock pH ranged from 7.1 to 9.9 with a median of 9.4 and mean of 9.3 and EC ranged from 45 uS/cm to 412 uS/cm (Table 4-36). Under the classification system given in (DME, 1995), pH falls in the Medium to Very High category and salinity falls in the Very Low to Low category. This indicates that although the initial pH may be high, there is little buffering capacity and leachate is likely to be influenced by receiving water and aquifer quality.

The sodicity risk plot, comparing Sodium Adsorption Ratio (SAR) with EC (Figure 4-51) indicates that some of the leachate may represent a risk to soil structure if used for long-term irrigation (ANZECC & ARMCANZ, 2000). The Piper Plot (Figure 4-52) indicates that the sodicity and high pH is most likely due to dissolved sodium bicarbonate. This can be ameliorated if the water is sodic and is required for irrigation or dust suppression by application of a non-alkaline calcium source such as gypsum.

Table 4-36 Salinity and pH summary

Parameter	Initial pH	EC (µS/cm)
Count	122	122
Minimum	7.1	45
Median	9.4	126
Mean	9.3	134
Maximum	9.9	412

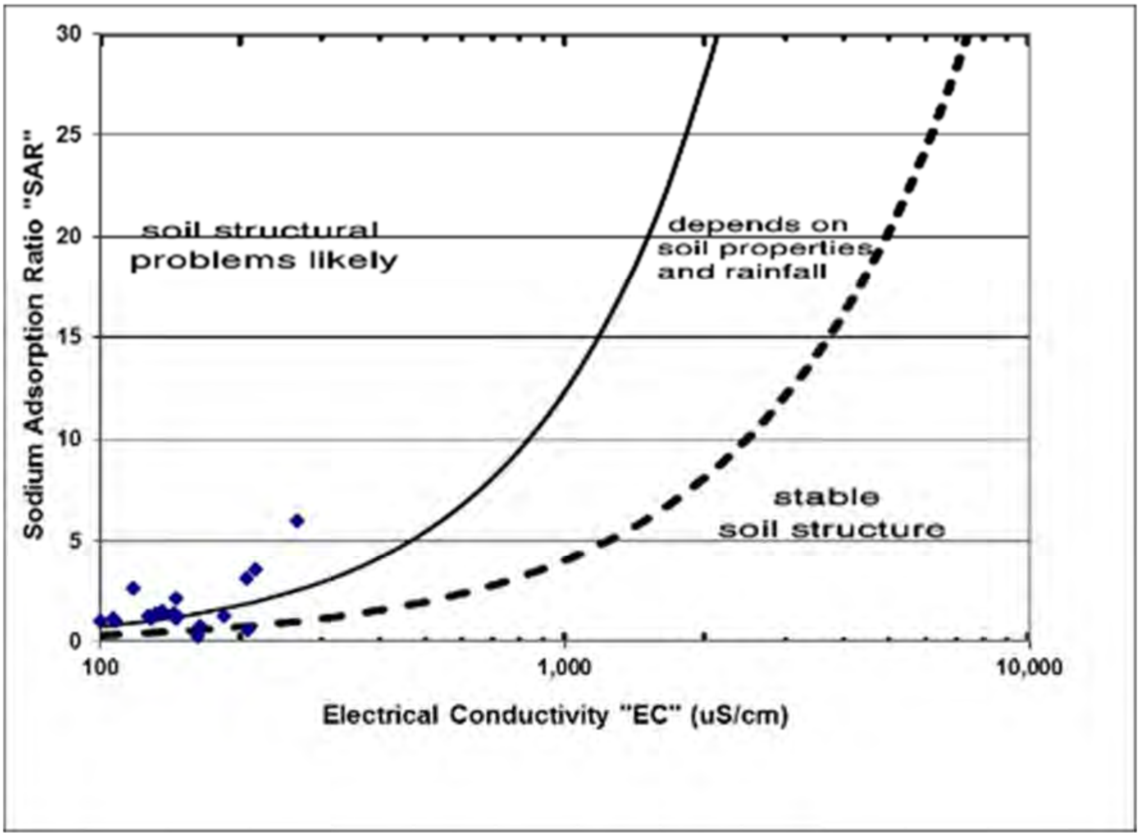


Figure 4-51 Waste rock leachate sodicity classification plot

The above results indicate that the leachate from NAF waste will not contain significant levels of dissolved metals or salinity, and although moderately alkaline and sodic, can be readily managed with common irrigation management techniques. The alkalinity also demonstrates the bulk of the waste rock has some potential to neutralise excess acidity from the small volumes of PAF identified at the site.

Additional large-scale, long term testing will be carried out using barrel leach tests to confirm likely leachate and runoff quality.

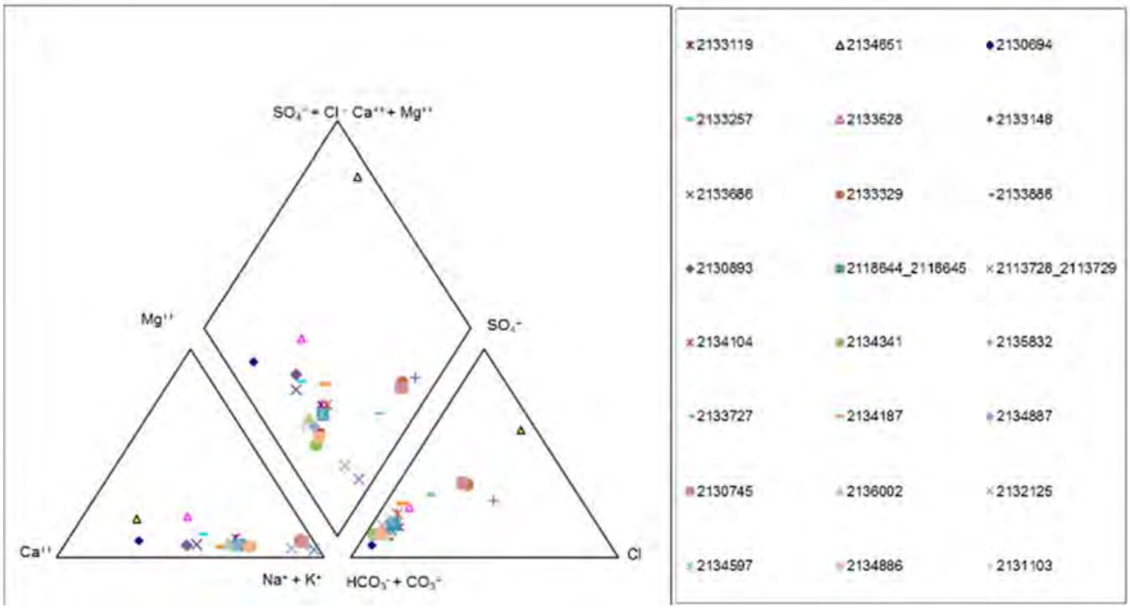


Figure 4-52 Waste rock leachate piper plot

4.29 Additional sampling

A representative sample can range in size from 100 gms to kilograms, depending on the sample split and the material being assayed.

Sampling methodology and strategy will be developed to ensure that Arafura obtain a representative sample from the bench height/interval being tested once determined. The analytical method and elements have not yet been determined but it is likely that XRF (calibrated for the target elements, including sulfur) will be used at a site laboratory as this will provide a rapid turnaround.

Geological and assay data collected from blast holes will be used for grade control assessments and to refine material type analysis to aid the selective mining of the mineralisation in this deposit. The geological and assay data collected will be critical to evaluating and confirming the current resource model. Based on knowledge of the mineralisation, it is expected that the blast hole data and the mineral resource drilling data will strongly correlate and the confidence in this is aligned with the defined Mineral Resource classification.

Current assays in the resource database have included representative samples between about 100g and 8 kg. These assays are considered representative splits of the material they were testing.

Arafura is unlikely to routinely use pXRF on site. Although pXRF instruments have provided useful data for Arafura, they are timely to use and the inherent REE spectral interferences complicate interpretations of the reported result. This occurs because there are different calibration curves for different matrices, one must therefore first know if there are REE present in the rock. Thus, in Arafura’s experience, the reported pXRF result is dependent on an accurate calibration curve for the desired matrix. This means knowing what the rock may contain before analysis. The presence or absence of Nolans Bore type mineralisation is much more readily determined by the mineralogy, colour and radioactivity and laboratory assay results are more clearly robust. There is a very strong correlation between radioactivity and rare earth grade.

As discussed in Section 4.25, there is very little sulfur in the waste rocks at Nolans Bore and the areas where this is likely to occur have been outlined. A more detailed assessment of these areas and their immediate surrounds will be undertaken to better define and understand these rocks later in operation, once mining approaches these places. Arafura is confident of its waste rock AMD analysis as its assessment is based on 3,473 total sulfur results.

Arafura calibrated a pXRF to detect the sulfur well below the suggested 3000 ppm trigger value that might indicate material with potential AMD. The manufacturer indicated a detection limit of about 50ppm sulfur however 100-200 ppm appears more realistic given the requirement for rapid field measurement

5. Commitments

A summary of commitments made in the EIS and this Supplement to the EIS is provided in Table 5-1.

Table 5-1 Summary of commitments

Aspect	Commitment	Timeframe
Tailings Storage Facility and Residue Storage Facilities	• TSF and RSFs will have a design storage capacity to contain a 1 in 100-year ARI average annual rainfall whilst retaining sufficient additional freeboard to accommodate a probable maximum precipitation (PMP) 72-hour storm rainfall event. • All storage structures will be built to ANCOLD guidelines. • Final TSF and RSF design to be included in the Mine Management Plan. • All TSFs and RSF will during construction be supervised by qualified engineering personnel. A construction quality assurance plan be implemented to ensure constructed dams meet design criteria. The plan will include quality control measures during the construction of the storage facilities, including records of the construction process and quality control results. • TSF and RSF design will include a low permeability liner system to reduce potential seepage vertically and laterally. The liner system will achieve a minimum 1 x 10-8 m/s permeability when placed. If clay liners are used it will be placed in layers and compacted and tested. • Undertake further site investigations to identify suitable borrow areas on site and nearby. Alternative borrow areas subject to additional regulatory approval prior to commencing with construction works. • Management plans will be developed and implemented to ensure that the dams are operated and managed in accordance with the design intent and will require that relevant records are kept. • Monitoring Plan for the TSF and RSF to include: - Embankment piezometers to monitor the phreatic surface within the TSF and RFS embankment. - Install shallow seepage detection bores outside but near the toe of embankments. - Daily inspections to identify evidence of seepage.	Planning phase Planning and pre-commissioning phases Operation phase Operation and closure phases Planning and operation phases

Aspect	Commitment	Timeframe
	• Annual dam safety audit will be completed by a suitably qualified person to inspect all the aspects of the dam, which includes the geotechnical stability of the dam and seepage. • Develop a Water Management Plan which incorporates an Emergency Response Plan including with specific actions to be implemented proactively to reduce the potential of an uncontrolled release or dam failure.	
Processing plant	• Processing area will be lined and drained to sumps for pumping back into the process or discharge to the tailings and residue storages. • Processing area will be inspected and action taken to clean spills and maintain sumps and sump pumps. • Final process plant design to be included in the Mining Management Plan.	Operation phase Operation phase Planning phase
Wastes	• Undertake test work on tailings and residues samples when they are available from current PAPL piloting test work program to confirm characteristics tailings and process waste streams.	Planning phase
Waste Rock Dump	• Final WRD design to be detailed in the Mining Management Plan when ‘representative’ waste rock is available from the mining process for further test work. • Implement WRD Concept framework. • Studies to be completed during operations utilising local material, to validate information on the degradation of engineered barriers and capping over time. • WRD design to manage potential seepage into groundwater or surface water drainage lines. • Undertake further testing the proposed thickness of covering for radioactive materials in WRDs.	Planning phase Planning and operation phases
Turkeys nest	• Turkey's nest dams is to be located outside of flood affected areas.	Planning phase
Slurry pipeline	• Telemetry systems to be used to monitor the pipeline for leaks, which will automatically stop pumping and alert maintenance staff. • Provide minimum 400m^3 storage in the event ponds, and bunding of the pipe corridor.	Planning, operation and closure phases

Aspect	Commitment	Timeframe
Water Balance	• The water balance model will be updated when final detailed design is completed. • The water balance will be updated when operational to assess the performance of the proposed water management system.	Planning phase following detailed design Operation phase
Community	• Develop and implement a Social Impact Management Plan including: - Establish a community reference group if requested by stakeholders. - Appoint a community liaison person. - Establish a presence in Alice Springs office. - Develop protocols to manage all community related matters including a register to record, resolve and report on issues raised. • Produce the following management plans and make them available on company website: - Environmental, health and safety plan - Community engagement plan - Workplace and employment plan - Traffic Management Plan and - Waste Management Plan. - Local Industry Participation Plan (to be developed after project approval). • Establish an annual budget for continued communication on the project. • Establish an annual budget for sponsorship of projects within its area of operations. • All staff and contractors to complete cultural awareness training. • Develop, in consultation with community reference group, key indicators to be monitored and reported on annually.	All phases
Traditional Owners	• Finalise the mining agreement/ILUA with the CLC and Traditional Owners including: - Access to land - Annual visits to the mine site (if requested) - Ongoing engagement commitments	Planning phase and then all phases

Aspect	Commitment	Timeframe
	- Protection and management of cultural sites and objects - Environmental commitments - Community benefits package and - Employment and business development. • Onsite meetings with Traditional Owners to discuss the management of archaeological sites and/or sacred sites prior to any works being undertaken and the likelihood of bush tucker consumption from the mine area.	
Surface Water	• Positioning and design of mine infrastructure (incl. WRDs and TSF) will take account of the risk of flooding and erosion along existing watercourses and will either position infrastructure outside the 1 in 1,000-year ARI flood extent; or incorporate flood protection measures into potentially flood prone areas. • Natural surface water flow to be incorporated into design, placement of road infrastructure and construction access including: - Undertake a detailed site survey to identify site drainage lines - Maintenance of natural surface water flows in minor watercourses by the use of floodways at creek crossings - Adoption of appropriately sized culverts to maintain flows at major creek crossings. - Develop and implement a Water Management Plan including: - No pit water to be discharged off-site - Flow diversion banks installed across the mine site to divert clean water away from infrastructure and - Runoff from disturbed areas will be diverted into sediment ponds and not discharged into the natural environment until monitored. • Adherence to relevant design standards for the provision of adequate freeboard allowance in water storage facilities (refer TSF commitments) to limit potential for overflow. • Stormwater management to include:	Planning phase Planning phase Planning phase

Aspect	Commitment	Timeframe
	- Appropriate consideration of surface water flow in design, placement of infrastructure and construction. - Detailed site survey to identify site drainage lines and modifications made to the concept design, specifically the location and extent of infrastructure, as appropriate. - A description of the soil and weathered rock profiles within the whole of the mine site and processing site including the TSF, evaporation ponds, power station etc. • Develop and implement Surface Water Monitoring Plan (as part of the WMP) including: - Establish baseline surface water conditions. - Rising stage samplers and gauging stations in creeks in and around the mine site to monitor surface flows and water quality in creeks during flow events. - Early and late flow sampling of waterways during flow events. - Routine inspections of seepages, discharge or emergency flows (if any). • Identify unprotected soil surfaces around mine infrastructure area where flow velocities are expected to be in excess of 0.5m/s, and provide suitable rock armour. • Arafura will conduct testing of the waste rock prior to use as rock armour in drainage areas.	
Pit water	• Model the long-term quality of the pit lake following commencement of mining and monitoring of pit seepage, pit water, dewatering, rainfall and quality of the water in and extracted from the pit.	Operation phase
Kerosene Camp Creek	• Riparian vegetation will be established along the Kerosene Camp Creek diversion. • Further geotechnical analysis will be undertaken to identify the suitability of these materials to achieve of 3:1 batter. Should it be determined that a lower batter ratio is required then this will be incorporated into the design.	Planning phase
Groundwater	• Continue hydrogeological investigations and predictive groundwater flow modelling (including ongoing calibration of modelling). • Run and update the models with baseline monitoring and other assessment data during: - The current planning phase.	All phases

Aspect	Commitment	Timeframe
	- The development phase as additional data becomes available from extraction of water for construction, and ramp up of the project based on groundwater and surface water monitoring. - Following commencement of the fully ramped up mine operational phase. • Further investigation of storage, once pumping (and mining) commences and groundwater level response. • Groundwater model review to be undertaken as part of annual Mine Management Plan review. • Develop and implement Groundwater Monitoring Plan including site specific Groundwater Trigger Values • Establish a monitoring network across the borefield for early identification of contamination, greater than expected groundwater drawdown, to validate the predictive model and improve model confidence. • Groundwater monitoring to include the monitoring of phosphate (including soil). • If future data indicates likely unacceptable impacts associated with planned extraction from the multiple borefields in the NE Southern Basins, implement management measures to mitigate the impact including: - Fully utilise water from the multiple borefields to minimise the project potential impacts. - Extract saline water from deeper aquifers known to be present in the area. - Expand the borefields south and possibly further west (there are known brackish water supplies to the west in the Whitcherry Basin and from Airborne Electro Magnetic surveys there are believed to be other paleochannels to the south). - Extract brackish water from the Ti Tree Basin either from deep paleochannels not currently utilised or a combination of use of these deep aquifers other brackish groundwater known from NTG investigations to exist in the southern sector of the NTG western Ti Tree Basin Water Management zone.	

Aspect	Commitment	Timeframe
	- Seek a Water Allocation from the Controller of Water (even though it is not a compulsory requirement) and follow all directions by the Controller of Water. - Provide substitute water source from elsewhere for existing stock bores if required.	
Water Management Plan	• Develop and implement a surface water, seepage and groundwater monitoring program suitable to detect long term changes in water quality and water levels. • Update and finalise the WMP after detail design is completed. • WMP to be peer reviewed prior to submission to DPIR.	All phases Planning phase following detailed design As part of EIS Supplement process
Soil	• Determine site specific Soil Trigger Values (to include phosphate and uranium). • Develop and implement an Erosion and Sediment Control Plan (ESCP) prior to commencement of construction.	Planning phase
Acid Mine Drainage	• Implement an Acid Mine Drainage Management Plan including: - Undertake barrel leach testing. - Develop site specific AMD Trigger Values over time as additional data is gathered. - Undertake regular testing of waste materials to confirm that conditions or materials are not changing and that a low residual risk for the generation of acid mine drainage persists. - Update waste management planning based on detail design of WRD and implement at the start of mining.	All phases
Flora	• Develop and implement a Biodiversity Management Plan (BMP) including: - Minimisation of vegetation clearing where possible particularly within sensitive vegetation community. - Adoptions of buffer widths recommended by the Northern Territory Land Clearing Guidelines in riparian areas, where possible. - Groundwater Dependant Ecosystem specific monitoring program including monitoring of water table levels, water table quality and tree condition.	All phases

Aspect	Commitment	Timeframe
	- Seed collection of listed flora species prior to vegetation clearance. - Prepare an offsets proposal using the EPBC Act Policy and Offsets assessment guide (if required). - Develop and implement a Weed Management Plan including a weed register and control options like:Provision of vehicle and equipment wash down facilities. - Keeping vehicles to established tracks and roads, and limiting the use of vehicles off-road. - Annual weed monitoring and mapping to identify hot spot areas. • Development and implementation of Fire Management Plan including: - Identify areas with high fuel loads requiring controlled burns. - Implement patchy burns of low scorch height wherever practicable.	
Fire	• Develop and implement a Fire Management Plan including: - Active vegetation reduction program (i.e. controlled burns) in collaboration with stakeholders including Traditional Owners, Pastoralists and NT Bushfires. - Maintain clear, continuous firebreaks around infrastructure prior to the commencement of the Dry Season. - Implement a ‘hot work’ permit system and procedure. - Fire detection and suppression systems, fire extinguishers – and firefighting training. - Develop an Emergency Response Management Plan including procedures, team and equipment required for fire management.	All phases
Fauna	• Develop and implement a Biodiversity Management Plan (BMP) to minimise impact on the threatened species populations of the area including: - Minimisation of vegetation clearing, where possible, particularly within sensitive vegetation community. - Undertake micro-scale fauna surveys once final design has been completed which includes a pre-clearance fauna surveys prior to all vegetation clearing.	All phases

Aspect	Commitment	Timeframe
	- Maintain an agreed buffer from known Great Desert Skink burrow for all borefield activities. - Avoid clearing of the Borefields area during the winter/spring months when fauna are inactive in burrows or breeding, implement clearing during autumn when breeding has ended. - Implement and enforce speed restriction controls for all sections of roads that across identified preferred habitat areas. - Implement wildlife reporting protocols. - Development and implementation of threatened species monitoring program. - Consult with and follow the advice of the NT DENR regarding detection and monitoring of the Great Desert Skink. - Develop and implement a pest monitoring plan (including control plan) targeting foxes, cats and dingoes. • Triggers in the BMP to be updated to include cumulative impacts over time. • Undertake additional targeted surveys for the Great Desert Skink in the borefield in accordance with a DEE approved survey method. • Tailing Storage Facilities management procedure to include factors to reduce the attractiveness of the facilities to avian fauna including: - Characterise water within the TSF and RSF and determine toxicological risk of TSF and RSF water to threatened fauna and avian fauna. - Fence off tailings storage facilities (during operation phase only) to prevent ground-based fauna from accessing the water. - Review fauna management practices based on fauna visitation and toxicological risk to maintain a risk ranking of low. • Develop and implement of an Air Quality and Dust Management Plan including: - Implementation speed limits on bitumen and gravel road, respectively as required.	

Aspect	Commitment	Timeframe
	• Traffic and Road Safety Management Plan to reduce the likelihood of vehicle collision with wildlife including: - Implementation of 60 km/h when the road passes in close proximity to identified sensitive areas. - Installation of signage to warn drivers to take caution of wildlife. - Develop and implement Waste Management Plan, including measures to control food source for pests. • Develop and implement Fire Management Plan with actions to minimise probability of extensive wildfires (existing reference to the use of burning for vegetation management will be removed from EMP). • Update triggers in the Environmental Management Plan to consider cumulative impacts over time.	
Air quality	• Develop and implement an Air and Dust Management Plan to mitigation dust impacts, including: - Chemical treatment or water spraying to treat roads - Implement road speed limits - Seal access road from Highway to Mine - Minimise open areas exposed to wind erosion - Topsoil striping to occur only during suitable wind and weather conditions - Ore to be sprayed with water prior to entering crushing circuit - Float cells will be installed on the windward side of the crushing circuit and a dust suppression system over the jaw crusher and - Continuous dust monitoring as required during preproduction and construction at site boundary and sensitive receptors. • Develop and implement Erosion and Sediment Control Plan. • Design of all aspects of the rare earths plant to include emission controls (scrubbers) to minimise dispersion of emissions.	Operation phase

Aspect	Commitment	Timeframe
	• Power Station stack height to be a minimum of 12.5 m and have an internal diameter of 0.6m. • Acid Plant stack height to be a minimum of 20 m and have an internal diameter of 1.36 m.	
Heritage	• Liaise with Traditional Owners and custodians, via onsite meetings, regarding cultural heritage management and specifically including the management of RWA 8. • Gain AAPA clearance certificate and CLC clearance certificates prior to construction commencing. • Gain regulatory approval if removal of cultural sites is required. • Undertake archaeological survey to identify sites of heritage value. • Development and implement a Cultural Heritage Management Plan, including: - Buffer distances or fencing surrounding identified and agreed archaeological sites and/or sacred sites - Pre-clearing / disturbance visual investigations - Research plan for an appropriate recording and salvage program (if requested) - Procedure for managing unexpected finds and unintentional disturbance - Mine site induction to all employees/visitors to include the identification and management of artefacts and cultural sites. - Investigate options to realign access road to avoid RWA 8 - Continue to liaise with Traditional Owners regarding the management of RWA 8 - Finalise Mining Agreement including provisions for: - Access to land and - Visits to the mine (if requested).	Planning and operation
Radiation	• Develop and implement a Radiation Management Plan (including Regulator approval), referencing appropriate ARPANSA Codes of Practice including: - Determine baseline radiation levels	All phases

Aspect	Commitment	Timeframe
	- Radiation action levels, for both workers and the public that trigger internal investigations or other controls - Identification of Controlled Areas - Hygiene procedures for personnel working within a Controlled Area and - Radiation Safe Work Permits for work within a Controlled Area. • Equipment exiting the Controlled Areas will first require formal decontamination clearance. Equipment and vehicles exiting will be required to pass through the Clean/Dirty boundary with wash down bay and facilities provided. • A grade control management system to be implemented with trucked ore to pass through two radiometric analysers when exiting the pit • Baseline and ongoing monitoring of radiation levels at the processing site and accommodation • Undertake regular testing of radiation levels and implement occupational health and hygiene practises for staff. • Develop and implement a Radioactive Waste Management Plan (RWMP) (including Regulator approval). • A baseline dataset of uranium levels in groundwater to be obtained prior to development works on site. • Water to be used for dust suppression will need to comply with certain criteria before being used. The final criteria will be part of the approved Air Quality and Dust Management Plan (part of the Mine Management Plan). • All materials leaving site will be transported in accordance with the relevant transportation codes. • Raditation doses will be incorporated into the ARPANSA ANRDR.	
Transport	• Develop and implement a Traffic Management Plan, including: - Journey Management Plans - Channelisation of Stuart Highway	

Aspect	Commitment	Timeframe
	- Site speed restrictions - Tyres and rims management plan and - Compliance with AS1742.3. • Consultation with NT Department of Infrastructure, Planning and Logistics regarding Stuart Highway intersection.	
Waste	• Develop and implement a Waste Management Plan including compliance with: - Central Australian Remote Landfill Operating Manual - Waste Management Guidelines for Small Communities in the Northern Territory - Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites In the Northern Territory • Cover landfill rather than burn it.	All phases
Hazardous substances	• Develop and implement a Hazardous Substances Management Plan including: - Ensure handling and storage of hazardous substances are in accordance with relevant Australian standards - Detail hazardous substances inventory requirements and - Detail fuel inventory and investigation requirements. • Provide spill response procedures and subsequent investigation requirements. • Finalise onsite chemical inventory and update risk assessment.	Planning and operation phases
Emergency management	• Liaise with the Local Emergency Committee regarding potential off-site emergencies. • Guidance, advice and assistance to be provided as requested by the Local Controller. • Finalise onsite chemical inventory (and update risk assessment). • Provide the Local Controller a copy of all MSD Registers. • Develop and implement an Emergency Response Management Plan including: - Emergency Response Team will undergo regular training and participate in regular mock and desktop exercises regulatory reporting requirements	Planning and operation phases

Aspect	Commitment	Timeframe
	- Emergency Response Plans for potential incidents and - Trained emergency response personnel will also be available to assist in emergency management as required by the Local Controller upon request.	
Human health and safety	- Develop and implement a Health and Safety Management Plan to mitigate the risk to human health and safety. The Management Plan will include emergency response procedures in the event of an emergency or accident. - Consideration of Environmental Health Fact Sheet (No. 700) as a Requirement for Mining and Construction Project /DoH requirements for mining camps and construction camps in the NT (https://nt.gov.au/property/building-and-development/health-requirements-mining-construction-projects).	Planning phase
Closure	- Develop conceptual Closure Plan prior to commencement of operations (after detailed design). - Studies to be completed during operation and utilising local material, to validate information on the degradation of engineered barriers and capping over time. - Undertake radiation level testing on tailings covered with benign waste rock. Obtain the minimum thickness required to reduce the radiation levels to background levels and/or license limits. Arafura will provide a cover of minimum two metres benign waste rock. - During operation of the mine, sample and assess the waste materials generated from the mining and processing of ore, and complete the closure system design based on the outcomes. - Undertake closure trials to assess the performance of the cover system, and adjust cover system design (if required). - Undertake modelling to assess the infiltration, water storage and net percolation rates for the selected cover system. - Review of Closure Plan in accordance with regulatory requirements including updated estimates of disturbance with associated rehabilitation estimates. - Monitor identified key environmental aspects of operation that are potentially most problematic at closure i.e. tailings, waste rock, seepage.	Planning phase (following detailed design) and throughout operations and closure

Aspect	Commitment	Timeframe
	• Stakeholder engagement and communications to inform local and regional communities and other stakeholders of closure planning processes. • Maintain responsibility for site until demonstrated that closure meets agreed closure objectives and criteria. • Rehabilitation of the Mine site to meet agreed final land use criteria	
General	• Comply with all applicable NT legislation.	Ongoing

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