Assessment Report 97

Assessment by Environmental Impact Statement (EIS)

Fountain Head Gold Project

PNX Metals Limited

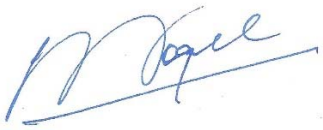
January 2023

ntepa Northern Territory Environment Protection Authority

This assessment report has been prepared by the Northern Territory Environment Protection Authority (NT EPA) pursuant to section 7(2)(g) of the *Environmental Assessment Act 1982*, and sections 296 and 299 of the *Environment Protection Act 2019* (EP Act). It describes the outcomes of the NT EPA's assessment of the Fountain Head Gold Project proposed by PNX Metals Limited.

This assessment report documents potential environmental impacts and risks identified during the environmental impact assessment process, focusing on those that could be significant, and the measures and recommended conditions required to address potentially significant impacts on the environment.

In accordance with section 64 of the EP Act, the assessment report is for the Northern Territory Minister for Environment, Climate Change and Water Security to consider when making a decision about whether to approve the action under the EP Act.



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3 January 2023

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Summary

This assessment report has been prepared by the Northern Territory Environment Protection Authority (NT EPA) pursuant to section 7(2)(g) of the *Environmental Assessment Act 1982* (EA Act) and sections 296 and 299 of the NT *Environment Protection Act 2019* (EP Act) for the Fountain Head Gold Project (proposal).

PNX Metals Limited (proponent) proposes to recommence mining of the Fountain Head open pit, approximately 170 km south of Darwin in the Victoria Daly Region and wholly within the pastoral property of Ban Ban Springs on Parcel 695 (Burrundie). Ore is proposed to be mined using traditional drilling and blasting and truck and shovel techniques, and gold extracted using a carbon-in leach process. Tailings would be co-disposed with waste rock and potentially acid forming waste rock would be backfilled into the pit. The life of mine is 3.5 years. Closure and rehabilitation will occur over 1.5 years.

The NT EPA assessed the proposal by Environmental Impact Statement (EIS) in accordance with the requirements of the EA Act and Environmental Assessment Administrative Procedures 1984, with transitional matters under the EP Act and Environment Protection Regulations 2020 (EP Regulations). The NT EPA examined the potential for significant direct, indirect and cumulative environmental impacts on the environment in accordance with the principles of ecologically sustainable development.

The NT EPA has examined potential significant impacts on the following seven key environmental factors:

1. Hydrological processes
2. Inland water environmental quality
3. Aquatic ecosystems
4. Terrestrial environmental quality
5. Terrestrial ecosystems
6. Community and economy
7. Culture and heritage.

To address potentially significant impacts of the proposal on the key environmental factors, the NT EPA has recommended conditions for the Minister for Environment, Climate Change and Water Security (Minister) to consider, if an environmental approval is granted. The proponent and statutory decision makers were consulted on the draft environmental approval as required by regulation 160 of EP Regulations.

The NT EPA's assessment concludes that the proposal can be implemented and managed in a manner that is environmentally acceptable and therefore recommends that environmental approval be granted, subject to the conditions recommended in Appendix 1. This assessment report and the draft environmental approval (Appendix 1) are provided to the Minister for consideration in deciding whether to grant an environmental approval.

Contents

1. Introduction

This assessment report provides advice and recommendations of the Northern Territory Environment Protection Authority (NT EPA) to the Minister for Environment, Climate Change and Water Security (Minister) on completion of the NT EPA's environmental impact assessment of the Fountain Head Gold Project (proposal). The proposal is to recommence mining of the Fountain Head open pit, approximately 170 km south of Darwin in the Victoria Daly local government area.

The NT EPA assessed the proposal by Environmental Impact Statement (EIS), and prepared this report pursuant to section 7(2)(g) of the *Environmental Assessment Act 1982* (EA Act), clause 14(3) of the Environmental Assessment Administrative Procedures 1984 (EAAP), and in accordance with sections 296 and 299 of the *Environment Protection Act 2019* (EP Act). In accordance with the EAAP, and as prescribed by regulation 156(3) of the Environment Protection Regulations 2020 (EP Regulations), this assessment report is to:

1. assess whether the proposal is likely to meet the environmental objectives
2. assess the potential significant environmental impacts of the proposal
3. make recommendations for avoiding, mitigating and managing those impacts
4. advise the Minister as to the environmental acceptability of the proposal.

This assessment report and the draft Environmental Approval (Appendix 1) are provided to the Minister for Environment, Climate Change and Water Security (Minister) for consideration in deciding whether to grant an environmental approval for the proposal, and concludes the NT EPA's environmental impact assessment process.

1.1. Proponent

The proponent is PNX Metals Limited (Australian business number (ABN) 67 127 446 271). The proponent is proposing to develop its portfolio of priority projects within the region that includes assets at Hayes Creek (the Hayes Creek zinc-gold-silver Project) incorporating the Iron Blow and Mount Bonnie deposits, and the Fountain Head Gold Project (this proposal).

1.2. Location and context

The proposal is situated in the Adelaide River Catchment[1] of the Victoria Daly local government area (**Figure 1**) wholly within the pastoral property of Ban Ban Springs on Parcel 695 (Burrundie). The location is north of the Mt Wells road between the towns of Pine Creek and Adelaide River approximately 170 km south of Darwin.

The Adelaide River catchment is one of the largest catchments in the Victoria Daly region with a diversity of habitats and significant environmental flows through to extensive freshwater and marine coastal floodplains and nationally significant wetlands. The streams, wetlands and riparian areas of the catchment are also culturally significant and provide nutritional food to Indigenous people. The Adelaide River coastal floodplain is a recognised site of conservation significance (SOCS).

The region has a tropical savannah climate and is characterised by distinct wet (November to April) and dry (May to October) seasons. The annual average rainfall recorded at the Douglas River Research Farm (approximately 55 km south west of the proposal) from 1968 to 2021 is 1,245.2 mm,

[1] CSIRO (2018). Water resource assessment for the Darwin catchments. An overview report to the Australian Government from the CSIRO Northern Australia Water Resource Assessment, part of the National Water Infrastructure Development Fund: Water Resource Assessments. CSIRO, Australia.

with about 90% of annual rainfall occurring from November to March, and the remainder occurring from June to August.

The proposal is located predominantly within the Rumwaggon land system (sandstone plains and rises with intervening alluvial flats), and the McKinlay land system (alluvial floodplains of the Margaret River). Soils are lithosols on the rises and podzolics on the alluvial areas.

The area surrounding the proposal contains a number of prospective sites that are predominantly gold mines. Historical mining activities have resulted in significant disturbance to the landscape and surrounding environment.

Remnant disturbance and infrastructure remains (in the footprint of the proposal) from past mining and exploration activities including the existing waste rock storage, the flooded Fountain Head Pit void, the existing water supply dam (currently used for stock water by pastoralists), Fountain Head Lake (former alluvial workings), roads and tracks. **Figure 1** shows the proposal location and **Figure 2** shows the site layout.

An intermittent waterway originating in the south of the proposal area flows into Fountain Head Lake within the proposal area, to join the ephemeral unnamed creek to the north-east of the proposal area. The Fountain Head Lake has formed by virtue of a haul road constructed at the northern end of the waterway during previous mining activity.

The existing infrastructure in the proposal area includes a water storage dam, likely to also be old alluvial workings, and the flooded Fountain Head Pit void. A perennial billabong and small waterhole that is a recorded sacred site is located along the unnamed creek downstream of the proposal area approximately 2.5 km to the north-east of the flooded Fountain Head Pit void. Hereafter both water bodies forming the sacred site, which are also recognised as an aquatic groundwater dependant ecosystem (GDE) will be referred to as the billabong.

2. Proposal

2.1. Description

The proposal is to dewater the existing flooded Fountain Head Pit void, expand the pit to a depth of 160 m by drilling and blasting, recommence mining of the Fountain Head Pit and construct new infrastructure to enable gold production from the mined resource. The post-closure use of the site is the removal of mining infrastructure and a return to pasture for grazing cattle. The resultant Fountain Head Pit is expected to form a pit lake. **Table 1** lists the key elements of the proposal.

Table 1 Proposal – key elements

Aspect	Description
Proposal area	634.6 ha as shown in Figure 2
Disturbance area	Total disturbance area of 245.9 ha as approximately: • 150 ha over existing disturbance • 96 ha land clearing of native vegetation
Mine Life	Mining over 53 months (4 years 5 months) • 47 months as staged and ongoing dewatering • 7 months site preparation and construction • 34 months mining operations and processing

Aspect	Description
	• 12 months closure and rehabilitation
Workforce	50 workers during the construction phase 134 workers total workforce (mining and processing)
Mining infrastructure	Site access roads, administration offices, workshops, power station, roads, magazine facility
Power supply	3 x 1500 kW diesel generators 1 x 1500 kW standby diesel generator
Mining product and method	Gold extraction by open pit drill and blast
Mineral processing	Gold production by carbon-in-leach processing with cyanide
Mining	Approximate quantities of mined material: • 3 million tonne (Mt) ore • 15 Mt waste rock • 2.7 Mt tailings
Integrated waste landform (IWL)	Designed for co-disposal of: • NAF/PAF-LC waste rock (capacity for 17.09 Mt) • filtered tailings in a tailings storage cell (capacity for 3.72 Mt)
Waste rock management	Waste rock characterisation: • 12.6 Mt NAF (non-acid forming, ≤0.2% total sulfur) • 0.6 Mt PAF-LC (potential acid forming - low capacity, >0.2% to ≤0.4% total sulfur) • 0.15 Mt PAF (potential acid forming, >0.4% total sulfur) Waste rock management: • NAF and PAF-LC waste material is to be stored in the IWL • PAF waste to be temporarily stored in 3 cells within the main pit • PAF waste to be permanently stored within the main pit at the end of mine life with minimum 2 m water coverage
Evaporation Pond	Remediation and expansion of the water storage dam to act as an evaporation pond: • wall height at 98.9 m AHD • spillway level at 98.6 m AHD • operating volume of 660 ML (at minimum 93 m AHD and maximum 97.4 m AHD)
Dewatering	• forced evaporation from flooded Fountain Head Pit void (x3 evaporators)

Aspect	Description
	• pumping water from Fountain Head Pit to the evaporation pond (ongoing) • forced evaporation from evaporation pond (x3 evaporators)
Water demand and sources	• Potable water – 5.5 m^3/hr peak consumption (trucked to site), and • Non-potable process water - 27 m^3/hr to be sourced from Fountain Head Pit dewatering
Water management	• flooded Fountain Head Pit void – dewatered by forced evaporation and pumping • water storage dam (existing feature) – remediated, expanded and converted to the evaporation pond • Fountain Head Lake (existing feature) • construction of six sediment dams • construction of flood protection structures (southern waterway diversion) • no offsite wastewater discharge is proposed
Mine closure and rehabilitation	• PAF placement at the base of Fountain Head Pit void under a water cover (pit lake) • IWL is re-profiled to create a stable, non-polluting landform, and progressively rehabilitated using native species • infrastructure is removed from site • disturbed areas returned to grazing pasture

Figure 1 The proposal location in the Adelaide River catchment

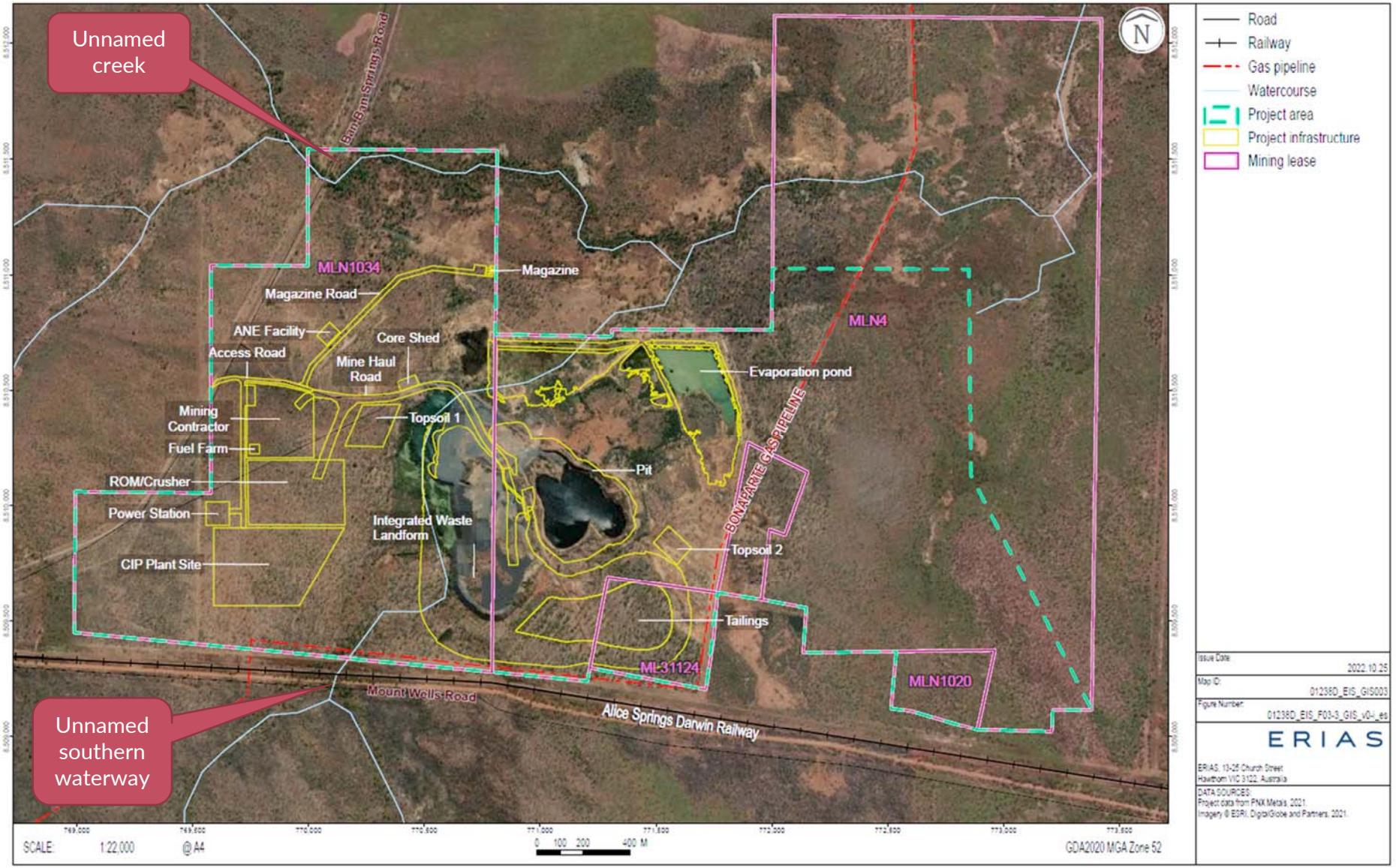

Figure 2 Proposal layout and extent (Fountain Head Gold Project area)

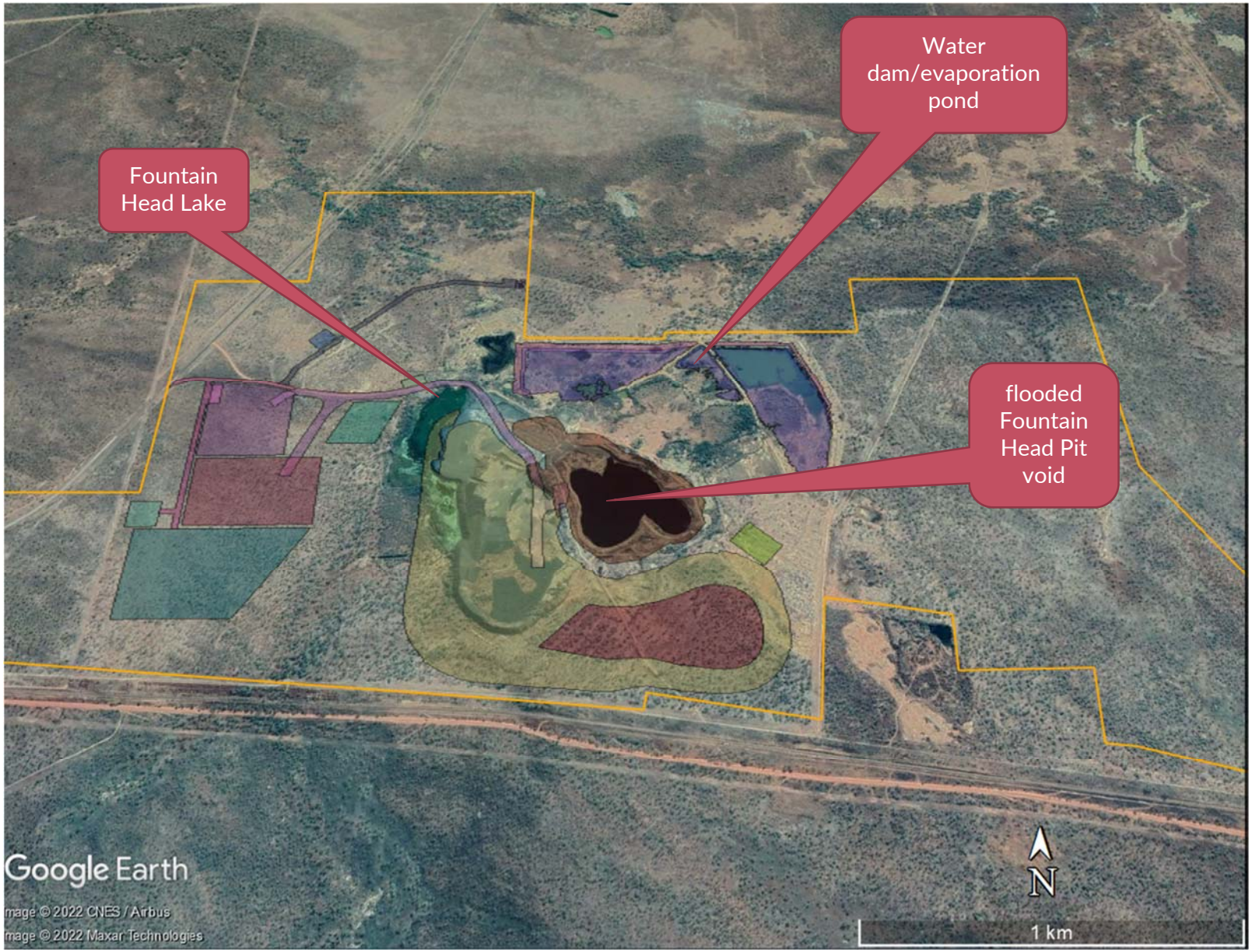

Figure 3 Overview and key features of the proposal

2.2. Justification for the proposal and alternatives

The proponent considered the potential to develop the adjacent Hayes Creek (zinc-gold-silver) Project ahead of the Fountain Head Gold Project. The draft EIS indicates that proceeding with the Fountain Head Project in advance of the Hayes Creek Project would allow the proponent to generate cash flow and generate positive economic benefits through local employment of the workforce, and for suppliers, service providers and contractors. In addition, key mine infrastructure at the site such as a gold processing facility, and IWL could facilitate any future development of the Hayes Creek Project.

3. Strategic context

3.1. Proposal benefits

The proposal would provide economic benefits to the NT Government (in the form of company taxes and royalties), to suppliers, service providers and contractors, and employment opportunities where the workforce required for the mining and processing operations will first be sourced from the local areas of Pine Creek, Adelaide River and Darwin.

3.2. Consistency of proposal with strategic planning

The proposal is consistent with the NT Government's commitment to creating jobs and economic growth, and with strategic plans and initiatives including:

- Darwin Regional Plan - identifies high level characteristics and needs that will shape development, management of growth and regional infrastructure.
- NT Economic Development Framework - establishes the directions and actions needed to accelerate the Territory's economic development, informs long term decision making and aims to deliver policy and regulatory certainty for investors.
- The Territory's Economic Reconstruction – the Territory Economic Reconstruction Commission sets out a blueprint to diversify the NT's industry base and take advantage of global market trends to accelerate the growth of its economy and economic recovery.

4. Statutory context

4.1. Overview

The proposal requires assessment by the NT EPA under the EP Act. The Northern Territory Minister for Environment, Climate Change and Water Security (the Minister) is the approval authority. Pursuant to section 61 of the EP Act, the purpose of the environmental approval is to manage the potentially significant environmental impacts of a proposal during all phases.

This assessment report and the draft environmental approval (Appendix 1) are available for the Minister to consider in making a decision on whether to grant or refuse an environmental approval for the proposal and conditions of the approval.

Approvals (requiring separate applications and processes) are required for the proposal under other legislation. It is the responsibility of the proponent to obtain all approvals that may be required. These may include, but not be limited to:

- approval of a mining management plan (MMP) which includes a mine closure plan (MCP) and granting of an authorisation to carry out approved mining activities pursuant to the *Mining Management Act 2001*
- authority certificate/s issued to the proponent for this proposal under the *Northern Territory Aboriginal Sacred Sites Act 1989*
- pursuant to the *Water Act 1992*, the approval and grant of a permit to interfere with a waterway, and licence for waste discharge, and to take water.

Under the *National Greenhouse and Energy Reporting Act 2007* (NGER Act), the proponent is obligated to report information about the greenhouse gas emissions generated as a result of implementing the proposal.

4.2. Mandatory matters for consideration

In preparing this assessment report, the NT EPA considered the following information in accordance section 7(2)(g) of the EA Act:

- the objects (EA Act, section 4)
- the principles of ecologically sustainable development (EP Act, Part 2 Division 1)
- the proponent's Notice of Intent (NOI)
- government authority submissions on the NOI information
- Terms of Reference
- draft EIS
- Supplement to the draft EIS
- additional information provided under clause 14(2)(a) of the Environmental Assessment Administrative Procedures 1984 (EAAP)
- government authority comments on the draft EIS, supplement to the draft EIS and additional information to the supplement
- any other information the NT EPA considers relevant under the EAAP.

The NT EPA took into account the purpose of the environmental impact assessment process under section 42 of the EP Act including consideration of:

- the objects (EP Act, section 3)
- the principles of ecologically sustainable development (EP Act, Part 2 Division 1)
- the environmental decision-making hierarchy (EP Act section 26)
- the waste management hierarchy (EP Act section 27)
- ecosystem-based management
- impacts of a changing climate.

Refer to Appendix 2 for further detail about matters that the NT EPA has taken into account during its assessment.

5. Consultation

The NT EPA invited government authorities to comment on PNX Metals Limited NOI between 20 December 2019 and 22 January 2020. Thirteen submissions on the NOI were received.

The NT EPA considered the submissions, and on 16 March 2020 decided the Fountain Head Gold Project required assessment under the *Environmental Assessment Act 1982* at the level of EIS.

Draft TOR were published for comment between 15 April 2020 and 28 April 2020. The TOR was finalised taking into account submissions received and was published on 11 May 2020.

On 9 June 2021 the NT EPA published a statutory notice inviting comment on the draft EIS for the proposal by Friday 6 August 2021. One public submission was received on the draft EIS along with submissions from six government authorities.

PNX Metals Limited was directed on 24 September 2021 to prepare a Supplement to the draft EIS to address issues raised in the submissions. On 6 January 2022, the NT EPA issued a further direction under clause 14(2)(a) of the EAAP for additional information considered necessary to facilitate the examination of the EIS. Government authority advice was received on the further information provided by the proponent.

In preparing this report, matters raised in the submissions were considered in relation to the proposal's potential environmental impacts. The issues raised in submissions are discussed in more detail in section 6 below.

The NT EPA consulted with and invited submissions from the proponent and statutory decision makers who may have a view on the draft environmental approval. Submissions were received from the proponent and statutory decision makers, and the NT EPA considered these submissions in finalising its recommendations to the Minister.

6. Assessment of key environmental factors

6.1. Overview

The NT EPA identified that the proposal has the potential to have a significant impact on environmental values associated with the seven key environmental factors (**Table 2**). The NT EPA considered other environmental factors during its environmental impact assessment; however, the impact on those factors was not considered to be significant.

In considering the key environmental factors and the recommended conditions in Appendix 1, the NT EPA took into account other statutory decision-making processes that can avoid or mitigate the potentially significant impacts of the proposal on the environment.

Table 2 Key environmental factors

Theme	Factor	Environmental objective
Land	Terrestrial environmental quality	Protect the quality and integrity of land and soils so that environmental values are supported and maintained.
	Terrestrial ecosystems	Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.
Water	Hydrological processes	Protect the hydrological regimes of groundwater and surface water so that environmental values including

Theme	Factor	Environmental objective
		ecological health, land uses and the welfare and amenity of people are maintained.
	Inland water environmental quality	Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.
	Aquatic ecosystems	Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.
People	Community and economy	Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians.
	Culture and heritage	Protect culture and heritage.

6.2. Hydrological processes

6.2.1. Environmental values

The proposal is located near the headwaters of the Margaret River in the Adelaide River Catchment where stream flows are intermittent. The streams are ephemeral in nature in that they are dry for most of the year and flows only occur following rainfall in the wet season.

The proposal area is mostly within the catchment of an unnamed southern waterway (**Figure 2**) that drains to into Fountain Head Lake (**Figure 3**) before overflowing into an unnamed creek to the north of the proposal area. The unnamed creek then drains in a north-easterly direction on the northern side of the proposal area into the Margaret River approximately 7 km downstream.

Surface runoff and overland flow are highly variable and discharge to drainage lines that dry out during dry seasons, although some instream pools have been observed to persist for extended periods into the dry season. The presence of instream pools in the dry season is usually dependent on the previous wet season's rainfall and runoff, and potentially on groundwater baseflow. The key surface water features in the proposal area include the Fountain Head Lake, the existing water storage dam, and the flooded Fountain Head Pit void.

The southern waterway enters the proposal area then flows into Fountain Head Lake (former alluvial workings), and the unnamed creek to the north-east. The southern waterway flows into the lake and hydrological modelling undertaken by the proponent for the draft EIS shows that the lake overflows and discharges over the causeway to the north of the site every year during the wet season, and that there is an average 0.3 m fluctuation in lake water levels between the dry and wet seasons.

The Fountain Head Lake is currently dammed at its northern end by the constructed haul road. The billabong located downstream of the unnamed creek and approximately 2.5 km to the north-east of the flooded Fountain Head Pit void is a recorded sacred site and aquatic GDE.

The proponent conducts surface water monitoring and sampling at four locations near the proposal footprint as well as the broader region and monitoring data provided is from 2012 to 2016, and from 2019 to 2021.

Groundwater in the vicinity of the proposal occurs within local alluvial aquifers and in fractured and weathered basement rocks of the Burrell Creek Formation, the Mt Bonnie Formation and Gerowie

Tuffs. The regional groundwater flow is conceptualised to be in a north-easterly direction and groundwater discharge is expected along drainage lines as groundwater evapotranspiration from riparian vegetation, and as direct groundwater discharge (i.e. baseflow).

The Margaret River and billabong located downstream of the proposal area are identified as having a high potential of being reliant on surface expressions of groundwater, as an aquatic groundwater dependant ecosystem (GDE). The riparian vegetation along the unnamed tributary creek to the north of the proposal area, as well as the Margaret River are classified by the Bureau of Meteorology[2] as having a moderate potential of being terrestrial GDEs based on a reliance on groundwater for any part of the year.

The natural water table level in the vicinity of the flooded Fountain Head Pit void is estimated to be about 95 m AHD[3], with the water table sitting 5 to 10 m below ground surface. The groundwater interacts with the now flooded Fountain Head Pit void which has fully recovered from previous dewatering and may now be acting as a groundwater throughflow feature where regional groundwater flows in from the southwest and out towards the northeast.

Locally, groundwater resources are identified for uses that includes stock and domestic water, commercial and industrial water, and for mineral exploration. Groundwater at the proposal area is monitored via a network of six monitoring bores and water quality data is available for the period 2011 to 2016 and from 2019 to the present time.

6.2.2. Investigations and surveys

The proponent undertook a number of investigations and surveys relevant to hydrological processes:

- Flood assessment and surface water management strategy (CDM Smith 2021a; Draft EIS, Appendix 4) including flood maps for existing conditions
- Soil infiltration and solute fate assessment (CDM Smith 2021b; Draft EIS, Appendix 5)
- Site water and solute balance modelling (CDM Smith 2021c; Draft EIS, Appendix 3)
- Evaporator Emissions Study (Minetek 2020; Draft EIS, Appendix 27)
- Groundwater monitoring plan (CDM Smith 2021d; Supplement to the Draft EIS, Appendix 4)
- Groundwater model update (CDM Smith 2022a; Additional information to Supplement, Appendix 6), including:
    - Peer review statement – Fountain Head groundwater model (HydroGeologic 2022; Additional information to Supplement, Appendix 7).
    - Pit lake water quality assessment (CDM Smith 2022b; Additional information to Supplement, Appendix 5) including Pit lake water quality predictions (Land and Water Consulting 2022)
- Water management plan (ERIAS Group Pty Ltd 2022; Additional information to Supplement, Appendix 3).

6.2.3. Consultation

Matters raised during consultation relating to potentially significant impacts on hydrological processes include:

[2] Bureau of Meteorology, 2012. National GDE Atlas. Bioregional assessment source dataset.
[3] Australian Height Datum (AHD) is the height datum for Australia (Geoscience Australia)

- protection of the billabong and sacred sites nearby and downstream of the proposal area
- establishing the baseline condition and values of potential GDEs adjacent to the proposal and assess the potential for groundwater drawdown or mounding to have impacts
- improved groundwater monitoring to assess mounding and drawdown effects and the identification and characterisation of downstream aquatic GDEs was provided in the additional information to the supplement
- passive discharges to receiving waters could impact the billabong which may be an important refuge habitat in an ephemeral system
- the need for major improvement to the groundwater model to be at least a Class 2 and fit for purpose in line with the Australian Groundwater Monitoring Guidelines (Barnett et al. 2012)
- adequate information has not been provided establish the baseline condition/values of GDEs, and to assess whether there is the potential for groundwater drawdown/mounding to have impacts
- requirement for a surface water extraction licence for taking water from either the evaporation pond or flooded Fountain Head Pit void, and
- requirement for a permit to interfere under section 41 of the *Water Act 1992* if the current water regime of Fountain Head Lake is altered.

6.2.4. Potentially significant impacts

Hydrological processes and associated values have the potential to be impacted through:

- altered surface flows and hydrology due to construction and siting new infrastructure within the proposal footprint. Flow velocities may increase causing flooding and erosion
- drawdown of groundwater as a result of pit dewatering. Drawdown of greater than 100 m at the base of the pit is predicted at the end of mining but is relatively steep, with the cone of depression largely restricted to the near vicinity of the pit. Modelling predicts groundwater drawdown extends up to 2 km from the pit
- mounding of groundwater via seepage at the evaporation pond
- evolving post-mining pit water quality and contaminant transport along the groundwater flowpath.

Changes to surface flows and groundwater level fluctuations may have significant impacts on aquatic and terrestrial GDEs as discussed in sections 6.4 and 6.6. Potential impacts on water quality and cultural values are discussed in sections 6.3 and 6.7.

6.2.5. Avoidance and mitigation of impacts

The proponent has proposed the following measures to minimise impacts on hydrological processes:

- implement the recommendations of the flood risk assessment including designing and siting key infrastructure above the 1% annual exceedance probability (AEP) peak flood level
- design and construct the wall and spillway of the evaporation pond in accordance with ANCOLD (2012 & 2019) guidelines and has the capacity to withstand a 1% AEP flood event
- construct diversions and flood protection structures and culverts under haul roads to manage flood risk
- containment of waste rock and tailings in a constructed integrated waste landform.

6.2.6. Assessment of impacts to environmental values

The proposal will require dewatering the flooded Fountain Head Pit void, the remediation and extension of the existing water storage dam (and conversion to an evaporation pond) prior to the commencement of mining (expanding the existing pit). The construction of the crushing and gold processing plants, the integrated waste landform, and supporting infrastructure (workshops, power station, roads, offices, magazine storage) will also affect hydrological processes.

The flooded Fountain Head Pit void currently contains approximately 2,064 ML of water which will need to be removed for mining to occur. Up to nine months of dewatering is proposed via a bank of evaporators positioned on the pit rim.

Groundwater inflow to the pit is expected to be 2 ML/day, and this will be pumped to the evaporation pond up to a maximum rate of 9 ML/day (to account for increased inflows during the wet season) to maintain dry working conditions in the pit. The evaporators will be subsequently relocated to allow for ongoing dewatering of the evaporation pond.

The proponent examined the effects of dewatering the pit through an integrated package of models to assess the dewatering, the site water balance, solute balance, and groundwater dynamics that included potential mounding beneath the evaporation pond. Post-mining, the Fountain Head Pit is expected to form a pit lake, and water quality of the pit lake was also modelled and assessed.

Altered surface flows and hydrology

The works required during the construction, operation, closure and post-closure phases of the proposal have the potential to impact hydrological processes through changes to surface water flow patterns. The proponent investigated the rainfall runoff characteristics of contributing catchments to assess the flood risk to site infrastructure, to incorporate flood protection in designs, and to develop the site water management plan.

The NT EPA acknowledges that the hydraulic modelling was applied to achieve an adequate level of flood immunity, reduce flood impacts and erosion risks for the proposal for the 10%, 5%, 2%, 1% and 0.1% AEP design events. The proponent's flood protection measures (e.g. bunds and rock armouring) is to mitigate against flood impacts to the structural integrity of the western and northern wall of the evaporation pond and the waste rock and topsoil stockpiles during the construction and mining phase.

Where flow velocities are predicted to increase, such as along the western toe of the IWL, erosion control measures are proposed to be installed to provide protection from scouring and maintaining the structural integrity of the IWL post closure into the long-term.

The NT EPA notes that the proposed remediation of water dam and conversion to the evaporation pond has incorporated design, construction and operational elements that ensures the dam can withstand impacts from flooding, dam break is avoided, and contaminated water does not enter groundwater and the downstream environment.

The NT EPA notes the proponent's commitment in the draft EIS to:

- complete geotechnical assessment of the existing wall
- design the wall alignment taking into consideration potential erosion from flood water
- design the wall and spillway in accordance with ANCOLD[4] (2012 & 2019) guidelines, and

[4] Australian National Committee on Large Dams (ANCOLD) (2012), Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure and Addendum (2019)

- develop the bill of quantities and technical specification for use in tender documents.

The NT EPA requires that the design objectives for the remediation must also focus on the management of seepage, and to meet closure objectives. The NT EPA requires that in remediating the evaporation pond, the design, construction and operation of the evaporation pond must ensure, seepage rates are minimised and controlled in accordance with ANCOLD (2012) guidelines.

The final design and construction of new infrastructure must be informed by all relevant environmental studies and will consider potential impacts to the environment in accordance with the NT EPA's environmental decision-making hierarchy.

The NT EPA is satisfied that through careful design and construction, and the proponent's commitment to implementing effective protection, erosion and sediment control measures, the impacts from flooding can be adequately mitigated and managed so risks to the environment is avoided or minimised to an acceptable level.

The NT EPA has recommended a condition that requires the construction of the evaporation pond is to acceptable standards.

The NT EPA notes that any material change to the shape of a waterway, change to the volume, speed or direction of the flow or likely flow of water in or into a waterway, or alteration to the stability of the bed or banks of a waterway, including by the removal of vegetation as a result of the proposal must be as low as reasonably practicable so as to not cause a significant impact to the environment.

Any activity that will alter surface flows and hydrology or is likely to impact a waterway may trigger a requirement for a permit to interfere with a waterway under the *Water Act 1992*.

<u>Groundwater drawdown (from pit dewatering) and recovery post-mining</u>

Recommencement of mining and expanding the Fountain Head Pit will require dewatering the existing flooded pit void. To facilitate dewatering, the remediation and extension of existing water storage dam wall to be used as an evaporation pond. Pit dewatering will continue through the construction phase as forced evaporation of pit water (over the pit), followed by natural and forced evaporation at the evaporation pond during the mining and processing phases of the proposal.

The proponent has applied predictive groundwater numerical modelling interfaced with the water balance model (GoldSim) to predict the shape and behaviour of the groundwater cone of depression that would develop at different stages of the operation including current status, end of mining and post-mining.

The predicted drawdown of groundwater in the refined model indicates a drawdown radius more than 2 km greater to the east, around 1.5 km to the west, and intersects the ephemeral unnamed creek to the north of the site. Drawdown at end of mining will be around 0.5-1.0 m affecting a 1,000 m section of the creek.

Post-mining, and after placement of PAF waste at the base of the Fountain Head Pit, the recovery/rebound of the water table and pit water level is predicted by the proponent to stabilise to an average height of 93.5 m AHD with seasonal variation of 2 m and forming a permanent pit lake. The future Fountain Head Pit Lake is expected to act as a groundwater sink post-mining for a period of at least 50 years after which a minor groundwater throughflow component may develop.

The NT EPA notes that while in the future Fountain Head Pit Lake is thought to be a net groundwater sink, there will still be outflow of denser groundwater from the pit lake due to gravitational forcing. The outflow of dense pit lake water would occur within first few years post

closure and the current monitoring demonstrates that water in the pit is influencing quality of nearby groundwater.

At the present time, and under current conditions, a groundwater throughflow component has been observed by the proponent which has not been adequately quantified. Solutes are mostly constrained within the pit lake with the measured arsenic concentrations in surrounding groundwater monitoring bores being significantly lower than in the pit lake.

The NT EPA notes that dewatering the flooded Fountain Head Pit void, and any take of water from the evaporation pond or recognised waterway will require a surface water extraction licence under the *Water Act 1992*.

Mounding of groundwater via seepage at the evaporation pond

The proponent proposes to convert the existing water dam to an evaporation pond by remediating degraded sections of the dam wall and base. To increase the storage capacity, the proponent will be raising the wall height to 98.9 m AHD with a spillway level at 98.6 m AHD. The proponent has specified a 1.2 m freeboard with the maximum operating level (MOL)[5] at 97.4 m. At this level, the pond will have an operating volume of 660 ML.

Dewatering of the flooded Fountain Head Pit void will report to the evaporation pond where three evaporators will be used to increase the natural evaporation rates. The proponent estimates the evaporators will be operating 20 hours/day at a rate of 135 m^3/hr and remove around 2 to 4.5 ML/d depending on evaporation efficiency.

The NT EPA notes that the proponent has investigated groundwater infiltration/seepage rates in the existing water dam footprint as part of the conversion to an evaporation pond. Infiltration tests were performed to measure vertical hydraulic conductivity (Kv) of the soils described as silty clays, silty sands and clayey silts. The proponent has modelled and predicts temporary mounding to occur directly beneath and adjacent to the evaporation pond.

The water balance modelling results presented in the proponent's water management plan indicates that forced (evaporators) and natural evaporation combined accounts for 77% of outflows (3543 ML), process water supply is 3.5% (161 ML) and excess water remaining in the pond is 0.33% (15 ML).

The NT EPA notes that seepage will be 20% (858 ML) of the total outflows from the evaporation pond assuming average conditions prevail. As the evaporation pond progressively fills, groundwater mounding is expected to develop beneath the evaporation pond a result of seepage to the extent that waterlogging of soils may be observed.

The NT EPA has recommended a condition that requires seepage rates at the evaporation pond is minimised by lining with a low permeability layer that has a minimum thickness of 0.5 m.

The proponent notes that the structural integrity of the evaporation pond could also be compromised, and environmental values of downstream waterways could potentially be affected through the transport of solutes that are of concern along the groundwater flow path. The proponent's modelling indicates that during dewatering the mounding would be captured by the cone of depression created by pit dewatering.

The NT EPA notes that the proponent's modelling indicate that at the end of mining operations and post mining, a residual drawdown of around 0.1 m to greater than 5 m exists around the pit and

[5] MOL is the maximum operating level of the evaporation pond and is 1.2 m below the spillway level of 98.6 m AHD.

evaporation pond at 10 years post-mining, with groundwater levels predicted to fully recover within 40 years following mining.

Fountain Head Pit water quality evolution and contaminant transport

The proposal is for the existing flooded Fountain head Pit void to be dewatered, and expanded to a final depth of 160 m.

Post-mining, the deepened Fountain Head Pit will again be flooded following the final placement of PAF at the base to form a pit lake with recovery of the groundwater and rebound of the water table. The proponent's modelling predicts that by 2061, pit water levels are predicted to reach around 90 m AHD, representing near full recovery.

Exposed wall rock with PAF material is likely to interact with pit water producing leachate e.g. arsenic into the pit water and the NT EPA has recommended a condition to monitor pit lake water quality and require proponent to take remedial action if pit lake metals concentrations are greater than predicted levels. This is further discussed below in section 6.3.6.

The NT EPA has recommended a condition for monitoring groundwater behaviour including groundwater throughflow as a mechanism for contaminant transport. The NT EPA's assessment of potential impacts to inland environmental water quality and aquatic ecosystems from pit water quality and contaminant transport post-mining are in sections below.

6.2.7. Summary of factor assessment and recommended regulation

The NT EPA has considered the potential significant impacts of the proposal on hydrological processes. In doing so, the NT EPA has considered whether conditions could be imposed, or whether other statutory decision-making processes could ensure the NT EPA's factor objective is likely to be met.

The NT EPA assessment findings are presented in **Table 3**. The NT EPA has also taken into account the objects and principles of the EP Act (Appendix 2) in assessing whether the residual impacts will meet its environmental factor objective and whether conditions can be imposed.

Table 3 Summary of assessment for hydrological processes

Residual impact to environmental value	Assessment finding	Recommended conditions and regulation by other statutory decision makers
Altered surface flows and hydrology.	Any material change to the shape of a waterway, change to the volume, speed or direction of the flow or likely flow of water in or into a waterway, or alteration to the stability of the bed or banks of a waterway, including by the removal of vegetation may trigger a requirement for a permit to interfere with a waterway under the *Water Act 1992*. Any take of water from the evaporation pond or recognised waterway will require a surface water extraction licence. The unauthorised discharge (active or passive) of polluted water (diluted or non-diluted) to a waterway is considered an offence under the	Regulated through recommended conditions: • Limit value for drawdown at the confluence of the southern waterway and the unnamed creek. Regulation by existing regulatory processes: *Mining Management Act 2001* • Mining authorisation. • MMP and MCP.

Residual impact to environmental value	Assessment finding	Recommended conditions and regulation by other statutory decision makers
	Water Act 1992 and the *Waste Management and Pollution Control Act 1998*.	*Water Act 1992* • Surface Water Extraction Licence, WDL and, permit to interfere with a waterway.
Mounding of groundwater from seepage.	The evaporation pond is constructed to be fit for purpose, and complies with ANCOLD guidelines. Seepage must be limited to ensure integrity of the dam is not compromised.	Regulated through recommended condition: • Evaporation pond is constructed according to ANCOLD guidelines and to minimise seepage through the base and walls.
Drawdown of groundwater as a result of pit dewatering, recovery, and post-mining groundwater throughflow and contaminant transport.	Post-mining the recovery/rebound of groundwater to pre-mining levels. The resulting Fountain Head Pit Lake water level is predicted to stabilise to an average height of 93.5 m. Wall rock with PAF material is likely to interact with pit water producing leachate. Groundwater throughflow is expected to develop as a mechanism with potential for contaminant transport and potential impact to inland water environmental quality and downstream ecological values.	Regulated through recommended conditions to: • Develop and implement the TARP with groundwater quality and level triggers and limits. • Implement the management actions to ensure drawdown limits are not exceeded. • Report on exceedances.

6.2.8. Conclusion against the NT EPA objective

With implementation of the proponent's commitments, the recommended conditions in Appendix 1 and regulation under the MM Act, the *Water Act 1992* and *Waste Management and Pollution Control Act 1998*, the NT EPA considers that the proposal could be conducted in such a manner that its objective for hydrological processes can be met.

6.3. Inland water environmental quality

6.3.1. Environmental values

Surface water

The proposal is located in the upper catchment of the Margaret River, a tributary of the Adelaide River, which flows through extensive coastal and marine floodplains into the Arafura Sea north-east of Darwin. The Adelaide River coastal floodplain is recognised as a site of conservation significance

(SOCS), extending from near the junction of the Margaret River in the south to the mouth of the Adelaide River at the coast and is a large seasonally inundated freshwater floodplain that is traversed by a permanent tidal section of the Adelaide River.

The proposal is approximately 100 km upstream of the proposed Adelaide River Off-Stream Water Storage (AROWS) project that would contribute to Darwin's water supply and provide future water security for the Darwin region.

There are a number of parks and reserves downstream including the Adelaide River Foreshore Conservation Area, Window on the Wetlands Visitor Centre, Harrison Dam Conservation Area, Djukbinj National Park and Melacca Swamp Conservation Area.

Within the vicinity of the proposal area the waterways are predominantly ephemeral, flowing briefly following rainfall in the wet season. The unnamed southern waterway flows through the proposal area into Fountain Head Lake before overflowing into the unnamed creek to the north of the proposal area (**Figure 4**). The unnamed creek drains into the Margaret River approximately 7 km downstream.

The catchment area of the southern waterway to the south of the proposal area is approximately 6 km^2 and the catchment area of the unnamed creek is approximately 33 km^2. The environmental values supported by inland surface water quality include terrestrial and aquatic ecosystems as instream and wetland habitats, including the billabong and riparian vegetation which may be GDEs.

Upstream of the proposal area, the water quality in the southern waterway is generally typical of ephemeral freshwater systems of northern Australia but with widespread microbial contamination and elevated concentrations of aluminium, chromium, copper and zinc. This water quality is also observed downstream of the proposal area in the unnamed creek, and the Margaret River, and is a function of historical mining and agricultural activities and practices.

Surface water quality data for Fountain Head was collected by previous mine operators from 2012 to 2016, and more recently by the proponent from April 2019 to April 2021.

Compared to the ANZECC/ARMCANZ (2000)[6] trigger values for slightly to moderately disturbed ecosystems, the water quality data indicates there is existing elevated background concentrations of dissolved metals and metalloids both upstream and downstream of the proposal area.

Additional aquatic surveys undertaken by the proponent investigated the surface water environment in the catchment that included water bodies in the proposal area (the dam, Fountain Head Lake and flooded Fountain Head Pit void). The water quality data for these water bodies were compared to the ANZECC/ARMCANZ (2000) trigger values (dissolved concentrations) for slightly to moderately disturbed ecosystems, and the livestock drinking water quality guidelines as total (unfiltered) concentrations.

Water quality at the existing water dam (proposed to be converted into an evaporation pond) has been characterised to have very low salinity and is suitable for use on sensitive crops. Ban Ban Springs Station has indicated that it is preferred that the dam is retained post-mining to support future pastoral activities.

For the flooded Fountain Head Pit void, the electrical conductivity (EC) is typically higher than the guideline values and pH was alkaline with an average of 8.1. Current pre-mining dissolved arsenic

[6] The ANZG (2018) Water Quality Guidelines replaces the previous ANZECC/ARMCANZ (2000) guidelines. Without updates to the trigger values for irrigation and general water use and as the revised livestock drinking water guidelines are yet to be published, the default guidelines values from ANZECC/ARMCANZ (2000) have been used.

consistently exceeds the trigger value for slightly to moderately disturbed aquatic ecosystems of 13 µg/L.

Arsenic concentrations consistently exceed the livestock drinking water guideline value of 500 µg/L with the average and median values also above this, indicating that pit water poses some risk to livestock if consumed. All remaining total metal concentrations were generally below the livestock drinking water guidelines trigger value.

Analysis of water quality data for the lake indicates water quality is similar to the pit water, varies seasonally, and EC is above the trigger value for slightly disturbed rivers in tropical Australia. With the exception of aluminium and iron, total metal and metalloid concentrations were well below the livestock drinking water quality guidelines.

Groundwater

The environmental values supported by groundwater quality include water supply for stock and domestic use, and the terrestrial and aquatic GDEs downstream of the proposal area. The proponent has assessed groundwater quality from six monitoring bores in the proposal area. The groundwater has an average electrical conductivity (EC) of 372±163 µS/cm where EC less than 650 µS/cm, is considered suitable for irrigation use on sensitive crops and as livestock drinking water, and the pH of the groundwater is circum-neutral.

The proponent notes that groundwater would not be suitable for drinking water based on regular exceedances of arsenic, iron and manganese drinking water guideline values. The average concentrations of arsenic and iron have been over an order of magnitude above their respective guideline values. However, groundwater is generally suitable for irrigation use and for livestock drinking water and bore RN024290 located outside the mine lease approximately 800 m northeast of the pit is periodically used by Ban Ban Springs Station for stock watering.

Sacred sites

Sacred sites located to the north of the proposal area and termite mounds greater than three metres tall that occur in the area are of cultural significance and could be impacted by changes to hydrological processes and inland environmental quality.

The NT EPA's assessment of potential impacts to cultural values is in Section 6.7. The NT EPA's assessment of terrestrial and aquatic GDEs are presented in the relevant sections below.

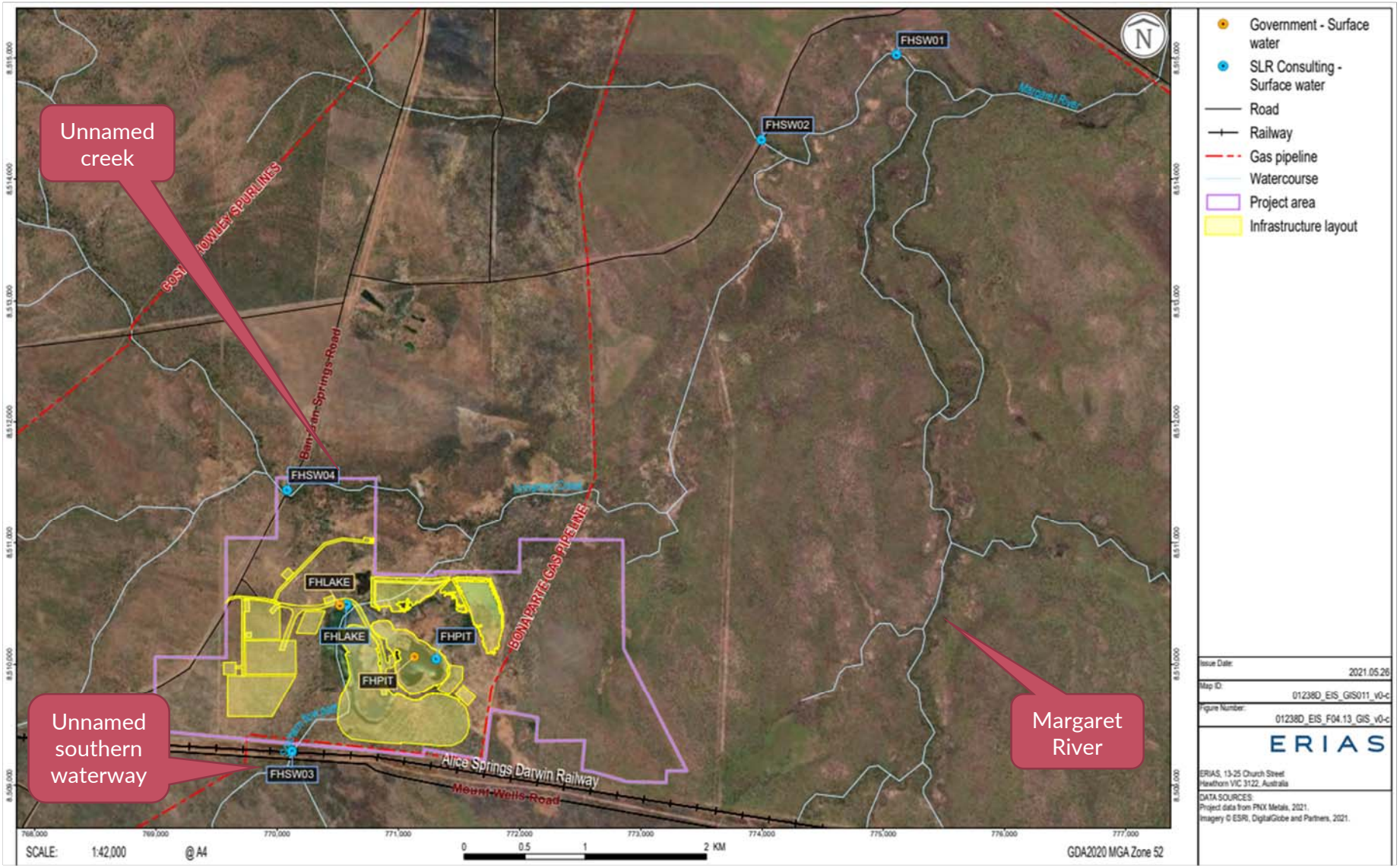

Figure 4 Surface water quality monitoring locations

6.3.2. Investigations and surveys

The proponent undertook a number of investigations and surveys relevant to inland water environmental quality:

- Aquatic baseline characterisation report – Fountain Head and Hayes Creek Zinc, gold and silver projects (ERIAS Group 2020; Draft EIS, Appendix 9)
- Site water and solute balance modelling - A technical report documenting the model predicted water fluxes and quality changes related to dewatering the flooded Fountain Head Pit void and Evaporation Pond storage through to the mine closure Stage, and other site water balance components (CDM Smith 2021c; Draft EIS, Appendix 3)
- Flood assessment and surface water management strategy (CDM Smith 2021a; Draft EIS, Appendix 4)
- Soil infiltration and solute fate assessment (CDM Smith 2021b; Draft EIS, Appendix 5)
- Pit lake water quality assessment (CDM Smith 2022c; Additional information to Supplement, Appendix 5) including:
- Pit Lake Water Quality Predictions (Land and Water Consulting 2022)
- Water management plan (ERIAS Group 2022; Additional information to Supplement, Appendix 3).

6.3.3. Consultation

Matters raised during consultation relating to potentially significant impacts on inland water environmental quality include:

- groundwater system underlying the proposal area is not well understood and further study is required to improve the groundwater model
- groundwater monitoring program is deficient with insufficient and inappropriately located groundwater bores
- unplanned overflows and leaks of contaminated mine water into receiving waters with the potential to impact aquatic health
- updating the biological monitoring program to establish the baseline water quality in the waterways that may be impacted through unplanned discharges to the receiving environment
- modelling of pit lake water quality should be undertaken to enable development of appropriate management systems
- addressing potential for biophysical impact on water related sacred sites downstream of the proposal from changes to water quality or hydrological processes.

6.3.4. Potentially significant impacts

Inland water environmental quality and associated values have the potential to be impacted through:

- seepage of dewatered pit water through the base and wall of the evaporation pond to ground and surface water leading to passive/uncontrolled discharge of mine affected water with high concentrations of arsenic to the environment

- migration of contaminants in the pit to the groundwater system and potentially to surface waters where there is groundwater/surface water connectivity.

6.3.5. Avoidance and mitigation of impacts

- installing appropriately sized sediment control structures to capture surface water runoff from the IWL, processing plant, ROM pad, mining contractor yard and hardstand areas that comply to the best practice erosion and sediment control guidelines (IECA, 2008).
- groundwater from the evaporation pond is predicted to be drawn back to the pit due to pit dewatering drawdown.

6.3.6. Assessment of impacts to environmental values

AMD from waste rock and tailings storage

The potential for waste rock and tailings to generate AMD from the IWL during mining is likely to be limited due to the geochemical characteristics of the waste rock, the physical characteristics of the filter-pressed tailings (10% moisture content), and the proposed design of the IWL. As the IWL is required to be a permanent stable structure, the NT EPA has recommended a condition that requires a low permeability basal layer that is installed to minimise and control the risk of seepage.

The NT EPA requires that the geochemical, geotechnical and structural integrity of the IWL is maintained in the short and long term. The tailings when encapsulated and compacted within a dedicated low-permeability cell contained by 20 m embankments constructed of low capacity (≤0.4% sulfur) PAF and NAF (≤0.2% sulfur) waste rock are likely to remain relatively stable. The NT EPA considers that the tailings cell must be compacted to a very low permeability and has recommended a condition accordingly.

The 'high capacity' PAF waste rock (>0.4% total sulfur), which was initially planned to be stored above-ground in a purpose-built storage facility, is to be disposed of in the pit at the end of mining. Backfilling PAF material into the mined pit below the groundwater level can be appropriate depending on the lithology and hydrogeological characteristics of the pit and the backfilling method employed.

While the groundwater model requires further validation, the NT EPA considers that disposal of PAF in the pit would likely prevent ongoing oxidation of the PAF waste rock once submerged and should result in improved outcomes for water quality. However, the exposed wall rock and waste rock that is stored in the pit pods during mining may generate acidity and mobile metals/metalloids potentially leading to flushing events to the pit void when water contacts the rock.

The NT EPA is of the view that PAF temporary storage pods must be managed to minimise exposure to water and air in the interim period until submergence. The NT EPA has recommended a condition to ensure that AMD from temporary PAF storage is minimised and the PAF and NAF is effectively segregated. At the end of mining the PAF is then relocated to the base of the mined-out pit to maximise depth of the water cover.

Exposed PAF wall rock would continue to react and generate AMD to the pit void including after it is flooded. Modelling indicates that dilution from groundwater and rainfall will maintain acceptable water quality. Validation of the model will be required based on the proponent's groundwater monitoring program, as discussed below.

The mine waste storage strategy adopted by the proponent will only be effective if the waste rock types are correctly identified, segregated and handled, with verification of waste materials and validation of the waste block model continuing during mining. A comprehensive quality assurance/quality control (QA/QC) program will be required to ensure waste characterisation and

placement is adequate, and the disposal sites are appropriately constructed. The NT EPA has recommended a condition to ensure that the QA/QC system is effective.

Contamination of ground and surface water from evaporation pond leaks

The proponent's peer-reviewed modelling predicted that dissolved arsenic concentrations in the evaporation pond are likely to peak during the mining phase to around 4,300 µg/L as pit water quality declines, and evapo-concentration occurs. During this period, any seepage through the base of the evaporation pond is likely to increase concentrations of arsenic and metals in groundwater, which will migrate down gradient.

While the hydraulic gradient towards the pit from the evaporation pond is likely to dominate groundwater movement on the site during mining, groundwater mounding under the evaporation pond could lead to passive discharge of contaminants beyond the mining lease to the north-east with the potential for contaminants to express to surface and to the downstream environment where groundwater and surface water interacts.

Particle tracking undertaken to support additional information as directed by the NT EPA, modelled potential contaminated groundwater plume pathways from the site. Eighty percent of model outputs simulated over a 50-year post-mining period predicted the maximum distance of particle travel to be less than 3.5 km from the evaporation pond. At this distance, a limited number of migration paths are predicted to intersect the unnamed creek (moderate potential terrestrial GDE) but not the billabong (high potential aquatic GDE), as discussed in section 6.4.6 below.

The model is not intended to be precise, and the predictions are highly sensitive to simulated changes in hydraulic conductivity in the aquifer. The NT EPA considers that the modelling should be refined through further hydraulic testing to the north-east of the proposal area prior to use of the evaporation pond.

Implementation of the proponent's groundwater monitoring program during mining is likely to detect any plume migration downstream of the proposal site. The NT EPA has recommended a condition that requires the water management plan to be updated to include specific and fully developed contingency measures in the event that monitoring indicates significant departure from the refined groundwater model predictions, with the potential to impact sensitive receptors.

Post-mining, arsenic concentrations in the evaporation pond are predicted to rapidly decrease to below the livestock drinking water guideline (500 µg/L) by the end of 2027 and below the aquatic ecosystem 80% protection level trigger value (140 µg/L) in early 2028. While groundwater from the site may reach the unnamed creek, the contaminant loads in groundwater are unlikely to be significant and any impacts are likely to be localised.

The proponent has proposed to convert the water dam to be re-purposed as an evaporation pond as the water dam is currently not fit for purpose. The pond would undergo remediation to improve the structural integrity of the existing wall, and an extension to increase storage capacity.

The NT EPA notes that for the structural integrity of the evaporation pond to be sound, the design objectives for the remediation must also focus on the management of seepage. The remediation of the wall and base of the evaporation pond will also be necessary to minimise and control seepage rates. The NT EPA requires that in remediating the evaporation pond, the construction and operation of the evaporation pond must be to ANCOLD (2012) guidelines.

Post-mining and as part of closure, further remediation of the evaporation pond will be necessary including removing bottom sludge from the evaporation pond for disposal. The evaporation pond must be made suitable for post mining a beneficial use where the agreed future use could be a water supply to support pastoral activities.

The NT EPA recommends that post mining, contaminated areas including the evaporation pond must be assessed, remediated and rehabilitated according to the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (ASC NEPM 1999) and the National Remediation Framework (NRF) (CRC CARE 2018).

Post closure contamination from the Fountain Head Pit Lake

During mining, the dissolved arsenic and metals concentrations in the pit water are predicted to increase due to exposure of mineralised pit walls to air and incident rainfall, dewatering and evapo-concentration. As discussed previously, PAF waste rock is to be stored within the pit area and will be exposed during mining before being pushed into the base of the pit and submerged as groundwater recovers after mine closure.

The current average arsenic concentration of pit lake water is about 567 µg/L; above the default guideline value for stock drinking water (500 µg/L) and the 80% aquatic ecosystem protection value (140 µg/L). The default guideline values have been applied as the proponent has not developed site-specific trigger values for the proposal. Dissolved arsenic concentrations in pit water are predicted to peak at 800 µg/L during mining.

The proponents' modelling indicates that when the Fountain Heat Pit water levels has effectively recovered, the concentration of all other leachate examined by the modelling such as copper and cobalt, are predicted to also be similar to, or less than the current pit lake water.

Once mining ceases, dewatering stops and groundwater elevation returns to pre-mining levels, dissolved arsenic concentrations in pit water are predicted to decrease rapidly to below the stock water guideline value within five years and to approximately 60 µg/L by 2061, below current background levels. Similarly, cobalt and copper concentrations are predicted to return to near current pit lake concentrations (0.6 µg/L and 0.7 µg/L respectively).

The NT EPA notes that due to the increased pit depth at the end of mining and exposure of PAF material in the wallrock and changes in pH, there is potential for leaching of metals to occur.

The NT EPA has recommended a condition which requires the proponent to monitor the post mining Fountain Head Pit lake water quality and groundwater beyond and down gradient of the proposal area and to validate the model predictions.

The NT EPA notes the uncertainty of water quality in the post mining pit lake and recommends a condition which requires the proponent to take remedial action if pit lake metals concentrations are greater than predicted levels.

6.3.7. Summary of factor assessment and recommended regulation

The NT EPA has considered the potential significant impacts of the proposal on inland water environmental quality. In doing so, the NT EPA has considered whether conditions could be imposed, or whether other statutory decision-making processes could ensure the NT EPA's factor objective is likely to be met.

The NT EPA assessment findings are presented in **Table 4**. The NT EPA has also taken into account the objects and principles of the EP Act (Appendix 2) in assessing whether the residual impacts will meet its environmental factor objective and whether conditions can be imposed.

Table 4 Summary of assessment for inland water environmental quality

Residual impact to environmental value	Assessment finding	Recommended conditions and regulation by other statutory decision makers
Evaporation pond seepage and contaminant transport.	Seepage rates through the floor of the evaporation pond would cause mounding to occur and drive groundwater flow as passive discharge back to the pit, as well as to the receiving environment. Post mining, the evaporation pond is to be remediated and rehabilitated according to the National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM 1999) and the National Remediation Framework (NRF) (CRC CARE 2018). Post mining, the evaporation pond must be made suitable for a beneficial use and the agreed future use is stock water supply.	Regulated through recommended conditions: • Construction to ANCOLD (2012) guidelines. • Use of low permeability liners on the base to limit seepage. • The dam operation will have operational triggers e.g. MOL, water quality, inspections, seepage monitoring according to ANCOLD (2012). • Evaporators are operated with operational triggers e.g. operating hours, wind direction, and wind strength. • Groundwater monitoring is required with groundwater quality and level triggers implemented as part of the TARP. • Post mining remediation is required according to ASC NEPM/NRF framework
Elevated concentrations of metals/metalloids in the post-mining Fountain Head Pit lake entering groundwater as throughflow.	All PAF materials are to be temporarily stored in designated areas during mining, and moved to be permanently placed at the bottom of the pit post mining to be under a water cover. There is potential for wall rock interaction with pit lake water where PAF materials are exposed in the deepened pit resulting in leaching of metals.	Regulated through recommended conditions: • Evaporator operation will be with operational triggers e.g. operating hours, wind direction, and wind strength. • Fountain Head Pit lake water quality monitoring is required with remediation post mining if the prescribed lake water quality is exceeded. • Groundwater monitoring is required with groundwater quality and level triggers implemented as part of the TARP.

Residual impact to environmental value	Assessment finding	Recommended conditions and regulation by other statutory decision makers
Generation of AMD from exposed waste rock placed in temporary storage pods during the mining stage.	During mining, the PAF material is placed temporarily up to three designated in-pit storage pods.	Regulated through recommended conditions that will: • Ensure isolation and containment of PAF material. • Ensure that leachate is collected for management and disposal.
Post mining generation of AMD from PAF waste rock (placed in bottom of the Fountain Head Pit Lake) and wall rock.	Post mining, the PAF material is placed at the bottom of the pit under a water cover.	Regulated through recommended conditions: • Groundwater monitoring is required to monitor potential contaminant transport. • Post-mining pit water quality monitoring is required. • The groundwater quality guideline values are the ANZG freshwater default guideline values 80% species protection level.
Seepage of leachate from the IWL	The tailings is to be encapsulated and compacted within a dedicated low-permeability cell contained by 20 m embankments constructed of low capacity PAF and NAF waste rock and is likely to remain relatively stable. The IWL is required to be a permanent stable structure that requires a low permeability basal layer installed to minimise and control the risk of seepage.	Regulated through recommended conditions: • Designed and constructed to limit seepage with a low permeability basal layer with leachate collection to ensure structural and chemical integrity in the long term.

6.3.8. Conclusion against the NT EPA objective

With implementation of the proponent's commitments, the recommended conditions in Appendix 1 and regulation under the MM Act and the *Water Act 1992*, the NT EPA considers that the proposal

could be conducted in such a manner that its objective for inland water environmental quality can be met.

6.4. Aquatic ecosystems

6.4.1. Environmental values

The proposal area is within the upper reaches of the Margaret River and the Adelaide River Catchment. The Adelaide River Catchment currently has no declared beneficial uses for surface and groundwater; however, the Margaret River intersects the Mary River groundwater catchment for 40 km. The beneficial uses declared for groundwater of the Mary River are environment, riparian and agriculture, and provide the objective for protection of aquatic ecosystems.

The aquatic ecosystems values in the zone of influence of the proposal are associated with the perennial billabong, approximately 2.5 km downstream of the proposal and ephemeral water within the unnamed tributary creek. Further downstream of the billabong, an alluvial floodplain feeds into the Margaret River. The billabong is approximately 3.5 km east of the Mary River Groundwater beneficial use declaration.

The billabong is recognised as having a high potential of being an aquatic GDE[7] and therefore may be reliant on groundwater to maintain its ecological integrity and functioning. Similarly, any standing water in the unnamed tributary creek between the proposal area and the mapped GDE is likely to be connected to groundwater influence. The riparian vegetation and woodland located along the unnamed tributary creek and the Margaret River, have been considered as terrestrial GDEs in the NT EPA's assessment of Terrestrial ecosystems (see section 6.6).

The importance and condition of biological values at the aquatic GDE has not been characterised; however, the proponent's EIS has identified that cattle, buffalo and introduced grasses are known to occur along the waterways north of the proposal area.

6.4.2. Investigations and surveys

The proponent conducted the following investigations, surveys and reports as relevant to aquatic ecosystems:

- aquatic and riparian habitat survey of three sites along the Margaret River system and one site located in an ephemeral swamp north of the proposal area, undertaken in May 2017 using AusRivAS methodology. (Low Ecological Pty Ltd 2020; Draft EIS, Appendix 8)
- aquatic baseline characterisation report with focus on Margaret River and its tributaries over the broader mining leases held by the proponent describing; aquatic habitats, fauna and introduced and invasive species. (ERIAS 2020; Draft EIS, Appendix 9)
- aquatic field surveys of seven sites (two in proximity to the proposal area and five on Margaret River, one of which is downstream of the proposal area) conducted from 2 to 4 April 2019 using adapted AusRivAS methodology. (ERIAS 2020; Draft EIS, Appendix 9)
- drone survey (33 ha) surrounding the billabong (1.3 ha), a potential aquatic GDE was conducted in April 2022 (Aquatic Ecology Services (2022); Additional information to Supplement, Appendix 9).

[7] Bureau of Meteorology, 2012. National GDE Atlas.

The NT EPA is of the view that surveys that were undertaken used recognised methods[8] to sample aquatic and riparian habitat; however, the application of survey effort is varied across surveys and sites, and limited in timing, location and number of sites.

Additional investigations and surveys undertaken by the proponent as described for Hydrological processes and Inland environmental water quality also informed the NT EPA's assessment of aquatic GDEs.

6.4.3. Consultation

Matters raised during consultation relating to potentially significant impacts on aquatic ecosystems include:

- inadequate survey effort to inform the environmental impact assessment and baseline condition of the aquatic GDEs
- site selection to characterise aquatic ecosystems requires greater sampling effort across environmental gradients, including the types of stream habitats and across the degree of exposure to impacts from previous mining
- the timing of surveys undertaken for fish, decapod crustaceans and macro invertebrates in April may:
    - be appropriate for most fish species
    - not be adequate to detect many aquatic invertebrate species
    - reveal a fauna characteristic of declining water quality, dominated by air-breathing water beetles and water bugs based on timing of the survey
- the analysis of macroinvertebrate assemblages appears to be limited in sample size and taxonomic level of species identification such that the results of the baseline characterisation appear to underrepresent the aquatic biodiversity of the sampled streams
- further information requirements about the baseline characterisation, condition, assessment and monitoring of the aquatic ecosystem values of the billabong located downstream of the proposal
- recommendation to establish a baseline condition and implement an updated biological monitoring program for waterways that may be subject to overflows/leakages, for the life of the mine until the site has been suitable rehabilitated
- Potential impacts on mapped aquatic GDE[9] :
    - expressed as the billabong
    - from altered water availability due to groundwater drawdown and mounding
    - from contaminants through annual overflows and leakages.

6.4.4. Potentially significant impacts

Aquatic ecosystems values have the potential to be significantly impacted through:

- habitat degradation or loss from:

[8] Australian Rivers Assessment System (AusRivAS) NT, Lloyd and Cook 1998
[9] Bureau of Meteorology, 2012. National GDE Atlas. Bioregional assessment source dataset.

  - altered hydrological regimes, from mine dewatering (causing drawdown) and storage activities (causing mounding) influencing surface and groundwater quantity and flow patterns
  - contaminant transport through surface or groundwater.
- mine rehabilitation not being properly carried out due to unplanned closure, extended periods of care and maintenance, or poor execution.

6.4.5. Avoidance and mitigation of impacts

The proponent proposes the following measures to avoid or minimise impacts on aquatic ecosystems:

- monitor groundwater drawdown at six new groundwater bores to inform groundwater availability and quality to the aquatic GDE
- monitor groundwater mounding at three new bores surrounding the evaporation pond
- implement the Trigger Action Plan (CDM Smith 2021e; Supplement to draft EIS, Appendix 4) based on groundwater monitoring.

6.4.6. Assessment of impacts to environmental values

The NT EPA recognises the proponent's consideration of the environmental management hierarchy to the protection of aquatic ecosystems in the zone of influence of the proposal. The proponent's Trigger Action Plan (TAP) describes the monitoring pathway leading to action to avoid or manage impacts from groundwater drawdown and contamination from mining operation through its improved surface and groundwater monitoring network; however, the TAP does not identify mitigation actions and management responses in the plan.

The NT EPA notes the proponent's initial assessment of GDEs considered two systems, mapped as high potential aquatic GDEs (Margaret River and a pit lake at a legacy mine site), as being outside the zone of influence of the proposal. The NT EPA recognises the perennial billabong, less than 3 km downstream of the proposal boundary in the unnamed creek, is mapped as having a high potential of being an aquatic GDE.

The NT EPA's assessment of GDEs is presented across two factors based on the surface expression of groundwater in an aquatic ecosystem (the billabong) and the subsurface expression of groundwater on a terrestrial ecosystem (riparian vegetation of the unnamed creek).

The proponent conducted various aquatic investigations, including an aquatic baseline characterisation report (ERIAS Group, 2020); however, have not sampled the aquatic GDE and therefore no biological baseline characterisation exists for the GDE. Further limitations are identified in the proponent's report such as the lack of sampling across seasonal and inter annual variability. The DEPWS advised that the additional information to the Supplement provides an adequate physical characterisation of the aquatic GDE.

<u>Habitat degradation or loss from altered hydrological regimes</u>

The DEPWS submission on the additional information to the Supplement indicates that potential impact, based on the proponent's revised model, from predicted groundwater drawdown less than 2 m should not result in adverse impacts on the aquatic GDE nor any pooled water in the unnamed tributary creek. The NT EPA considers that the steep cone of depression maintains drawdown effects that are largely restricted to the pit with limited impact on the aquatic GDE. Potential impacts on the terrestrial GDE are discussed in section 6.6.6.

Habitat degradation or loss from solute/contaminant transport

In contrast, the DEPWS submission provides advice about the aquatic GDE as an important refuge area for aquatic species and identifies the potential for impact on aquatic fauna through groundwater contaminant transport. The proponent's water modelling shows that the predicted pit lake arsenic concentrations could reach 800 µg/L during mining, and the billabong lies within the exceedance probability curve for particle travel through groundwater i.e. there is a 20% chance of solutes reaching the aquatic GDE.

The NT EPA's assessment of Inland water environmental quality identified that the contaminant loads in groundwater are unlikely to be significant at the unnamed tributary creek (moderate potential terrestrial GDE), including the billabong (high potential aquatic GDE) and ephemeral aquatic GDEs and that any impacts are likely to be localised.

The proponent's modelling demonstrates that immediately following mining arsenic levels would decrease to between 400 µg/L and 150 µg/L and therefore be lower than the current arsenic concentrations in the Fountain Head Pit Lake (567 µg/L) and stock water guideline value of 500 µg/L.

The NT EPA recognises that there is potential for impact on aquatic fauna due to the range of arsenic concentration trigger values for aquatic animals (including fish) identified as 250 to 150 µg/L. The proponent proposes to manage solute concentrations at the source, the Fountain Head Pit pre, during and post mining and the evaporation pond, to mitigate impacts on aquatic ecosystems within the unnamed tributary creek, including the mapped aquatic GDE.

The proponent's proposed monitoring and response actions are identified in its Trigger Action Plan of the Groundwater Monitoring Plan. The NT EPA notes that further detail is required about actions to be undertaken should groundwater quality monitoring indicate exceedance of parameters against the 80th percentile. The NT EPA considers that the proponent should address the DEPWS advice and include measures to establish the baseline condition at a minimum to inform subsequent biological monitoring and/or mine closure criteria to ensure the site has been suitable rehabilitated as an important inclusion to the proponent's Trigger Action Plan. This could be regulated as part of the proponent's mine closure and rehabilitation required under the MM Act.

GDE integrity and functioning during mining operation, closure and rehabilitation

The biological monitoring program for waterways that may be subject to overflows/leakages throughout mine operation and closure is important. The NT EPA considers that the inclusion of the biological monitoring program to the proponent's Trigger Action Plan would support aquatic ecosystem protection for the duration of the proposal.

The NT EPA considers that the proponent's improved network of water monitoring sites and management measures outlined in its Groundwater Monitoring and Water Management plans would be sufficient to monitor both water flow and solute transport for the purpose of GDE protection. The NT EPA is satisfied that with the inclusion of appropriate physical, chemical and biological monitoring actions, the proponent's Trigger Action Plan (CDM Smith. 2021e) can be implemented as a Trigger Action Response Plan (TARP) to detect, avoid and manage deleterious changes to groundwater flows and quality and therefore impacts on the aquatic GDE.

6.4.7. Summary of factor assessment and recommended regulation

The NT EPA has considered the potential significant impacts of the proposal on aquatic ecosystems. In doing so, the NT EPA has considered whether conditions are necessary, or whether other statutory decision-making processes exist to ensure the NT EPA's factor objectives are likely to be met. The NT EPA's assessment findings are presented in **Table 5**.

The NT EPA has also taken into account the objects and principles of the EP Act and the EA Act (Appendix 2) in assessing whether the residual impacts will meet its environmental factor objective and whether conditions can be imposed.

Table 5 Summary of assessment for aquatic ecosystems

Residual impact to environmental value	Assessment finding	Recommended conditions and regulation by other statutory decision makers
GDE degradation from altered hydrological regimes	The Mary River groundwater beneficial use declaration for environment is relevant to the proposal and provides for aquatic ecosystems protection. The billabong in the unnamed creek is considered an aquatic GDE and therefore requires ecosystems protection. The NT EPA notes the findings of the proponent's groundwater modelling that indicate the residual risk to the aquatic GDE from groundwater drawdown is low. However, the models have not been sufficiently calibrated or validated with field data to have a high degree of confidence in predictions.	Regulated through recommended conditions: • Develop and implement an approved erosion and sediment control plan • Develop an environmental monitoring program that includes required monitoring with key bores. • Develop and implement a TARP with triggers for corrective actions. • Compliance to the limit value for groundwater drawdown at the confluence of the southern waterway and the unnamed creek. • Update and validate the models to improve confidence in predictions.
GDE degradation from contaminant transport during: • mining operations • closure and • rehabilitation.	The NT EPA notes the findings of the proponent's groundwater modelling that indicate the residual risk to the aquatic GDE from contaminant transport can be managed. However, the models have not been sufficiently calibrated or validated with field data to have a high degree of confidence in predictions. The NT EPA recognises that some uncertainty remains about the interaction between groundwater quality based on dewatering and water storage prior to mining. The NT EPA considers that through implementation of the proponent's proposed groundwater monitoring	Regulated through recommended conditions: • compliance with TARP • Monitoring during mining and post closure to improve confidence in the model predictions. • Remediation of the pit lake if pit water quality or groundwater exceed trigger values. Regulated through existing regulatory processes: *Mining Management Act 2001*:

Residual impact to environmental value	Assessment finding	Recommended conditions and regulation by other statutory decision makers
	program, trigger action response plan (TARP) and recommended physical, chemical and biological monitoring activities, the residual risk to the aquatic GDE from groundwater contamination can be managed.	• Mining authorisation • MMP and MCP.

6.4.8. Conclusion against the NT EPA objective

With implementation of the proponent's commitments, the recommended conditions in Appendix 1 and regulation under the MM Act and the *Water Act 1992*, the NT EPA considers that the proposal could be conducted in such a manner that its objective for aquatic ecosystems can be met.

6.5. Terrestrial environmental quality

6.5.1. Environmental values

The proposal is within a region that has been subject to extensive mining and exploration, and disturbances from historical mining activity is evident within the proposal area. The proposal is surrounded by land, and soils of the McKinley and Rumwaggon land systems comprising open woodland on sandstone plains, open forest on the upland areas of the Margaret River alluvial floodplain, and along creek lines and riparian zones.

On low to steep sandstone hills and ridges, the soils are shallow stony sands/pale sands without B horizons, and firm siliceous sand with pale sands with colour B horizons. The slopes and plains are mainly yellow earth sands with coherent earth subsoils, with gravelly ironstone and red non-calcareous massive earths, yellow neutral massive earths and mottled yellow earth soils.

Soils of the basal hill slopes, valleys and floodplain are hard acidic, and also neutral, yellow mottled soils. On the upper hill slopes, the soils are shallow stony and gravelly loams including pale grey brown and firm shallow siliceous loams and sands such as hard-settling red duplex soils and yellow and yellow grey acid soils.

6.5.2. Investigations and surveys

The following investigations, surveys and reports were used to inform the NT EPA's assessment of the potential impacts on terrestrial environmental quality:

- Fountain Head evaporator emissions study (Minetek 2020; Draft EIS, Appendix 27)
- Fountain Head Gold Project: Flood assessment and surface water management strategy (CDM Smith 2021a; Draft EIS, Appendix 4)
- Fountain Head Gold Project mine closure plan (ERIAS Group, 2021c; Draft EIS, Appendix 18)
- Geochemical characterisation of Fountain Head CIL tailings (Environmental Geochemistry International (EGI) 2021; Draft EIS, Appendix 7)
- Geochemical characterisation of waste rock and ore – Fountain Head (EGI 2020; Draft EIS, Appendix 6)
- Water management plan (ERIAS Group 2022; Additional information to Supplement, Appendix 3).

6.5.3. Consultation

Matters raised during consultation relating to potentially significant impacts on terrestrial environmental quality include:

- potential for fugitive emissions (spray droplets) from evaporators used for dewatering the pit to contaminate soils off site
- potential for soil contamination due to seepage from mine waste (waste rock and tailings) or chemical spills
- infestation of land with a declared weed.

6.5.4. Potential significant impacts

Potentially significant impacts on the quality of surrounding land and soils could occur as a result of:

- soil contamination from chemical spills or leaks
- contamination of soils due to AMD runoff from waste rock and tailings
- fugitive spray drift from the evaporators with high levels of metals including aluminium, cobalt, copper, iron, manganese and particularly arsenic dispersed and drying on soil surfaces
- land degradation due to weed infestation
- incomplete remediation, rehabilitation or restoration activities, and closure requirements under an approved MCP.[10]

The potential for impacts on water quality as a consequence of soil erosion and AMD are addressed in section 6.5.6 of this report.

6.5.5. Avoidance and mitigation of impacts

The proponent's application of the management hierarchies[11] includes measures to avoid and mitigate potential significant impacts on terrestrial environmental quality:

- hydrocarbons, chemicals and hazardous substances (potential sources of contamination) are stored, handled and managed according to NT standards, or Australian standards
- ore is processed in CIP tanks rather than on heap leach pads
- stockpile PAF mine waste within the pit during mining, and dispose of in-pit below groundwater level on completion of mining
- tailings are encapsulated by NAF waste rock and low-permeability floor and embankment foundations, and compacted upstream batters within the IWL
- storm water is managed to contain contaminated water and sediments on site
- continuous monitoring of weather conditions and shutting off evaporators during unfavourable wind conditions

[10] A mining management plan under the *Mining Management Act 2001* that includes a plan and costing of closure activities (Mine Closure Plan).
[11] Environmental decision-making hierarchy and Waste management hierarchy (*Environmental Protection Act 2019* sections 26 and 27).

- monitoring undisturbed soils within 500 m of the evaporators to detect fallout and the need for remediation
- installing appropriately sized sediment control structures to capture surface water runoff from the IWL, processing plant, ROM pad, mining contractor yard and hardstand areas that comply to the best practice erosion and sediment control guidelines (IECA, 2008)
- complete remediation, rehabilitation or restoration activities and closure requirements under an approved mine closure plan that meets the closure criteria[12] for the mining site.

6.5.6. Assessment of impacts to environmental values

The proponent has an opportunity to improve the environmental quality of the site and surrounds by recommencing mining of the brownfield proposal site. There is a risk, however, that continued mining could exacerbate existing issues on site if the landform design is not appropriate and implementation of the proposal is not well executed and managed.

Soil contamination from AMD runoff and spills

A number of existing disturbed areas on the site, as well as proposed mine landforms and mining activities, have the potential to result in contamination of soils and impacts to terrestrial environmental quality. While the proponent has attempted to locate key components of the proposal within already disturbed areas of the site, potentially polluting infrastructure such as the power station, fuel storage, ROM pad and processing area are to be established in undisturbed areas.

The proposal includes a number of catchment areas within the mine site that, during mining, would be managed to divert clean storm water away from dirty areas, and capture potentially contaminated water and sediments from the WRS and other infrastructure within the mine site.

The proponent plans to progressively rehabilitate the site, including the IWL as it is expanded during operations to incorporate much of the existing WRS, to reduce erosion potential in the proposal area. PAF waste rock, which was initially planned to be stored above-ground in a purpose-built storage facility, is to be disposed of in the pit at the end of mining.

The NT EPA considers that the design of the storm water management system is appropriate and likely to minimise the contamination of soil surfaces beyond the mine site.

Contamination of soils from pit dewatering and evaporator spray drift

The proponent does not propose to discharge water from the mining lease. Rather, water is proposed to be evaporated, both passively from an evaporation pond and actively through the use of an evaporator system, within the proposal area.

The intent is to evaporate as much water from the pit as possible during mining using mechanical evaporators with excess water returning to the evaporation pond area. The quality of water in the pit is likely to be poor, with high concentrations of arsenic and other metals in pit water mixed with rainfall runoff from oxidising sulfidic material in the exposed pit walls (discussed in section 6.3.6 of this report).

A key concern was the potential for contaminants dissolved in pit water, particularly arsenic, to become airborne and deposit on the soil surface and vegetation beyond the proposal site.

[12] Closure criteria means the standard or level of performance, as specified in the mine closure plan that demonstrates successful closure of the site.

The proponent modelled the expected evaporation and deposition of particulates from evaporator water droplets. The model predicted that individual droplets would only partially evaporate, with 50% of an average-sized droplet remaining and retaining its dissolved load of contaminants. The unevaporated water is expected to fall out within the evaporation pond area or the pit catchment. While the partial evaporation of droplets would lead to concentration of dissolved particulates, this would be contained within the ponds or the pit void on the proposal site and managed as part of the water management system.

The NT EPA is satisfied that impacts to terrestrial environmental quality beyond the proposal area as a result of evaporator operation are likely to be minimal and can be managed in accordance with the proponent's commitments and NT EPA recommended conditions.

Soil erosion and sedimentation

Proposed activities, including vegetation clearing, mining and heavy vehicle movement have the potential to result in increased soil erosion and sedimentation, in addition, altered surface flows and hydrology due to construction and new infrastructure have the potential to increase erosion in flooding events (section 6.2.6).

The NT EPA is satisfied that through careful design and construction (including progressive rehabilitation), and the proponent's commitment to implementing effective protection, erosion and sediment control measures, the impacts of erosion and sedimentation can be adequately mitigated and managed so risks to the environment is avoided or minimised to an acceptable level.

Rehabilitation and closure

The NT EPA considers that the proponent has the opportunity to improve the environmental quality of the site and surrounds, provided that the environmental decision-making hierarchy is effectively implemented and managed for mining activities throughout operations and closure. The proponent has prepared an MCP which outlines remediation and rehabilitation activities and closure requirements to meet closure criteria for the mining site.

The NT EPA's recommended conditions for erosion and sediment control, monitoring, reporting and implementing corrective actions if trigger levels are exceeded will provide regulatory certainty that the proponent's commitments would be implemented, and greater confidence that the environmental outcomes relating to mine closure will be achieved.

The NT EPA notes the very short mine life of the project, and proponent's commitment to implement progressive implementation of its mine closure plan along with progressive rehabilitation of the IWL and other areas.

To ensure the NT EPA's environmental objectives are met, the mine closure plan must include provisions for unplanned closure, and the rehabilitation effort must include auditing and reporting on progress against closure criteria.

The NT EPA expects that any residual impacts remaining after implementation of the proponent's commitments, and additional measures would not be significant.

6.5.7. Summary of factor assessment and recommended regulation

The NT EPA has considered the potential significant impacts of the proposal on terrestrial environmental quality. In doing so, the NT EPA has considered whether conditions could be imposed to ensure the NT EPA's factor objective is likely to be met in implementing the proposal. The NT EPA assessment findings are presented in **Table 6**.

In assessing whether the residual impacts of the proposal will meet the NT EPA environmental factor and objective, and whether and appropriate regulatory conditions can be imposed, the assessment findings, recommendations, and conditions of approval are presented below in **Table 6**.

Table 6 Summary of assessment for terrestrial environmental quality

Residual impact to environmental value	Assessment finding	Recommended conditions and regulation by other statutory decision makers
Soil contamination and land degradation.	Remediation and rehabilitation of contaminated areas will be according to the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (ASC NEPM 1999) and the National Remediation Framework (NRF) (CRC CARE 2018).	Regulated through recommended conditions: • Sites that are contaminated will require remediation to be conducted under the ASC NEPM/NRF framework. • Implementation of approved ESCP.
Soil erosion and sedimentation.	The proponent would be required to prepare and implement an erosion and sediment control plan consistent with IECA (2008).	Regulated through recommended condition: • Erosion and sediment control through an approved erosion and sediment control plan.
Remediation, rehabilitation or restoration activities, and closure requirements	The proponent would be required to prepare a MCP consistent with contemporary best practice guidance to manage closure and rehabilitation (including unplanned closure and progressive rehabilitation) to meet the mining regulator's requirements under the MM Act. This would support achievement of the NT EPA's objective for terrestrial environmental quality.	Regulated through recommended condition: • Rehabilitation and closure Regulated by existing regulatory processes: *Mining Management Act 2001*: • Mining authorisation, MMP and MCP.

6.5.8. Conclusion against the NT EPA objective

With the implementation of the proponent's proposed management measures, commitments, recommendations, and conditions for avoidance, monitoring, and mitigation of impacts identified in the draft Environmental Approval (Appendix 1), the NT EPA considers that the proposal can be

conducted in such a manner that its objective for terrestrial environmental quality is likely to be met.

6.6. Terrestrial ecosystems

6.6.1. Environmental values

The terrestrial ecosystem values of the Pine Creek bioregion[13] associated with the proposal area include the native vegetation and habitats of open forest and woodland on the alluvial floodplain, open woodland on sandstone plains, creek lines and riparians zones[14], as well as threatened plant and animal species. The pit lakes, tailings dams and modified areas may also support terrestrial ecosystem values.

The proponent identified vegetation within and surrounding the proposal area associated with open forest on alluvial floodplains, open woodland on sandstone plains, creek lines and riparian zones as well as disturbed areas containing weeds. The vegetation is well represented and not considered to be rare or threatened at a regional scale; however, the riparian vegetation and woodland habitat located along the unnamed tributary creek to the north of the proposal area and the Margaret River to the northeast are mapped as moderate terrestrial GDEs potential on the Bureau of Meteorology GDE Atlas[15].

The proponent has identified the dominant species associated with the GDEs as the paperbarks, *Melaleuca leucadendra* and *Melaleuca viridiflora*. The proponent describes the subterranean expression of vegetation as comprising shallow and deep-rooted dominant trees, a midstorey of shallow rooted trees and understorey of native and introduced grasses. Disturbance impacts from livestock and feral animals along the unnamed creek and alluvial floodplain are evident.

The proponent's desktop analysis identified two threatened flora species (listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)), the herb *Stylidium ensatum* and shrub, *Acacia praetermissa*, as potentially occurring within the proposal area. However, appropriately designed field surveys identified that these species are not present in the disturbance footprint.

The Merten's water monitor, *Varanus mertensi*, listed as vulnerable under the *Territory Park and Wildlife Conservation Act* (TPWC Act) was the only threatened fauna species of concern in the proposal area.

6.6.2. Investigations and surveys

General and targeted flora and fauna investigations and surveys were undertaken by the proponent in and around the disturbance footprint. These are:

- flora and fauna field surveys conducted from 15 to 18 May 2017 and 20 to 24 August 2019. (Low Ecological Pty Ltd 2020; Draft EIS, Appendix 8)
- flora and fauna report over the broader mining leases held by PNX describing; threatened species and habitats (including aquatic and riparian habitats) and invasive weed and pest species within the proposal area. (Low Ecological Pty Ltd 2020; Draft EIS, Appendix 8)
- desktop assessment and field survey of modelled potential habitat for *Acacia praetermissa* and *Stylidium ensatum* in disturbance areas proposed for mining activity. The field survey

[13] Under the Interim Biogeographic Regionalisation for Australia (IBRA): Pine Creek Bioregion
[14] Wetlands and riparian vegetation as defined in the NT Planning Scheme Land Clearing Guidelines (DEPWS 2021).
[15] Bureau of Meteorology, 2012. National Groundwater Dependent Ecosystems (GDE) Atlas.

was conducted over the 13 and 14 October 2021 (Supplement to the Draft EIS, section 5.2.5)

Two investigations were undertaken to describe the potential terrestrial GDE downstream of the proposal. These are:

- groundwater dependant ecosystem conceptualisation (CDM Smith 2022c, Additional information to Supplement, Appendix A in Appendix 6)
- drone survey of the unnamed creek (4.2 km), a potential terrestrial groundwater dependant ecosystem, was conducted in April 2022 (Aquatic Ecology Services 2022; Additional information to Supplement, Appendix 9).

The proponent's surveys were undertaken in accordance with standards set out in the NT EPA Guidelines for Assessment of Impacts on Terrestrial Biodiversity. Methods for specialist surveys (camera trapping and drone survey) are described in relevant appendices.

Additional investigations and surveys undertaken by the proponent as described for Hydrological processes and Inland environmental water quality also informed the NT EPA's assessment of terrestrial GDEs.

6.6.3. Consultation

Matters raised during consultation relating to potentially significant impacts on terrestrial ecosystems include:

- low risk to threatened species and biodiversity given the limited habitat availability due to the landscape modification and disturbance of the legacy mine site
- recognising the value of targeted field survey for two threatened flora species
- further information requirements about the baseline characterisation, condition and monitoring of the biodiversity values of riparian vegetation and wetland habitats located adjacent and downstream of the proposal, recognising these as significant and sensitive vegetation[16] known to support important biodiversity values
- potential impacts on mapped terrestrial GDEs[17] :
    - from altered water availability due to groundwater drawdown and mounding
    - from contaminants through annual overflows and leakages
    - from uncertainty about predicted drawdown, given the location of the evaporation pond between the pit and the ephemeral creek.
- presence of gamba grass *(Andropogon gayanus)* and likely presence of mission grasses *(Cenchrus polystachios*, *Cenchrus pedicellatus)* as listed components of the Key Threatening Process 'Invasion of northern Australia by Gamba Grass and other introduced grasses' under the EPBC Act
- high biomass of weeds contributing to the increased management measures required to control bushfire and weeds
- lack of an adequate strategy to manage grassy weeds, particularly the existing levels of gamba grass, during construction operation and closure.

[16] NT Land Clearing Guidelines
[17] Bureau of Meteorology, 2012. National Groundwater Dependent Ecosystems (GDE) Atlas.

6.6.4. Potentially significant impacts

Terrestrial ecosystem values have the potential to be significantly impacted through:

- direct loss or reduction of habitat value from vegetation clearing and mining activity
- causing a decrease in the population of threatened species, in particular, *Stylidium ensatum* and *Acacia praetermissa*
- habitat degradation, fragmentation or loss from the introduction or spread of weeds and the associated increase in bushfire risk
- habitat degradation or loss from:
    - altered hydrological regimes, from mine dewatering and storage activities causing changes to surface water and groundwater quantity and flow patterns
    - contaminant transport through surface or groundwater
- mine rehabilitation not being properly carried out due to unplanned closure, extended periods of care and maintenance, or poor execution.

6.6.5. Avoidance and mitigation of impacts

The proponent proposes the following measures to avoid or minimise impacts on terrestrial ecosystems:

- site selection of proposal components on previously disturbed land where possible would minimise the amount of land clearing of native vegetation required
- targeted field surveys confirmed that threatened flora is not present in areas proposed for land clearing
- land clearing for proposal components will remove areas of known weed incursions, implementation of the weed management plan that includes weed hygiene procedures for vehicles and equipment would prevent the movement, introduction and spread of weeds
- implement a pest management plan to manage introduced fauna
- monitor potential groundwater drawdown impacts on groundwater dependent ecosystems including woodland areas and riparian vegetation based on groundwater level measurements in the vicinity of the unnamed creek, and implement the trigger action plan
- progressive rehabilitation on exposed areas and the IWL and establish native vegetation and habitat in accordance with an approved MCP.

6.6.6. Assessment of impacts to environmental values

The NT EPA recognises that a significant proportion of proposal area has been previously disturbed due to historical mining activity, and that the further disturbance proposed within those areas will likely have an environmental impact due to land clearing, spread of weeds, groundwater drawdown and recovery, and changes to water quality.

The NT EPA's assessment of Inland water environmental quality identifies that the contaminant loads in groundwater are unlikely to be significant at the unnamed tributary creek, and that any impacts on the terrestrial GDE are likely to be localised. Therefore, impacts resulting from groundwater solute transport on groundwater dependent terrestrial ecosystems will be managed by requiring groundwater monitoring and active remediation if the trigger value is exceeded.

Loss of habitat and threatened species from land clearing and mining activity

The proponent conducted appropriate flora and fauna investigations and surveys to conclude that the risk to threatened species and on-site biodiversity is low, given the limited habitat availability due to landscape modification and disturbance of the legacy mine site.

Approximately 40 ha of native vegetation is proposed to be cleared for the crushing pad, processing plant and contractor infrastructure (**Table 1** and **Figure 2**). The proponent has identified approximately 35 ha of land clearing of 'undisturbed land' for the IWL; however, the NT EPA notes that much of the land clearing for the IWL is over the rehabilitated WRD from previous mining.

The proponent has committed to clearing and progressively rehabilitating exposed areas in line with an appropriate Weed Management Plan, Bushfire Management Plan and an approved Mine Closure Plan with the final land use defined as native vegetation.

Advice from the DEPWS in its submission on the draft EIS confirms that the risk to threatened species from the proposal is low. However, the DEPWS submission on the draft EIS identified that additional measures were required to address past, present and future management of weeds on site, particularly existing dense gamba grass. Habitat loss due to increased fuel load problems associated with the existing dense gamba grass are to be addressed by the proponent's integrated Weed Management and Bushfire Management plans.

DEPWS advice on the Supplement to the draft EIS identified that the proponent has addressed the recommendations and comments with regard to weed management in the Supplement. DEPWS also identified additional information requirements about biodiversity values of riparian vegetation and wetland habitats located adjacent and downstream of the proposal area were necessary.

The NT EPA considers that the proposal is unlikely to have a significant impact on threatened flora and fauna based on appropriate survey of the site and due to the modified condition of the site. The NT EPA's assessment of biodiversity values supported by sensitive and significant vegetation (riparian vegetation) is considered in the context of terrestrial GDEs below.

GDE habitat degradation or loss from mine dewatering and water storage

The NT EPA assessed changes to hydrological processes in section 6.2 and impacts on aquatic GDEs in section 6.4. The information below focuses on the proposal's potential impacts on downstream riparian and potentially groundwater dependent vegetation.

The riparian vegetation and woodland areas along the unnamed tributary creek downstream of the proposal area and the Margaret River are recognised as terrestrial GDEs with a moderate likelihood of being reliant on groundwater[18]. Table 4.25 of the draft EIS lists the land classification and primary vegetation recorded comprising key vegetation species (onsite) that may be potentially reliant to some degree on groundwater, these are:

- Open forest on alluvial floodplain (43.85 ha in proposal area)
- Creek lines and riparian zones (15 ha in project area).

The proponent's GDE conceptualisation identifies that vegetation dependant on groundwater is commonly associated with riparian zones and floodplains of ephemeral creeks such as the proposal area. Plants may use groundwater from either shallow soil moisture supply or the deeper water table through dimorphic root structures (shallow and deep roots).

[18] Bureau of Meteorology, 2012. National Groundwater Dependent Ecosystems (GDE) Atlas

The proponent recognises that a minor component of the trees' environmental water requirements may be derived from groundwater[19]. The NT EPA considers that while vegetation is generally well adapted and resilient to periods of limited water availability, additional drawdown of groundwater may exacerbate dry periods and affect vegetation reliant on groundwater.

The proponent's additional information to the Supplement (drone survey of the unnamed creek and GDE conceptualisation) provides information about the terrestrial GDE that demonstrates uncertainty about the relationship and reliance of riparian and woodland vegetation on groundwater. The proponent identified the primary driver of vegetation condition as seasonal rainfall; though it noted that the lack of surface water flow does not discount the presence of groundwater base flows.

Surface water present during the wet season is thought to recharge the water table during the dry season. Further, the proponent's groundwater monitoring plan[20] conceptualises that direct groundwater discharge is expected along ephemeral creek lines when groundwater heads are higher than bed height of the ephemeral creeks. The proponent's groundwater model[21] indicates that drawdown effects may intersect with the unnamed creek with the zone of influence extending towards Margaret River. It is therefore possible that the riparian vegetation and the biodiversity values it supports may be impacted by the proposal.

The proponent concluded that the potential terrestrial GDE classification of the unnamed creek is low based on the riparian vegetation observed during the drone survey. The NT EPA recognises that the unnamed creek is mapped as a moderate potential terrestrial GDE. Advice from DEPWS, based on the additional information to the Supplement, is that the predicted groundwater drawdown identified by the proponent of less than 1 m at the confluence of the southern waterway and the unnamed creek should not result in adverse impacts on the terrestrial GDE.

Uncertainty remains about the duration and extent of the potential impacts from groundwater drawdown on the terrestrial GDE due to the lack of evidence surrounding the groundwater dependency of the vegetation in and surrounding the unnamed creek. The NT EPA understands that isotope studies could be used to confirm whether the subsurface water accessed by the terrestrial vegetation is surface or groundwater in origin.

The proponent has identified physical baseline monitoring of groundwater levels in the vicinity of the unnamed creek to update hydrogeological conceptualisation in its Water Management Plan.

The NT EPA considers that the proponent's improved network of water monitoring sites and management measures outlined in its groundwater monitoring and water management plans would be sufficient to monitor both water flow and solute transport for the purpose of GDE protection.

Further, the NT EPA considers that the proponent's trigger action plan with the inclusion of appropriate action and responses could detect deleterious changes to water flows and quality and enact corrective action to avoid or minimise impact on any terrestrial GDEs.

6.6.7. Summary of factor assessment and recommended regulation

The NT EPA has considered the potential significant impacts of the proposal on terrestrial ecosystems. In doing so, the NT EPA has considered whether conditions are necessary to ensure

[19] Fountain Head Gold Project – Supplement to the EIS Addendum – response to request for information (ERIAS 2022)
[20] Fountain Head Gold Project – Response to the draft EIS and groundwater monitoring plan, Supplement to the draft EIS, Appendix 4 (ERIAS 2021)
[21] Fountain Head Gold Project – Groundwater model update for Supplementary EIS response, Appendix 6 (CDM Smith 2022)

the NT EPA's factor objectives are likely to be met. The NT EPA's assessment findings are presented in **Table 7**.

The NT EPA has also taken into account the objects and principles of the EP Act and the EA Act (Appendix 2) in assessing whether the residual impacts will meet its environmental factor objective and whether conditions can be imposed.

Table 7 Summary of assessment for terrestrial ecosystems

Residual impact to environmental value	Assessment finding	Recommended conditions and regulation by other statutory decision makers
Loss of habitat and threatened species from land clearing and mining activity.	Potential impacts from land clearing are largely avoided due to the location of clearing on modified and previously disturbed land, ESCP measures and the low likelihood of threatened species present onsite. Further potential impacts arising from the introduction and spread of weeds from land clearing and mining activity can be addressed by the proponent's weed management measures. Proposal activities conducted in accordance with proposed commitments and recommended conditions are not likely to result in significant impacts so the environmental outcome is likely to meet the NT EPA's objective for Terrestrial ecosystems.	Regulated through recommended conditions: • ESCP • Environmental Performance Report. Regulated by existing regulatory processes: • obligations under the *Weed Management Act 2001*.
Habitat degradation or loss from mine dewatering and water storage.	The Groundwater Monitoring Plan contains measures to monitor and manage the impact of proposal activities on surface and groundwater, and potential GDEs. Residual impact can be regulated through conditions so the environmental outcome is likely to meet the NT EPA's objective for Terrestrial ecosystems.	Regulated through recommended conditions: • See GDE condition. • Requirement for monitoring and to implement an approved TARP.
Rehabilitation and closure.	The proponent would be required to prepare a MCP consistent with contemporary best practice guidance to manage closure and rehabilitation (including unplanned closure and progressive rehabilitation) to meet the mining regulators requirements under the MM Act.	Regulated through recommended condition: • Rehabilitation and closure. Regulated by existing regulatory processes: *Mining Management Act 2001*: • MMP and MCP.

Residual impact to environmental value	Assessment finding	Recommended conditions and regulation by other statutory decision makers
	This would support achievement of the NT EPA's objective for Terrestrial ecosystems.	

6.6.8. Conclusion against the NT EPA objective

With the implementation of the proponent's proposed management measures, commitments, recommendations, and conditions for avoidance, monitoring, and mitigation of impacts identified in the draft environmental approval (Appendix 1), the NT EPA considers that the proposal can be conducted in such a manner that its objective for terrestrial ecosystems is likely to be met.

6.7. Social, economic and cultural surroundings

6.7.1. Environmental values

Community and economy

The proposal is located in a relatively remote rural area where the land uses have historically been cattle grazing, mining and mineral exploration. The area surrounding the proposal contains a number of historic mines, some of which may recommence operations (including Cosmo Gold Mine, Union Reefs, and Woolwonga).

The proposal is located approximately 13 km from Hayes Creek (a former hotel/tavern/fuel station complex), 50km northeast of Pine Creek, and 50 km south of Adelaide River. The nearest residential locations are the historic Grove Hill Hotel and residence approximately 5.5 km east of the proposal area, and the Ban Ban Springs homestead, approximately 9 km to the north. Tourism operators including Emerald Springs Roadhouse, Journey Beyond Rail Expeditions (operators of the Ghan), Lazy Lizard Caravan Park, Pine Creek Railway Resort, would potentially be impacted by the proposal.

Culture and heritage

There are two recorded sacred sites under the *Northern Territory Aboriginal Sacred Sites Act 1989*, located approximately 550 m and 1300 m north of the proposal area. The billabong (and a small waterhole) that occurs approximately 2.5 km downstream of the Fountain Head Pit is sacred site 5271-7; and sacred site 5271-8 includes dark rock outcrops. The proponent holds an AAPA Authority Certificate to avoid these sacred sites. Termite mounds greater than three metres tall are also considered culturally significant and occur in the proposal footprint.

6.7.2. Investigations and surveys

The following investigations, surveys and reports were used to inform the NT EPA's assessment of the potential impacts on community and economy and culture and heritage:

- Archaeological assessment of PNX Metals' Fountain Head Gold Project (Martin-Stone 2020) (Draft EIS Appendix 10)
- Archaeological survey for the proposed Fountain Head open cut east Burnside Project, NT (Crassweller, 2006)
- Fountain Head Gold Project: socio-economic impact assessment (ERIAS 2021b) (Draft EIS Appendix 11)

- Fountain Head Gold Mine, Northern Territory: blasting impact on railway line & gas pipeline. Terrock Consulting Engineers (Unknown) (Supplement to the draft EIS Appendix 9)
- Fountain Head Gold Project: Stakeholder Engagement Plan (PNX 2021) (Draft EIS Appendix 21).

In addition, the proponent's investigations and surveys on hydrological processes described in section 6.2.2 inform consideration of potential impacts on community and cultural values.

6.7.3. Consultation

Matters raised during consultation relating to potentially significant impacts on community and economy, and culture and heritage include:

- potential for impacts to the community including tourism operators, resulting from flyrock, air blast ('blast noise') and ground vibrations associated with blasting, and noise and vibration from evaporators
- the potential requirements for traffic management due to increased traffic near the level crossing along Ban Ban Spring Road
- potential for biophysical impact on sacred site 5271-7, directly downstream from the proposal.

6.7.4. Potentially significant impacts

Potential impacts to the community resulting from flyrock, air blast and ground vibrations associated with blasting (approximately 65 blasts per year), and noise and vibration from evaporator, have been addressed in the blast impact report (Terrock consulting engineers, Unknown) and the Supplement (Section 5.2.16.2) respectively. In all cases, the impacts at the nearest receptors (Grove Hill Hotel and residence, and the Ban Ban Springs homestead) are below the relevant flyrock clearance zones, permitted levels, or acceptable environmental limits and no significant impacts are predicted.

Culture and heritage and associated values have the potential to be impacted through biophysical impact on sacred site 5271-7 directly downstream of the proposal, caused by changes to water quality or hydrological processes.

6.7.5. Avoidance and mitigation of impacts

The proponent will comply with the requirements of the Authority Certificate issued by AAPA for the proposal. In addition, surface water monitoring described in the water management plan has been designed to assess the effectiveness of the surface water management measures, including their effectiveness for protecting the downstream sacred site. The plan includes triggers for contingency actions.

Surface water quality will be monitored in onsite sediment dams, the evaporation pond, Fountain Head Lake, the flooded Fountain Head Pit void and two sites immediately downstream of the mine (and upstream of the sacred site) to understand the potential risk to downstream surface waters from proposal activities. Contingency actions will be undertaken if required. The proponent has committed to, where possible, avoiding disturbance to termite mounds over three metres.

6.7.6. Assessment of impacts to environmental values

The NT EPA considers that the proposal is unlikely to cause significant impacts to the community or economy.

The NT EPA considers that if the proposal is implemented in accordance with the AAPA certificate for the proposal, the construction, operation, closure and post-closure of the proposal will not have a significant impact on Aboriginal cultural values.

6.7.7. Summary of factor assessment and recommended regulation

The NT EPA has considered the potential significant impacts of the proposal on its factors, Community and economy and Culture and heritage (previously considered as Social, economic and cultural surrounds). In doing so, the NT EPA has considered whether conditions could be imposed to ensure the NT EPA's factor objectives are likely to be met in implementing the proposal. The NT EPA assessment findings are presented in **Table 8**.

Table 8 Summary of assessment for culture and heritage

Residual impact to environmental value	Assessment finding	Recommended conditions and regulation by other statutory decision makers
Impacts to sacred site 5271-7 resulting from changes to water quality or hydrological processes.	The risk of impacts to sacred site 5271-7 can be effectively mitigated by ensuring that surface water is managed according to the approved water management plan and compliance with the AAPA Authority Certificate issued to the proponent for the proposal. The residual impacts are not significant and the environmental outcome is likely to meet the NT EPA's objective for culture and heritage.	Regulated through recommended conditions: • GDEs Regulated by existing regulatory processes: • Authority Certificate granted under the *Northern Territory Aboriginal Sacred Sites Act 1989*.

6.7.8. Conclusion against the NT EPA objective

With the implementation of the proponent's proposed management measures, commitments, recommendations, and conditions for avoidance, monitoring, and mitigation of impacts identified in the draft environmental approval (Appendix 1), the NT EPA considers that the proposal can be conducted in such a manner that its objectives for Community and economy and Culture and heritage are likely to be met.

7. Whole of environment considerations

The NT EPA has considered connections and interactions between the key environmental factors together with other environmental factors (including community and economy, and culture and heritage) in its consideration of impacts to the whole of environment.

When the separate environmental factors of the proposal were considered together in a whole of environment assessment, the NT EPA formed the view that the impacts from the proposal would not alter its views about whether the proposal could meet its factor objectives.

The NT EPA considered the potential significant impacts of the proposal on terrestrial ecosystems including the loss of habitat and threatened species from land clearing and mining activity, habitat degradation or loss from mine dewatering (drawdown effects), and residual impacts from rehabilitation and closure.

The NT EPA considers that an environmental performance report is required from the proponent at the mine closure phase, given the interconnected environmental values in the area likely to be affected by the proposal, to validate the proponent's modelled predictions of groundwater mounding, drawdown and recovery of the groundwater table post mining, and water quality of the post closure Fountain Head Pit.

The NT EPA has recommended a condition to this effect. The purpose of the environmental performance reporting is to provide the proponent and the Minister with a current evaluation of the performance of the proposal with respect to actual impacts on environmental values over the life of the project compared to those predicted during the environmental impact assessment process.

The proponent has conducted an air quality and greenhouse gas assessment for the Fountain Head Gold Project to address emissions to the environment which are considered low to negligible. The NT EPA acknowledges that the use of alternate sources of energy was considered by the proponent, to be achievable, and that the use of renewable sources (e.g. solar) is not practical due to the short duration of the action. The NT EPA also notes that due to the short duration of the action, the effects of a changing climate on the proposal will likely have a diminished effect.

The NT EPA is satisfied that the potential impacts of the proposal on the whole of environment, with consideration of the intrinsic interactions between environmental factors, would not lead to any significant impacts and that the NT EPA's environmental objectives can be met.

8. Conclusion and recommendation

The NT EPA has considered the proposal by PNX Metals Limited to develop the Fountain Head Gold Project. The NT EPA's assessment of the proposal identified potentially significant environmental impacts associated with the environmental factors hydrological processes, inland water environmental quality, aquatic ecosystems, terrestrial environmental quality, terrestrial ecosystems, culture and heritage and community and economy.

The NT EPA considers that the proposal can be implemented and managed in a manner that is environmentally acceptable and therefore recommends that environmental approval be granted subject to implementation of the proponent's commitments to avoid, minimise, manage and monitor environmental impacts and the conditions recommended in Appendix 1.

9. References

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Appendix 1 – Draft Environmental Approval

Draft Environmental Approval

PURSUANT TO SECTION *69* OF THE *ENVIRONMENT PROTECTION ACT 2019*

Approval number	EPA2022/021-001
Approval holder	PNX Metals Limited
Australian business number (ABN)	67 127 446 271
Registered business address	Level 1, 135 Fullarton Road, Rose Park, South Australia, 5067

Action: Fountain Head Gold Project

Recommence gold mining at the Fountain Head Pit. Ore is proposed to be mined using traditional drilling and blasting and truck and shovel techniques, and gold extracted using a carbon-in-pulp (CIP) process. Tailings would be co-disposed with waste rock and any potentially acid forming (PAF) waste rock would be backfilled into the pit. The life of mine is approximately 4 years and 5 months.

The action includes:

- dewatering of existing open pit through ongoing natural and forced evaporation during the mining phase
- expansion of existing open pit and mining to a pit depth of approximately 160 m
- construction of crushing facilities and gold processing plant
- construction of supporting infrastructure including workshops, power station, roads, and offices
- construction and progressive rehabilitation of the integrated waste landform (IWL).

Post closure, the Fountain Head Pit is expected to form a pit lake, with material placed at the base of the pit.

Table 1 Description and indicative metrics for action elements provided in the EIS

Action element	Description
Waste characterisation	a) Non Acid Forming (NAF) – total sulfur content ≤0.2% b) Potential Acid Forming-Low Capacity (PAF-LC) - total sulfur content >0.2% to ≤0.4% c) PAF – total sulfur content >0.4%
Waste rock volumes	a) 12.6 Million tonnes (Mt) NAF b) 0.6 Mt PAF-LC c) 0.15 Mt PAF
Waste rock storage and disposal	a) PAF-LC – permanent storage and containment in the IWL b) PAF - temporary storage and containment at in-pit designated areas
IWL metrics	a) maximum crest height 50 m b) total capacity 20.8 Mt c) tailings volume 2.7 Mt

Draft Environmental Approval

Advisory notes

i. Approval is granted under section 69 of the *Environment Protection Act 2019* for the action to be undertaken in the manner described, including with implementation of the environmental management measures, commitments and safeguards documented in the Environmental Impact Statement (EIS) (including the Supplement to the Draft EIS). If there is an inconsistency between the EIS and this environmental approval, the requirements of this environmental approval prevail.

ii. This approval does not authorise the approval holder to undertake an activity that would otherwise be an offence under the *Water Act 1992*.

iii. Submission of all notices, reports, documents or other correspondence required as a condition of this approval must be provided in electronic form by emailing environmentalregulation@nt.gov.au

Address of action	NT Portion 695, Burrundie, NT Ban Ban Springs pastoral lease 1111
NT EPA Assessment Report number	97
Decision maker	NOT FOR SIGNING Hon Lauren Jane Moss MLA, Minister for Environment, Climate Change and Water Security
Date of approval	

Environmental approval conditions

1 Limitations and extent of action

1-1 When implementing the action, the approval holder must ensure the action does not exceed the following limitations and extent:

Action element	Figure	Limitation or maximum extent
Land clearing	Figure 1	No more than 96 ha in total to be cleared within the **approved extent**
End of mine life PAF storage	N/A	In-pit PAF placement is at least 130 m below ground level
Groundwater drawdown	Figure 1	<1.0 m drawdown at the confluence of the southern waterway and Unnamed Creek (to the north of Mineral Lease) is the **limit value**

2 Action rehabilitation and closure

2-1 The action must be progressively rehabilitated and closed in such a manner that the approval holder can demonstrate that it:

(1) is physically safe to humans and animals;

(2) is geo-technically stable;

(3) is non-polluting, non-contaminating;

(4) supports productive, self-sustaining, resilient ecosystems;

(5) achieves improvement to the local biophysical environment; and

(6) does not cause material environmental harm or significant environmental harm.

3 Mine closure plan (MCP)

3-1 The approval holder must prepare a mine closure plan before **substantial disturbance** that:

(1) achieves the outcomes in condition 2;

(2) is consistent with contemporary best practice guidance on mine closure and transition to the agreed post-mining land use;

(3) includes remediation of the Fountain Head Pit, IWL, and evaporation pond (including removal of contaminated material in the base and walls):

(a) required by condition 2-1

(b) required by condition 4-2(2)

(c) to achieve an end use of stored water suitable for stock consumption.

3-2 The approval holder must provide the Minister a copy of any MCP approved by the **responsible Minister** (that may supersede the version required by condition 3-1), within 10 business days of the date of the mine closure plan being approved.

4 Terrestrial environmental quality

4-1 The approval holder must implement, remediate and complete the action to meet the following environmental objectives and outcomes:

(1) Protect the quality and integrity of land and soils so environmental values of the **Adelaide River Catchment** are supported and maintained.

4-2 To support the achievement of condition 4-1(1):

(1) at the end of mining, the approval holder is required to assess the **approved extent** of the action for contamination in accordance with the National Environment Protection (Assessment of Site Contamination) Measure (as amended);

(2) if the environment is contaminated above the baseline contamination assessment conducted prior to **substantial disturbance**, it must be remediated in accordance with the CRC CARE National Remediation Framework prior to closure of the action;

(3) at all times contamination of land and soils must be avoided or minimised by shutting off the evaporators during **unfavourable wind conditions**, as determined by automated continuous weather monitoring and annual monitoring of soils for contaminants of concern including but not limited to salinity and arsenic.

5 Inland water environmental quality and hydrological processes

5-1 The approval holder must implement and complete the action to meet the following environmental objectives and outcome:

(1) protect the quality of groundwater and surface water so that environmental values including ecological health, land uses, and cultural values are maintained; and

(2) **passive discharge** of any mine-affected water from the action must not cause groundwater and surface water quality to exceed the guideline values (**ANZG**), beyond the **approved extent**.

5-2 To support the achievement of condition 5-1(1) the evaporation pond must be:

(1) constructed and operated with a wall crest height, spillway level and freeboard in accordance with **ANCOLD** guidelines;

(2) lined before dewatering of the pit commences with compacted clay material to achieve a saturated hydraulic conductivity of less than 1×10^{-8} m/s over a minimum thickness of 0.5 m;

(3) operated in accordance with the proponent's **trigger action response plan** including management responses to exceedances in operational groundwater level and quality triggers in relation to dewatering; and

(4) remediated and rehabilitated at end of mining in accordance with the MCP required by condition 3-1 and the requirements of condition 4-2.

5-3 To support the achievement of condition 5-1(1) the PAF waste within the **Fountain Head Pit** containing >0.4% total sulfur must be:

(1) differentiated and segregated from low capacity PAF and NAF waste;

(2) temporarily stored and isolated in 1 of 3 separate storage areas within the pit perimeter during the mining phase; and

(3) permanently stored at the base of the pit under a water cover at the end of mining and completion of rehabilitation.

5-4 To support the achievement of condition 5-1(2):

(1) the guideline values for surface water quality are the **ANZG** freshwater default guideline values for slightly to moderately disturbed systems 95% species protection level;

(2) the guideline values for groundwater quality are the **ANZG** freshwater default guideline values 80% species protection level; and

(3) where natural background levels exceed **ANZG** freshwater default guideline values, or default guideline values have not been set by **ANZG**, site-specific guideline values must be derived in accordance with **ANZG**.

5-5 The site-specific guideline values required by condition 5-4(3) must be:

(1) derived prior to any substantial ground disturbance , from the collected baseline water quality dataset; and

(2) derived for the physical and chemical indicators appropriate to the mineralogical properties of mined material and the range of declared beneficial uses, in accordance with **ANZG**.

6 Integrated waste landform (IWL)

6-1 The IWL must be designed and constructed to:

(1) limit seepage in the area of tailings with the use of liner materials to achieve a saturated hydraulic conductivity of less than 1×10^{-8} m/s over a minimum thickness of 1.0 m; and

(2) include an underdrainage system within the IWL to collect and manage seepage and leachate.

7 Quality assurance / quality control for waste rock characterisation

7-1 The approval holder must conduct an audit of quality assurance / quality control procedures and waste rock identification and handling performance 12 months after **substantial disturbance**, and at 12 monthly intervals thereafter, for the **life of the action**.

7-2 The findings of 7-1(1) must be submitted to the **Minister** within three months of conducting the audit.

7-3 The audits and reporting required must be undertaken by an **independent qualified person**.

8 Erosion and sediment control

8-1 The approval holder must submit to the Minister an Erosion and Sediment Control Plan (ESCP) prior to commencement of **substantial disturbance** that is:

(1) developed by a Certified Professional in Erosion and Sediment Control (CPESC), in accordance with International Erosion Control Association Australasia (IECA) 2008, *Best Practice Erosion and Sediment Control*;

(2) implemented for the **life of the action**; and

(3) revised by a CPESC prior to 30 September in any calendar year during the **life of the action**, and in the event that site conditions change significantly from those considered within the ESCP.

8-2 All erosion and sediment control measures, including drainage control measures, must be maintained in proper working order at all times during their operational life.

8-3 The approval holder must report on its compliance with the ESCP and conditions 8-1 and **8-2.** Each report must:

(1) be prepared by a CPESC;

(2) cover a reporting period from 1 October to 30 April in any calendar year during the **life of the action**; and

(3) be submitted to the **Minister** by 31 May in any calendar year during the **life of the action** unless otherwise directed by the **Minister** in writing.

9 Groundwater dependent ecosystems

9-1 The approval holder must implement, remediate and complete the action to meet the following environmental objective:

(1) Protect **groundwater dependent ecosystems** to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

9-2 To support the achievement of condition 9-1(1) the approval holder must:

(1) develop and implement an environmental monitoring program that includes measures for monitoring of the potential impacts of the action on **groundwater dependent ecosystems** that are within the zone of influence of groundwater drawdown and recovery.

9-3 The approval holder must conduct dewatering of the pit according to a **trigger action response plan (TARP)** that:

(1) is reviewed by an **independent qualified person** to ensure it is consistent with achievement of the environmental objectives and outcomes required by condition 9-1(1);

(2) is submitted, with the review and a statement addressing how the reviewer's findings have been addressed, to the **Minister** at least three months before **substantial disturbance**;

(3) is implemented for the **life of the action**;

(4) specifies quantitative **limit values** to demonstrate compliance with condition 9-1(1);

(5) includes quantitative **trigger values** to initiate contingency and/or management actions to ensure achievement of the environmental objective in condition 9-1(1);

(6) includes contingency and/or management actions for exceedances of **trigger values** and **limit values**; and

(7) identifies requirements for notifying the **Minister** on any exceedance of **trigger values** or **limit values**, including:

(a) date, time and cause of any exceedance;

(b) any contingency and/or management actions implemented;

(c) the outcomes of investigative, contingency and/or management actions, stop work or recommencement actions; and

(d) a timeframe within which the **Minister** would be notified.

9-4 To support the achievement of condition 9-2(1) the approval holder must:

(1) prior to commencement of dewatering of the pit, expand the groundwater monitoring network with **key bores** to monitor seepage, water level and quality of groundwater.

(2) prior to **substantial disturbance**, prepare a baseline **groundwater dependent ecosystem** characterisation report that includes at a minimum:

(a) seasonal **baseline data** for surface water flows and quality in waterways and/or waterbodies that could be affected by the action;

(b) seasonal **baseline data** for groundwater levels and quality in aquifers that could be affected by the action;

(c) vegetation assessment for the terrestrial **groundwater dependent ecosystems**; and

(d) aquatic value characterisation for the aquatic **groundwater dependent ecosystems**.

(3) implement monitoring of the Fountain Head Pit **lake water quality** and surrounding groundwater using **key bores** for the **life of the action**;

10 The report required by condition 9-4(2) must:

(1) be reviewed by an **independent qualified person** to ensure it is consistent with achievement of the environmental objectives and outcomes required by condition 9-2(1); and

(2) be submitted, with the review and a statement addressing how the reviewer's findings have been addressed to the **Minister** 3 months prior to **substantial disturbance**.

11 Post-closure Fountain Head Pit lake water quality

11-1 To support the achievement of condition 9-1(1) the approval holder must;

(1) monitor the Fountain Head Pit **lake water quality** for a post-closure period of 15 years;

(2) ensure the Fountain Head Pit **lake water quality** does not exceed the **ANZG** livestock drinking water quality guideline values; and

(3) update, calibrate and validate the models used to predict the post closure Fountain Head Pit **lake water quality** and groundwater quality, and

(4) remediate the Fountain Head Pit **lake water quality** if **ANZG** livestock water quality guideline values are exceeded in accordance with the MCP required by condition 3-1 and the requirements of condition 4-2.

12 Commencement of action

12-1 This approval expires five years after the date on which it is granted, unless **substantial disturbance** has commenced on or before that date.

13 Within 10 business days of **substantial disturbance** of the action the approval holder must provide notification in writing to the **Minister**.

14 Change of contact details

14-1 The approval holder must notify the **Minister,** in writing, of any change of its name, physical address or postal address for the serving of notices or other correspondence within 10 business days of such change.

15 Compliance reporting

15-1 The approval holder must:

(1) Within six months of the commencement of **substantial disturbance**, obtain from an **independent qualified person**, a report on compliance with the conditions of this environmental approval; and

(2) Obtain further such reports at regular intervals not exceeding 12 months from the report referred to in condition 15-1(1); and

(3) Submit each report to the CEO within 90 days of its completion.

15-2 The reports required by conditions 15-1(1) and 15-1(2) must:

(1) Be endorsed by the approval holder's Chief Executive Officer or a person delegated to sign on the approval holder's Chief Executive Officer's behalf;

(2) Include a statement as to whether the approval holder has complied with the conditions of this approval; and

(3) Identify all non-compliances and describe corrective and preventative actions taken.

16 Environmental Performance Report

16-1 The approval holder must submit an Environmental Performance Report to the **Minister** on completion of the **mine life**.

16-2 The report required by condition 16-1 must be prepared by an **independent qualified person**.

16-3 The Environmental Performance Report must verify and report on impacts of the action on the state of the following environmental values:

(1) Terrestrial environmental quality;

(2) Terrestrial ecosystems;

(3) Inland waters including surface water;

(4) Groundwater hydrological processes and quality;

(5) Community and economy;

(6) Culture and heritage; and

(7) the whole of environment within the area of influence of the action.

16-4 The Environmental Performance Report must include:

(1) a comparison of the environmental values identified in condition 16-3 at the end of the mine life against the state of each environmental value prior to **substantial disturbance**;

(2) a comparison of the predicted impacts of the action as identified in the EIS, and the actual impacts of the action as verified by baseline data and ongoing environmental monitoring data; and

(3) a cumulative impact assessment on the aquatic ecosystem condition of the **Adelaide River Catchment** that includes actions for which the approval holder is responsible.

17 Provision of environmental data

17-1 All environmental monitoring data required to be collected or obtained under this environmental approval must be retained by the approval holder for a period of not less than 25 years commencing from the date that the data is collected or obtained.

17-2 The approval holder must, as and when directed by the **Minister**, provide any validated environmental data (including sampling design, sampling methodologies, empirical data and derived information products (such as maps) relevant to the assessment of the action and implementation of this environmental approval, to the **Minister** in the form and manner, and at the intervals specified, in the direction.

Definitions

The terms used in this approval have the same meaning as the terms defined in the *Environment Protection Act 2019* and Environment Protection Regulations 2020.

Adelaide River Catchment	The catchment area of the Adelaide River and tributaries as depicted in Figure 2.
adaptive management	A systematic approach to improving environmental results and management practices during action implementation through the application of learning from monitoring of outcomes and management actions.
AHD	Australian Height Datum (AHD) is the height datum for Australia (Geoscience Australia).
ANCOLD	The Australian National Committee on Large Dams (ANCOLD) (2012), Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure and Addendum (2019).
ANZG	ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines. Note: The ANZG (2018) Water Quality Guidelines replaces the previous ANZECC/ARMCANZ (2000) guidelines. Without updates to the trigger values for irrigation and general water use and as the revised livestock drinking water guidelines are yet to be published, the default guidelines values from ANZECC/ARMCANZ (2000) will apply.
approved extent	The extent identified in Figure 1 of this approval that is the Project area identified in the EIS and includes equipment, plant and structures, whether stationary or portable, and the land and water on which the action is situated.
baseline data	Environmental monitoring data includes chemical, physical and biological data collected (from studies undertaken) prior to **substantial disturbance**, that is used to characterise baseline conditions.
CEO	The Chief Executive Officer of the Department of Environment, Parks and Water Security [or another name for that department, which may vary from time to time], or their delegate.
EP Act	*Environment Protection Act 2019*.

groundwater dependent ecosystems (GDEs)	Refers to ecosystems that are dependent on the surface expression (aquatic GDEs) or subsurface expression (terrestrial GDEs) of groundwater for all or part of their water requirements. The riparian vegetation of the unnamed creek is mapped as a moderate likelihood terrestrial GDE and may rely on access to groundwater for its water requirements during the dry season to maintain biodiversity, ecological integrity and ecological functioning. The billabong in the unnamed creek is mapped as a high likelihood aquatic GDE and its aquatic habitats are considered to rely on groundwater to maintain biodiversity, ecological integrity and ecological functioning.
independent qualified person	A qualified person as defined under section 4 of the **EP Act**; and who also meets the following requirements: a) was not involved in the preparation of the approval holder's **EIS**; and b) is independent of the personnel involved in the design, construction and operation of the action; and c) has obtained written approval from the **CEO** to be the qualified person to satisfy the **independent qualified person** reporting requirements under this approval.
key bores	The monitoring bores for the purpose of updating the hydrogeochemical and groundwater models, and for informing management responses and corrective actions.
lake water quality	The Fountain Head Pit lake water quality that is the volume weighted averaged concentration determined by profiling the pit with surface, mid-depth and bottom samples, and with profiling to be undertaken at three locations.
life of the action	The period of time from **substantial disturbance** until the issue of a closure certificate under section 213 of the **EP Act**, or revocation of the environmental approval by the Minister at the request of the approval holder under section 114 of the **EP Act**.
limit value	Values of monitored environmental parameters that represent the limit of acceptable impact beyond which the environmental values and objectives are not being met.
mine-affected water	Surface water and groundwater that is impacted or contaminated as a result of mining operations.
mine life	The period of time nominated by the approval holder in the **EIS** to carry out construction, operation and rehabilitation of the action, including 7 months construction, 34 months operation and 12 months rehabilitation (53 months total).
Minister	Responsible Minister (or delegate) under the *Environment Protection Act 2019* and Environment Protection Regulations 2020.
NT EPA	Northern Territory Environment Protection Authority.

PAF	Potentially acid forming.
passive discharge	The uncontrolled discharge of mine-affected water
responsible Minister	The responsible Minister (or delegate) under the *Mining Management Act 2001*.
substantial disturbance	Means substantial disturbance of a mining site as defined under section 35(3) of the *Mining Management Act 2001*.
trigger action response plan (TARP)	The Trigger Action Plan in the proponent's Groundwater Monitoring Plan as updated in accordance with condition 9 of this approval. The Trigger Action Response Plan provides the corrective actions and management responses required to be implemented to avoid and prevent significant environmental impact.
trigger value	Values of monitored environmental parameters that indicate when response actions are required to prevent exceedance of limit values.
unfavourable wind conditions	Refers to conditions when wind speeds are greater than 7.6 m/s.

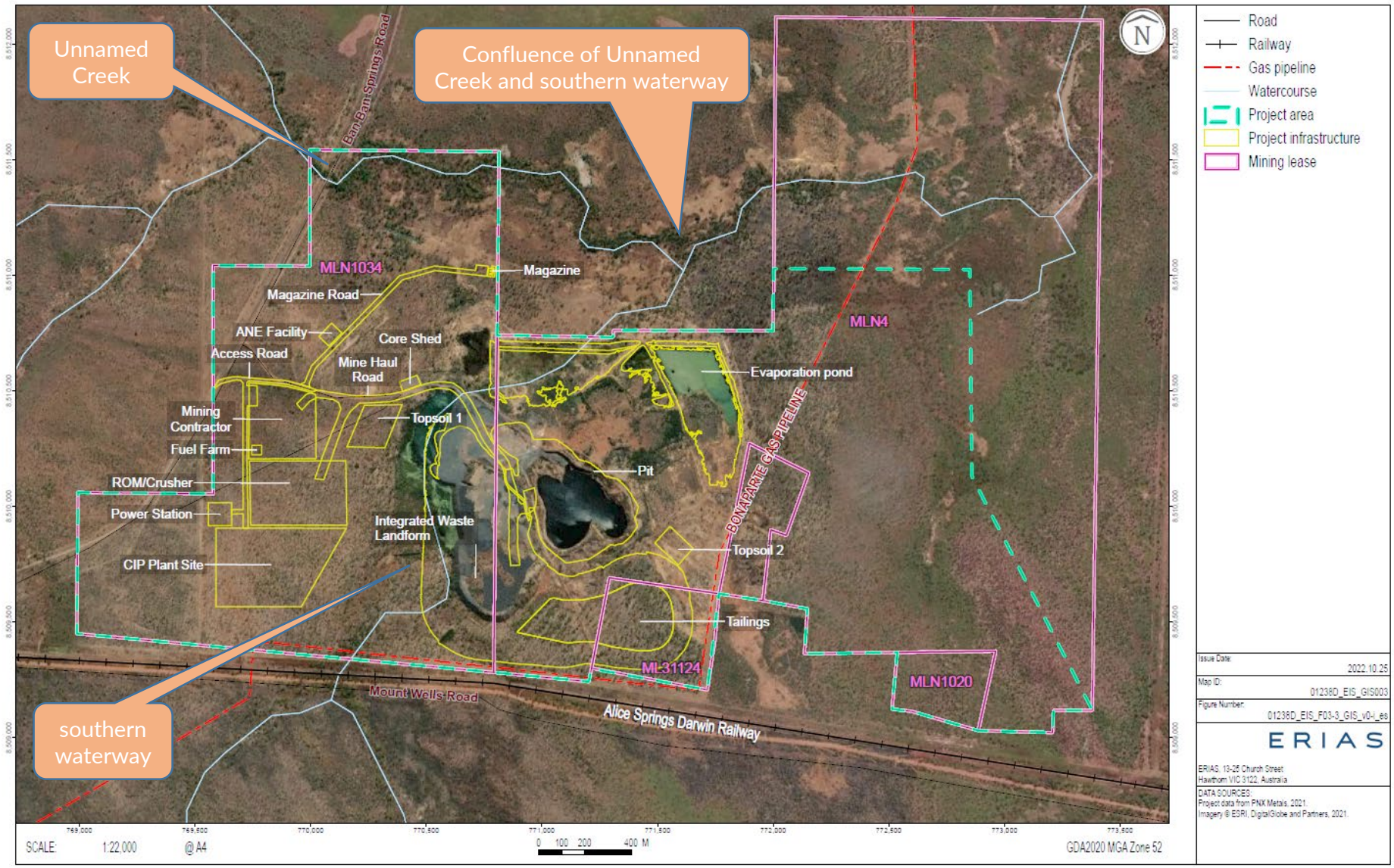

Figure 1 Proposed location of project infrastructure and mine extent

Figure 2 Adelaide River catchment and the proposal location

Appendix 2 – Matters taken into account during the assessment

Matters taken into account during the assessment	Consideration
Objects of the EP Act	
To protect the environment of the Territory	The proponent's EIS and this assessment report, including the NT EPA's recommended conditions for an environmental approval, provide detail about how the environment of the Territory would be protected from potentially significant environmental impacts that could occur as a result of implementation of the proposal.
To promote ecologically sustainable development so that the wellbeing of the people of the Territory is maintained or improved without adverse impact on the environment of the Territory	The NT EPA's consideration of the principles of ecologically sustainable development in relation to the proposal is addressed below.
To recognise the role of environmental impact assessment and environmental approval in promoting the protection and management of the environment of the Territory	The NT EPA recognises the importance of the environmental impact assessment and approval processes in the protection and management of the environment of the Territory. The NT EPA has assessed the potential environmental impacts of the proposal to inform an environmental approval decision by the Minister that, in the NT EPA's view, promotes the protection and management of the Territory.
To provide for broad community involvement during the process of environmental impact assessment and environmental approval	The NT EPA's public consultation undertaken during its assessment of the proposal provides for community involvement during the environmental impact assessment process. One submission received in relation to the proposal has been taken into account in the preparation of the recommended conditions for an environmental approval.
To recognise the role that Aboriginal people have as stewards of their country as conferred under their traditions and recognised in law, and the importance of participation by Aboriginal people and communities in environmental decision-making processes.	The NT EPA recognises the role of Aboriginal people as stewards of their country and the importance of participation by Aboriginal people and communities in environmental decision-making. The public consultation process provided an opportunity for interested persons to make a submission in relation to the proposal.

Matters taken into account during the assessment	Consideration
Principles of ecologically sustainable development	
Decision-making principle 1. Decision-making processes should effectively integrate both long-term and short-term environmental and equitable considerations. 2. Decision-making processes should provide for community involvement in relation to decisions and actions that affect the community.	The NT EPA has considered the decision-making principle in its assessment and has had particular regard to this principle in its assessment of Hydrological processes, Inland water environmental quality, Aquatic ecosystems, Terrestrial environmental quality, Terrestrial ecosystems, Community and economy, and Culture and heritage. The NT EPA notes the interconnectedness between environmental factors and recognises that the mitigation measures to avoid and minimise impacts on the factors listed above may also reduce the significance of impacts on other environmental factors. The NT EPA acknowledges that design requirements are a combination of the application of the environmental decision-making hierarchy under section 26 of the EP Act, the waste management hierarchy under section 27 of the EP Act, and the principles of ESD. The NT EPA has recommended conditions for environment protection outcomes to be achieved through design, construction, operation and maintenance, and appropriate disposal of waste. The NT EPA notes that air quality and human health would also be regulated through the *Work Health and Safety (National Uniform Legislation) Act 2011*. The NT EPA considers that its environmental impact assessment and recommended conditions for an environmental approval have identified and mitigated both short-term and long-term environmental impacts, and that this has not resulted in any compromise between short and long term environmental and equitable considerations. The community has been provided the opportunity for involvement in the environmental impact assessment process during public consultation on the proposal, and the submissions received have been taken into account in the preparation of this report and the recommended conditions to inform the Minister's decision on environmental approval.

Matters taken into account during the assessment	Consideration
Precautionary principle 1. If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. 2. Decision-making should be guided by: (a) careful evaluation to avoid serious or irreversible damage to the environment wherever practicable; and (b) an assessment of the risk-weighted consequences of various options.	This principle was considered by the NT EPA when assessing the impacts of the proposal on the key environmental factors. The proponent has identified measures to avoid or minimise impacts on the environment. The NT EPA has considered these measures during its assessment, and has recommended conditions for environment protection outcomes to be achieved. From its assessment of this proposal the NT EPA has concluded that the environmental values will be protected provided its recommended conditions, and the proponent's commitments, are implemented. The proposal may result in some irreversible impacts associated with loss of vegetation from clearing and potential groundwater dependent ecosystem loss, however those residual impacts are not considered significant.
Principle of evidence-based decision-making Decisions should be based on the best available evidence in the circumstances that is relevant and reliable.	The NT EPA has considered the available evidence during the course of its assessment of the proposal, and this scientific evidence provides the foundation for its decision making and recommended conditions. In its assessment of the proposal, where the NT EPA considered that further evidence is required to inform the management of potentially significant impacts to hydrological processes, inland water environmental quality, aquatic ecosystems, terrestrial ecosystems, community and economy, and culture and heritage, the NT EPA has recommended conditions requiring the proponent to undertake additional work to provide further evidence about how the impact would be effectively avoided and/or mitigated.
Principle of intergenerational and intragenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of present and future generations.	The NT EPA acknowledges that it is important to protect the sensitive cultural, environmental and water resource values of the Adelaide River catchment for the benefit of future generations. It considers that the recommended conditions for an environmental approval would provide an appropriate degree of protection for these values and not constrain the ability of future generations to continue to access the cultural and water resources for a range of beneficial uses.

Matters taken into account during the assessment	Consideration
	The NT EPA has considered the principle of intergenerational equity and intragenerational equity in its assessment. From the assessment of this proposal the NT EPA has concluded that the environmental values will be protected and that the health, diversify and productivity of the environment will be maintained for the benefit of future generations.
Principle of sustainable use Natural resources should be used in a manner that is sustainable, prudent, rational, wise and appropriate.	The NT EPA acknowledges the importance of sustainable use of resources and has considered this principle during the environmental impact assessment process. It considers that this principle is closely linked to the principles of intergeneration and intragenerational equity, and conservation of biological diversity and ecological integrity.
Principle of conservation of biological diversity and ecological integrity Biological diversity and ecological integrity should be conserved and maintained.	This principle was considered by the NT EPA when assessing the impacts of the proposal on the environmental values of the Adelaide River catchment. In considering this principle, the NT EPA notes that hydrological processes, inland water environmental quality, aquatic ecosystems, terrestrial ecosystems, community and economy, and culture and heritage could be significantly impacted by the proposal if appropriate measures were not implemented to avoid and mitigate impacts. The assessment of these impacts is provided in this report. Biological diversity and ecological integrity are likely to be conserved due to the avoidance, minimisation and mitigation measures that will be implemented by the proponent and the conditions recommended by the NT EPA to ensure that environmental protection outcomes are achieved. From its assessment of this proposal the NT EPA has concluded that the proposal would not further compromise the biological diversity and ecological integrity of the affected areas.
Principle of improved valuation, pricing and incentive mechanisms 1. Environmental factors should be included in the valuation of assets and services.	This principle was considered by the NT EPA when assessing the impacts of the proposal. The NT EPA notes that the proponent would bear the costs relating to containment of contaminants, avoidance and abatement of pollutants to the terrestrial, aquatic and air environment.

Matters taken into account during the assessment	Consideration
2. Persons who generate pollution and waste should bear the cost of containment, avoidance and abatement. 3. Users of goods and services should pay prices based on the full life cycle costs of providing the goods and services, including costs relating to the use of natural resources and the ultimate disposal of wastes. 4. Established environmental goals should be pursued in the most cost-effective way by establishing incentive structures, including market mechanisms, which enable persons best placed to maximise benefits or minimise costs to develop solutions and responses to environmental problems.	
Environmental decision-making hierarchy	
1. In making decisions in relation to actions that affect the environment, decision-makers, proponents and approval holders must apply the following hierarchy of approaches in order of priority: (a) ensure that actions are designed to avoid adverse impacts on the environment; (b) identify management options to mitigate adverse impacts on the environment to the greatest extent practicable; (c) if appropriate, provide for environmental offsets in accordance with this Act for residual adverse impacts on the environment that cannot be avoided or mitigated.	In its assessment of the proposal, the NT EPA considered the extent to which the proponent has applied the environmental decision-making hierarchy in its design of the proposal and the proposed measures to avoid and then mitigate significant impacts. Where the NT EPA was not satisfied that this hierarchy had been applied, it has recommended conditions requiring that the proponent take reasonable measures to avoid and/or mitigate impacts. With regard to waste and pollution that would be generated by the proposal, the NT EPA has focussed on strategies to avoid the generation and disposal of waste and pollution, in particular for discharges to land, water and emissions to air. The NT EPA has had regard to this hierarchy during the assessment of the proposal and did not identify any residual impacts that would require offsetting.
2. In making decisions in relation to actions that affect the environment, decision-makers, proponents and approval holders must ensure that the potential for actions to enhance or restore	The proposal is located in an area that is subject to extensive disturbances from historical mining and exploration activity with existing levels of measurable contamination. The NT EPA has recommended conditions requiring rehabilitation and closure of the action, to ensure that environmental quality is enhanced or

Matters taken into account during the assessment	Consideration
environmental quality is identified and provided for to the extent practicable.	restored to the highest extent practicable. Proposed rehabilitation and closure of the site may improve the environmental quality of the site if undertaken successfully.
Waste management hierarchy	
1. In designing, implementing and managing an action, all reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment. 2. For subsection (1), waste should be managed in accordance with the following hierarchy of approaches in order of priority: (a) avoidance of the production of waste; (b) minimisation of the production of waste; (c) re-use of waste; (d) recycling of waste; (e) recovery of energy and other resources from waste; (f) treatment of waste to reduce potentially adverse impacts; (g) disposal of waste in an environmentally sound manner.	The NT EPA has considered the waste management hierarchy in its assessment and has had particular regard to this principle in its assessment of hydrological processes, inland water environmental quality, aquatic ecosystems, terrestrial ecosystems, community and economy, and culture and heritage. The proponent is required to comply with the waste management hierarchy and the environmental decision-making hierarchy.
Ecosystem-based management	
Management that recognises all interactions in an ecosystem, including ecological and human interactions.	The NT EPA acknowledges the importance of ecosystem-based management for achieving both sustainable development and biodiversity protection goals. With consideration of the link between inland waters (surface water and groundwater), hydrological processes, terrestrial environmental quality, terrestrial ecosystems and community and economy, the NT EPA also considered the connections and interactions between parts of the environment to inform a holistic view of impacts to the whole environment.

Matters taken into account during the assessment	Consideration
	The NT EPA formed the view that the impacts from this proposal can be managed to be consistent with the NT EPA's environmental factors and objectives.
The impacts of a changing climate	
The effects of a changing climate on the proposal and resilience of the proposal to a changing climate	The NT EPA considered the short working design life of the proposal (3.5 years) in the context of resilience to climate change, and how climate change may impact the proposal. The NT EPA had regard to measures and controls relating to extreme weather events such as flooding and high intensity rain events. The NT EPA considered that specific conditions did not need to be recommended to address this requirement. The NT EPA had regard to this matter during its assessment of the proposal.

Appendix 3 – Environmental impact assessment timeline

Date	Assessment stages
20 December 2019	The NOI for the Fountain Head Gold Project received
16 March 2020	The NT EPA decided the Fountain Head Gold Project requires assessment under the *Environmental Assessment Act 1982* at the level of EIS.
11 May 2020	Terms of Reference for preparation of an EIS issued.
9 June 2021	Public comment invited on the draft EIS. Submissions (closed 6 August 2021).
24 September 2021	The proponent is directed to: • consider any submissions received on the draft environmental impact statement during the consultation period; and • prepare a supplement to the draft environmental impact statement to address issues raised in the public submissions, and the comments from government agencies that relate to the assessment of potentially significant environmental impacts.
6 December 2021	The Supplement (Revision of statement) to the draft EIS is published on the NT EPA web page.
6 January 2022	Further information is sought under clause 14(2)(a) of the Environmental Assessment Administrative Procedures 1984. The proponent is directed to provide information considered necessary to facilitate the examination of the EIS.
25 July 2022	Proponent's additional information is accepted.
22 November 2022 to 29 November 2022	Consultation with proponent and statutory decision makers on the draft environmental approval.
3 January 2023	Assessment report and draft environmental approval provided to the Minister.