SOUTH32

GROOTE EYLANDT MINING COMPANY (GEMCO)

J Quarry Haul Road Realignment

Environment Protection Act Referral

November 2020

Volume 1

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

GROOTE EYLANDT MINING COMPANY (GEMCO)

J Quarry Haul Road Realignment

Environment Protection Act Referral

November 2020

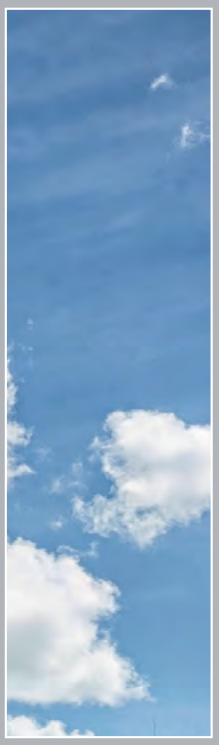
Volume 1

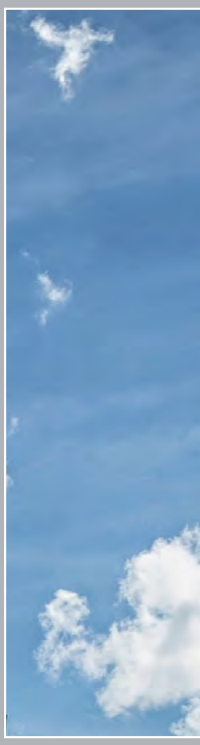
Volume 1 - Main Report

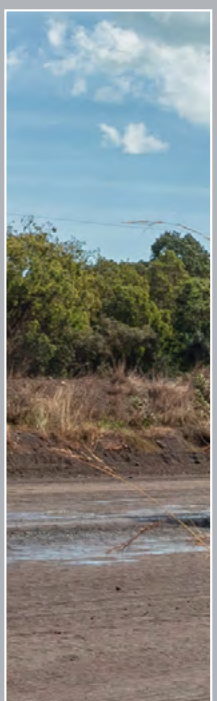
Volume 2 - Appendices

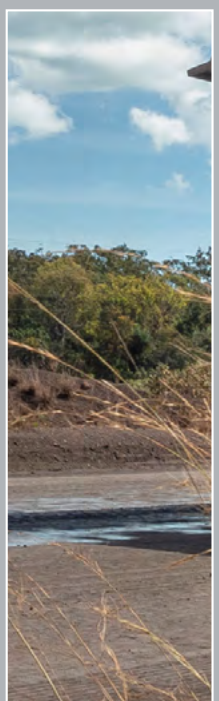
Hansen Bailey
ENVIRONMENTAL CONSULTANTS

Executive Summary









CONTENTS

Tables

Figures

EXECUTIVE SUMMARY

INTRODUCTION

The Groote Eylandt Mining Company Pty Ltd (GEMCO) (the "proponent") operates a manganese mine on Groote Eylandt in the Gulf of Carpentaria, approximately 650 km south-east of Darwin (Figure 1). Mining occurs in multiple mineral leases, known as the Western Leases (Figure 1). The proponent is proposing to realign an existing approved access corridor that connects existing mineral leases within the Western Leases mining operations. The existing approved access corridor provides for the future development of a haul road within the corridor.

A referral under the *Environment Protection Act 2019* (EP Act) (this document) has been prepared to assess the potential impacts of the realignment of the access corridor and the construction of a haul road within the realigned corridor. The referral has been prepared to enable the Northern Territory Environment Protection Authority (NT EPA) to determine whether the project is predicted to give rise to significant impacts and hence whether it requires an approval under the EP Act. The referral has been prepared in accordance with the information requirements described in the NT EPA Guideline *Referring a Proposed Action to the NT EPA, Environmental impact assessment guidance for proponents* (NT EPA, 2020b).

Project Overview

The proponent's existing mine is the main development on Groote Eylandt and has been operating for over 50 years. Mining occurs in multiple mineral leases, known as the Western Leases (Figure 1). The Western Leases were progressively granted in the 1960s and 1970s. The proponent's existing operations in the Western Leases are located on the northern side of the Emerald River. In 2023, mining is scheduled to progress into the southernmost mineral lease (ML) 961, which contains a future mining area known as J Quarry, located on the southern side of the Emerald River (Figure 2). ML 961 includes an access corridor connecting J Quarry to the mineral leases north of the Emerald River (the existing approved access corridor). Gaining access to the J Quarry mining area requires the construction of a new haul road within the access corridor. The haul road requires a bridge across the Emerald River and a crossing of an ephemeral tributary of the Emerald River, referred to as the Southern Tributary (Figure 2).

However, a recent survey identified the presence of a sacred site in close proximity to the existing approved access corridor. It is therefore necessary to realign the existing approved access corridor to provide a suitable buffer around the sacred site and the project involves the realignment of the access corridor and the development of a haul road within the realigned corridor. The key elements of the project are shown in Figure 3 and include:

- Construction of a haul road that links the existing Western Leases mining operations north of the Emerald River to J Quarry. The road includes a bridge over the Emerald River and also traverses the Southern Tributary.
- Construction of an access track to enable construction equipment to access the area to the south of the Emerald River.
- Realignment of an existing public access track to enable safe public access to the western coast of Groote Eylandt and the Emerald River boat ramp. The realignment includes construction of a single lane light vehicle underpass beneath the haul road.

The project site for the purposes of the environmental assessment is the area to be disturbed by these project elements.

As shown in Figure 3, the realigned access corridor is located beyond the proponent's existing mineral leases. Approval is required for activities that are beyond the existing mineral leases. Activities within the Western Leases,

including mining in J Quarry and construction and operation of the haul road within the Western Leases and existing approved access corridor, are authorised under existing approvals.

Proponent

The proponent, GEMCO, has two shareholders, South32 Limited (60%) and Anglo Operations (Australia) Pty Ltd (40%).

South32 is an independent global metals and mining company. The company is listed on the Australian, Johannesburg and London Stock Exchanges, and is headquartered in Perth. South32 is globally diverse, with interests in five countries, including Australia and South Africa. South32 has high-quality operations in aluminium, bauxite, coal, lead, nickel, silver, zinc and manganese.

Anglo Operations (Australia) Pty Ltd is a wholly owned subsidiary of Anglo American Plc, a mining group based in the United Kingdom that is listed on the London Stock Exchange. Anglo American Plc is one of the world's largest mining companies and has a diverse portfolio of interests in coal, iron ore, manganese, base metals, precious metals, and minerals.

Regulatory Approvals

The key regulatory approvals required for the project are listed in Table 1.

Table 1 Key Regulatory Approvals

APPROVAL	LEGISLATION	AGENCY	STATUS
NORTHERN TERRITORY APPROVALS			
Environmental Approval	*Environment Protection Act 2019* (NT) (EP Act)	NT EPA	Under the EP Act, if a project has the potential to have a significant impact on the environment, a referral must be made to the NT EPA to confirm if an approval is required and, if required, the appropriate approval pathway. This referral describes the environmental assessment and is being submitted to the NT EPA to determine if an approval is required under the EP Act.
Mining Management Plan	*Mining Management Act 2001* (NT)	Department of Primary Industry and Resources (DPIR)	Mining activities in the Western Leases are described in a Mining Management Plan (MMP) that forms the basis for an Authorisation under the *Mining Management Act 2001.* The existing MMP describes the proposed mining activities and details the environmental management measures to be adopted. Mining activities associated with the project (i.e. the realignment of the access corridor and associated development of the haul road and construction access track), will be required to be included in an amended MMP. The Authorisation of the amended MMP will not be granted until the NT EPA has undertaken any necessary environmental assessment under the EP Act.
Access Authority	*Mineral Titles Act 2010* (NT)	DPIR	The section of the access corridor located beyond GEMCO's existing mineral leases requires an Access Authority. An Access Authority was granted on 12 October 2020 (Access Authority 32517).

APPROVAL	LEGISLATION	AGENCY	STATUS
FEDERAL GOVERNMENT APPROVALS			
EPBC Act Approval	*Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)	Department of Agriculture, Water and the Environment (DAWE)	The EPBC Act requires approval to be obtained for activities that are likely to have a significant impact on Matters of National Environmental Significance (MNES). Threatened Species and Communities, and Migratory Species are the only two MNES that may be relevant to the project. An assessment of significance has been undertaken using the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* prepared by the Department of the Environment (2013). The assessment of significance was prepared by specialist ecologists and is provided in the *Aquatic Ecology Report* (Appendix C) and the *Terrestrial Ecology Report* (Appendix D). It has concluded that the project is unlikely to have a significant impact on these MNES.
Landowner consent	*Aboriginal Land Rights (Northern Territory) Act 1976* (Cth) (ALRA)	Federal Minister for Indigenous Affairs	The ALRA is Commonwealth legislation which provides Aboriginal landowners with legal title to traditional lands. Freehold land granted under ALRA is referred to as Aboriginal land. Groote Eylandt is Aboriginal land under ALRA and the Anindilyakwa Land Council (ALC) is the land council responsible for this land. The proponent reached an agreement with the ALC, on behalf of the Traditional Owners, allowing the realignment of the access corridor and associated development of the haul road. The agreement is in the form of a Haul Road Agreement, under ALRA, which was signed on 15 July 2020.

PROJECT DESCRIPTION

Regional Setting

Groote Eylandt is largely undeveloped, and much of the island is still used for traditional practices such as hunting and gathering. The mine is the main development on the island and has been operating for over 50 years. There are three townships on Groote Eylandt, namely Alyangula, Angurugu and Umbakumba (Figure 1) which have a combined population of approximately 2,500 people (Australian Bureau of Statistics, 2017a). Angurugu is the closest township to the project site and is located approximately 10 km to the north of the site. There are also several small, rural Aboriginal settlements (termed “outstations”) on Groote Eylandt. Outstations typically have varying levels of use, from occasional visitation to sporadic residency. Yedkiba Outstation is located in close proximity to the project site (Figure 2).

Groote Eylandt, and the surrounding marine area, has significant ecological value. The threatened terrestrial fauna species present on the island are relatively protected from key threatening processes that exist on the mainland (such as Cane Toads).

Site Setting

The project site traverses the Emerald River and the Southern Tributary (Figure 3). The Emerald River has its headwaters located to the east of the project site, starting in rocky outcrops of the geological basement commonly referred to as “white rock”. As the river traverses the landscape towards the coast, the relatively flat, low-lying topography forms heavily vegetated shallow gradient valleys converging onto coastal plains. This topography promotes the establishment of off-channel wetlands during the wet season when flood flows expand across the coastal plains. The Emerald River is primarily spring-fed, maintaining flows all year round. At the project site, the river is a mix of estuarine and freshwaters. Freshwater lies over saline waters, creating a saltwater wedge that pushes upstream with the incoming tide, while underneath the freshwaters flow downstream.

The Southern Tributary starts as a defined gully in its upper reaches before forming a wide overland floodplain that eventually connects with the main channel of the Emerald River, near the mouth of the river, downstream of the project site (Figure 3). The Southern Tributary can maintain limited water in small billabongs for several months following the end of the wet season, however, it is ephemeral in the vicinity of the project site.

The project site comprises natural bushland dominated by Eucalyptus and Melaleuca open woodlands and forests, as well as riparian woodlands along the Emerald River and the Southern Tributary. The most common eucalypts are Darwin Stringybarks (*Eucalyptus tetrodonta*) and Darwin Woollybutt (*Eucalyptus miniata*), but a wide variety of other native plants and vegetation communities occur. Melaleuca-dominated vegetation also occurs within riparian zones. A number of permanent and seasonal wetlands occur within the vicinity of the project site including sedge wetlands and Paperbark dominated wetlands.

The area surrounding the project site is largely undeveloped and heavily vegetated. The primary access to the area is via the Emerald River Road, an unsealed public road, which is located to the east of the project site (Figure 3). An existing public access track, which connects to the Emerald River Road, traverses the project site and is used by the Traditional Owners to access the mouth of the Emerald River and other key cultural and recreational areas along the western coastline of Groote Eylandt (Figure 2). It also provides access to an area on the Emerald River, to the west of the project site, from which small recreational boats are launched.

Yedikba Outstation includes a few small buildings and is located approximately 450 m from the project site (Figure 2). The outstation is used by the Traditional Owners for recreational purposes. A number of sacred sites also occur in proximity to the project site and are culturally significant to the Traditional Owners. The location of these sites is confidential and at the request of the Traditional Owners has not been disclosed in this referral.

Selection of Realigned Access Corridor and Haul Road Design

The proponent has undertaken an extensive process over several years to select an optimal realignment for the access corridor and to design the associated haul road to minimise environmental and cultural impacts. This process included identification and investigation of a number of alternative access corridor alignments, developed through a detailed options assessment and pre-feasibility study process. Each alternative access corridor alignment was evaluated against the following cultural, environmental and engineering constraints:

- Cultural constraints in the vicinity of the existing approved access corridor were identified. The identification of cultural constraints was based on a cultural heritage survey undertaken within and adjacent to the Western Leases. The cultural heritage survey was undertaken by the ALC’s anthropologist and included extensive consultation, including on country meetings with the Traditional Owners. This work was documented in a Sacred Sites Instructions Report which provides a clear description of sacred sites and the required protection measures that Traditional Owners believe are suitable for the management of sacred sites in perpetuity.
- Environmental constraints were identified. The identification of environmental constraints was based on several fieldwork programs to confirm the baseline environment and included consultation with the ALC. Baseline work included vegetation mapping, terrestrial and aquatic ecology field surveys, review of LiDAR imagery, drone and topographic data and bathymetric surveys.

- Engineering considerations were identified. Engineering considerations included: locating the Emerald River crossing at the narrowest point on the river, crossing perpendicular to the riverbank; consideration of visibility and sight lines for haul trucks, safety aspects and optimal road inclines and speed limits; as well as consideration of the mineralisation within the Western Leases and Southern Lease to ensure the haul road would not sterilise potential future resources. Costs were also considered.

A multi criteria assessment was then undertaken to select a preferred access corridor alignment based on the risk profile of each alternative alignment. The preferred realignment (shown in Figure 2) was selected based on the following objectives:

- There would be no disturbance of nearby sacred sites;
- There would be no disturbance of the Emerald River main channel, which is both culturally and environmentally sensitive; and
- There would be no disturbance of significant vegetation types such as monsoon vine thicket and mangroves, due to their cultural and environmental sensitivities.

Once a preferred access corridor alignment that met those objectives was selected, the proponent undertook an iterative engineering design process for the haul road and waterway crossings. This design process sought to optimise the location of the haul road within the access corridor in order to reduce the clearing width, as well as to design the haul road to minimise impacts on the Emerald River floodplain and flood flows. The engineering design process also included consideration of the optimal design of the waterway crossings to minimise impacts on existing sediment transport characteristics and water quality in the waterways. Further impact assessment work was undertaken to inform the engineering design, including the following:

- An assessment of the hydraulic and sediment transport characteristics of the Emerald River and floodplain, including flood modelling. This work was undertaken to ensure the Emerald River and Southern Tributary crossings were optimally designed to minimise impacts on waterways, surface water quality and riparian vegetation. The hydrologic and hydraulic modelling work is described in this referral.
- An assessment of the geomorphological impacts of the project on the Emerald River, the Southern Tributary and the associated Emerald River floodplain. This work was undertaken to refine the design of the waterway crossings to minimise potential impacts and to identify mitigation measures required to address potential impacts such as scouring. This work is described in this referral.

This iterative planning process culminated in the selection of the haul road design described in this referral.

The entire engineering planning and design process was undertaken over several years and included extensive consultation with the ALC and the Traditional Owners. Consultation aimed to ensure the Traditional Owners were informed of the constraints and potential impacts of alternatives and to progressively advise them of the progress in developing a suitable design. In December 2019, the ALC issued the proponent a letter of ‘in-principle agreement’ indicating their agreement to the access corridor realignment. Subsequent to the letter, the ALC, on behalf of the Traditional Owners signed a Haul Road Agreement under ALRA in July 2020, consenting to the realignment of the access corridor and development of the associated haul road, construction access track and realigned public access track.

Project Activities

The key elements of the project are the construction of a haul road, development of a construction access track and realignment of an existing public access track. Figure 3 shows the location of these project elements. The total clearing footprint comprises approximately 24 ha. The development of a haul road within the existing, approved access corridor would have involved clearing approximately 10 ha of vegetation and would also have required realignment of the existing public access track and development of a construction access track. Consequently, the project involves additional clearing of less than 14 ha of native vegetation. The additional

clearing is required because the original alignment granted in the 1970s did not account for modern day haul road requirements such as safety berms, surface water infrastructure to manage runoff and the size of haul trucks.

Haul Road Design

The haul road itself will be a dual lane, unsealed road designed for use by mine vehicles only. Similar to haul roads at the existing mine, the haul road will be constructed using compacted laterite and middlings. The road is designed generally at grade with two low-level causeways in floodplain areas. This design minimises the impact the haul road will have on flood behaviour.

The haul road design incorporates a drainage system that is designed to limit the potential for suspended sediment to impact adjacent vegetation and downstream waterways. The haul road surface is designed with a central crown to ensure there is suitable drainage from the road surface. Runoff from the road will be captured by drains which feed into sediment ponds, located strategically along the haul road. Sediment dams will be subject to detailed design however are expected to accommodate a 20% Annual Exceedance Probability (AEP) event. Treated water from the sediment ponds will be released into surrounding vegetation. Clean water diversion drains (or bunds depending on local relief) will also be constructed to convey clean water away from the haul road formation.

Similar to the existing approved corridor, the haul road crosses two waterways – the Emerald River and the Southern Tributary. The haul road design includes a bridge to cross the perennial Emerald River and culverts within the channel of the ephemeral Southern Tributary. These are discussed in the following sections.

Emerald River Bridge Crossing

The haul road design includes a bridge to cross the perennial Emerald River. The bridge has been designed to minimise impacts on the Emerald River by spanning the river channel without piers or encroaching abutments. The bridge abutments are set back from the main river channel to avoid disturbance of the main channel. The abutments will be constructed of steel tubular piles with a reinforced concrete abutment. Erosion protection will be installed around the abutments in the form of either rock gabion baskets or sheet piles. The bridge will also include safety bunds, a dewatering pipeline, guide posts and solar powered lighting for the safety of truck operators.

The bridge deck will span approximately 36 m and will be constructed of steel girders overlain by a concrete deck and a wearing course. This large span design allows bank full flood flows to pass beneath the bridge with negligible impact on flood levels, velocities and sediment transport capacity. There is also sufficient clearance to enable small boats to pass underneath under normal flow conditions.

A low-level causeway will be constructed on the southern side of the Emerald River. The causeway will allow flood flows that break the river banks to pass downstream. Detailed design of the causeway will be undertaken prior to construction, however it is expected to consist of a lower layer up to 1 m thick that is made up of geofabric and middlings. Cement stabilised fill will then be placed on top at a thickness of up to 1.5 m. The fill layer will then be topped with 200 mm of middlings as a wearing course. A rip rap rock apron will be installed on either side of the causeway for erosion protection.

Southern Tributary Crossing

The haul road alignment will also traverse the Southern Tributary. The Southern Tributary crossing will consist of culverts in the Southern Tributary channel and on the southern floodplain, with a low-level causeway in between. Detailed design of the crossing will be undertaken prior to construction, however it is expected that the proposed culverts are a series of box culverts, which will allow low flows to pass through. Within the southern floodplain, a series of pipe culverts are proposed to be excavated below ground level. Detailed design of the culverts will be undertaken prior to construction and the design will take into account relevant fish passage guidelines and requirements.

During larger flood events, water from the Southern Tributary will also flow to the causeway. Erosion protection (in the form of rip rap) will be installed in minor areas predicted to have the potential to be subject to scour.

Realignment of Public Access Track

There is an existing public access track that provides local access from the Emerald River Road to the western coastline of Groote Eylandt and a boat ramp on the Emerald River (Figure 2). The existing public access track traverses both the existing approved access corridor and the realigned access corridor. The public access track will be realigned to ensure the public can continue to access the western coastline safely (Figure 3).

The realigned public access track will be similar to the existing track, and will comprise a single lane, unsealed track. The track will be cleared and graded to follow the natural ground elevation. No drainage infrastructure is required. The portion of the existing public access track that will no longer be used will be decommissioned and rehabilitated.

Where the track crosses the haul road, an underpass beneath the haul road will be constructed. The underpass is designed as a single lane, reinforced concrete box culvert. This will ensure separation between public vehicles and mine haul traffic.

Construction

Construction of the project will involve:

- Vegetation clearing and burning;
- Topsoil stripping;
- Foundation preparation;
- Bridge construction;
- Haul road and access track construction; and
- Drainage installation.

Construction will be undertaken using standard techniques and involve the use of mobile equipment including but not limited to cranes, pile drivers, dozers, scrapers, graders and water carts. Erosion and sediment controls will be adopted as an integral part of construction activities, and are further described in this referral.

Construction of the haul road and bridge will require access from the southern side of the Emerald River. During construction, access will be provided via the existing Emerald River Road and the existing bridge (Figure 2). An existing exploration track will be extended and widened up to 10 m to provide direct access to the project site on the southern side of the river. The alignment of the construction access track is shown in Figure 3. The track will be cleared and graded to follow the natural ground elevation. No drainage infrastructure is required. This track may be intermittently used post-construction to provide light vehicle access to the haul road for maintenance activities.

Environmental and Cultural Controls

Training

The proponent has established induction and training procedures relating to environmental management and cultural awareness. All personnel (including contractors) working on the project will be required to undertake this training.

Erosion and Sediment Controls

Construction will be undertaken predominantly in the dry season, which limits the potential for issues with erosion and sediment control. An Erosion and Sediment Control Plan will be prepared for the construction of the project to manage potential issues, and will include the following control measures:

- All exposed batters will be vegetated.
- Riprap will be placed on the upstream and downstream shoulders of the causeway sections of the haul road to reduce erosion of the road surface.
- Silt fencing will be installed, as appropriate, in the vicinity of construction work around waterways.
- A polymer coating will be regularly applied to causeway surfaces to reduce the breakup of the road surface during overtopping events.

Permit to Clear Process

The proponent's Permit to Clear process will be adopted prior to the commencement of any construction activities. The Permit to Clear process includes undertaking pre-clearance surveys to delineate the precise location of clearing and to identify the presence of weeds in the area to be cleared. Clearing will be kept to the minimum possible required to safely construct the haul road, construction access track, and realigned public access track.

Weed and Pest Management

Weed management of the areas to be disturbed will be conducted in accordance with the Weed Management Plan (WMP) currently in place for the existing mine. The WMP is supported by a suite of procedures that are designed to manage and control weeds on the proponent's mining and exploration tenements. These documents include measures to ensure that disturbance does not introduce weeds. All construction equipment and support vehicles will be required to undertake weed inspections and wash down at the mine site, prior to commencing construction activities.

GEMCO also has in place a management plan and quarantine program to prevent the introduction of Cane Toads to Groote Eylandt. This is critical to maintaining populations of threatened species such as the Northern Quoll (*Dasyurus hallucatus*). The management plan includes preventative measures such as quarantine procedures relating to barging of equipment, inspections of barges and vehicles, Cane Toad fencing at the port and the use of a Cane Toad detection dog at the port. There are also monitoring measures and, in the event of a Cane Toad being found, reporting and disposal procedures.

Rehabilitation

Conservatively, this assessment assumes that the haul road and construction access track are permanent disturbances because the long-term future use of this infrastructure post-mining depends on agreement with Traditional Owners and is uncertain. In the event Traditional Owners require the haul road and construction access track to be permanently closed, rehabilitation will be undertaken.

The unused portion of the existing public access track will be closed and rehabilitated once the realigned public access track is constructed and open for public use. Rehabilitation will include ripping the track, applying topsoil and seeding to encourage regeneration of vegetation. The track will be inspected following rehabilitation to confirm vegetation is regenerating and to identify any erosion issues or presence of weeds.

Timing

Current scheduling anticipates construction could commence from January 2022 or earlier, subject to environmental approvals being in place and depending on the timing and extent of the wet season. Construction will be undertaken to avoid periods with a high likelihood of significant rainfall (i.e. undertaken predominantly during the dry season) and is expected to be completed within approximately 10 months.

The haul road will be used to transport ore from J Quarry to the existing mine site. Consistent with current mining operations, the haul road may be in use up to 24 hours a day, seven days a week.

Workforce and Accommodation

The peak workforce required to construct the project is approximately 90 people. This will include existing mine employees, civil works contractors and existing mine site contractors. Specialist bridge contractors will be hired to construct the bridge.

Contractors undertaking construction activities are anticipated to be a combination of existing residents of Groote Eylandt and non-residents, employed on a fly-in and fly-out basis. Accommodation will be provided in the proponent's existing accommodation facilities, located near Alyangula. Contractors will be sourced from the existing contractor workforce as well as from the other states as required.

REVIEW OF ENVIRONMENTAL FACTORS

The NT EPA has produced a guideline on environmental factors and objectives (NT EPA, 2020a), which is designed to provide a systematic way to categorise information about the environment to enable effective environmental impact assessment and reporting. Environmental factors are aspects of the environment that may be impacted by a proposed action. The guideline identifies a total of 14 environmental factors, characterised under five themes, namely Land, Water, Sea, Air, and People (NT EPA, 2020a). Environmental objectives have been developed for each environmental factor and potential impacts must be considered relative to these objectives.

As per the guideline, this referral focuses on addressing environmental factors and objectives that are most relevant to the proposed activities. The following proposal specific factors were identified:

- Hydrological Processes;
- Inland Water Environmental Quality;
- Aquatic Ecosystems;
- Terrestrial Ecosystems; and
- Heritage and Culture.

These factors are discussed in detail in this referral. The assessments conclude that the project is not predicted to have a significant impact on the proposal specific factors. The overall conclusion of the referral is, therefore, that the project is not predicted to have a significant effect on the environment.

SURFACE WATER

Surface Water Use and Environmental Values

The project site is indicative of Groote Eylandt, being located in a relatively pristine setting. The surface water resources in the vicinity of the project site currently support a range of environmental values including aquatic ecosystems and human uses. No farming or agricultural activities have been undertaken within the project site or surrounding area. The environmental and cultural values of the site have been considered in developing the project design and assessing the potential impacts of the project.

Project Planning and Design

The project planning process identified the Emerald River as being culturally and environmentally sensitive. It was therefore a design priority to minimise potential impacts on this waterway and the Southern Tributary. The project design involved an iterative process whereby the haul road was initially designed as an embankment across a

large part of the Emerald River floodplain. This initial design would have provided optimum flood immunity for the haul road. However, hydraulic modelling and scour modelling of this initial design identified significant potential for scour in the bed of the Emerald River. Alternative lower impact haul road designs were subsequently investigated to avoid these impacts.

The preferred haul road design includes a number of design features that were adopted to minimise impacts on the Emerald River and its floodplain. These features include the following:

- The haul road is designed with a large span (36 m) bridge over the Emerald River. The large span bridge minimises geomorphic impacts on the Emerald River by spanning the river channel without piers or encroaching abutments. This design avoids the need for any construction or disturbance within the main river channel.
- To the south of the river, the haul road is designed to be generally at grade with two low-level causeways on the floodplain. This design minimises the impact of the road on flood flows across the floodplain.
- The haul road has been designed with drainage and suspended sediment controls to limit impacts on adjacent vegetation and downstream waterways.
- The haul road crossing of the Southern Tributary has been designed as a series of culverts in the tributary main channel and on the southern floodplain, with a low-level causeway in between. This design allows low flows to flow underneath the haul road via the culverts and larger flows to flow over the causeway, minimising impacts on flood flows in the floodplain.
- Culverts in the Southern Tributary will be designed in detail prior to construction. The design will take into account relevant fish passage guidelines and requirements.

Waterway Assessment Methodology

In order to assess the potential impacts of the project on surface water, hydraulic modelling was conducted as part of the haul road design to assess the effects on flood flow and flood velocities on the Emerald River and its floodplain. This information was then utilised to conduct an assessment of the geomorphologic impacts of the project.

Impact Assessment

The potential impacts on surface water values that were assessed for the project include the following:

- Potential changes to flood behaviour including flood levels and flow velocities, as well as potential changes to the geomorphology of the Emerald River and/or Southern Tributary; and
- Potential impacts on surface water quality as a result of erosion and sedimentation or contamination from spills and construction activities.

The assessments concluded that significant impacts are not predicted, largely due to the design features that have been adopted for the project. In addition, the proponent will adopt measures to avoid and mitigate potential impacts during the construction phase. These will include development of an Erosion and Sediment Control Plan and an Acid Sulfate Soils Management Plan, and adopting procedures for mobile refuelling and dust management. Given these measures, it is considered unlikely that project activities will significantly affect the surface water quality of the Emerald River or Southern Tributary.

AQUATIC ECOLOGY

Methodology

The assessment of aquatic ecology was undertaken by C&R Consulting for the project. The methodology for the aquatic ecology impact assessment included a desktop study, field surveys, data analysis and impact assessment. The aquatic ecology field survey of the Emerald River system was undertaken toward the beginning of the 2018 dry season (17th – 20th July 2018). Survey timing was heavily influenced by access constraints and safety concerns as well as the requirements for surveying protected aquatic fauna. The survey aimed to provide an indication of the different habitat types present within the Emerald River system by sampling within a range of estuarine and freshwater sites.

A likelihood of occurrence assessment was undertaken for listed species identified in database searches or field surveys to determine their potential to occur within the project site. The likelihood of occurrence was based on the known habitat preferences of these species, and the availability and condition of habitats which were evaluated during field surveys.

Assessments of Significance were undertaken for threatened or migratory fauna species listed under the EPBC Act that are present or have a moderate or high potential to occur in the project site. Assessments of Significance are threshold tests of significance prepared according to the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE 2013b) (the Significant Impact Guidelines). Assessments in accordance with the Significant Impact Guidelines were undertaken to gauge the significance of predicted impacts to threatened and migratory species. The guidelines are designed specifically to determine whether an activity is considered under the EPBC Act to have a significant impact on the species.

Impact Assessment

The potential impacts of the project were assessed for the aquatic environment. This referral relates to the realignment of an access corridor that would have required a bridge over the Emerald River and a crossing of the Southern Tributary. These crossings would have had the potential to impact on aquatic ecology. However, detailed design of these crossings had not been undertaken prior to the need to realign the access corridor being identified. As such, an assessment of the incremental impacts of the realigned access corridor (and haul road waterway crossings) is not possible. Consequently, the impact assessment has assessed the potential impacts of the proposed haul road design on aquatic ecology, rather than the incremental impacts that would have arisen from the realignment.

Design Features of the Project

The project has been designed to minimise impacts on the Emerald River floodplain and impacted waterways, which, in turn, minimises potential impacts on the aquatic ecology values inhabiting these waterways. The assessment of potential impacts on the Emerald River, its floodplain and the Southern Tributary concluded that the project is unlikely to have a significant adverse impact on the Emerald River and its floodplain. The key design features that have been adopted to avoid and mitigate potential impacts were described previously and reduce the project's potential to impact aquatic ecology inhabiting these waterways.

Potential Impacts on Emerald River Aquatic Ecology

An assessment of the following potential impacts on the aquatic ecology of the Emerald River was undertaken:

- Impacts to aquatic habitats from the alteration of hydrology around the bridge and the removal of riparian vegetation;
- Impacts to fish passage;

- Impacts to water and sediment quality/composition; and
- Increased risk of introducing pest flora and fauna.

The assessment concluded that these impacts will be localised and relatively minor, with a negligible influence on the downstream aquatic ecology values identified within this assessment.

Potential Impacts on Southern Tributary

The Southern Tributary culvert array will span the tributary channel. The following potential direct and indirect impacts to the aquatic ecology values of the Southern Tributary were assessed for the project:

- Impacts to aquatic habitats arising from the construction of the culverts and the associated removal of vegetation;
- Impacts to fish passage;
- Impacts to water and sediment quality/composition; and
- Increased risks from pest flora and fauna.

The assessment concluded that these impacts will be relatively minor, with a negligible influence on the downstream aquatic ecology values identified within this assessment.

Potential Impacts on Threatened and Migratory Species

As discussed previously, potential impacts from the Emerald River bridge have been minimised due to the bridge design (i.e. designing the bridge to span the breadth of the river, with no piers required in the main channel). As such, the potential impact of the Emerald River bridge on threatened or migratory species that may potentially inhabit this portion of the river are expected to be minimal. In addition, flood modelling and a geomorphological assessment undertaken for the project suggest that the project will have negligible influence on the Emerald River downstream of the project site and/or on coastal/marine ecosystems. As such, threatened or migratory species that may potentially inhabit the Emerald River downstream of the bridge are also unlikely to be impacted by the bridge.

As discussed previously, culverts are proposed to be constructed in the Southern Tributary. Therefore, direct and indirect impacts may arise for threatened or migratory species that have the potential to be present in this waterway. One of the identified species listed under the TPWC Act was determined to potentially utilise the Southern Tributary, namely Largetooth Sawfish (*Pristis pristis*) (listed as Vulnerable under the TPWC Act, and listed as Vulnerable and Migratory Marine under the EPBC Act). An assessment of significance was undertaken on this species to determine the potential to be impacted by the construction of the culverts on the Southern Tributary. The assessment concluded that the project will not have a significant impact on the listed species.

Overall, the project is not predicted to give rise to significant impacts on aquatic ecology.

TERRESTRIAL ECOLOGY

Methodology

The assessment of terrestrial ecology was undertaken by Cumberland Ecology for the project. The methodology for the assessment included a literature review and database assessment, and review of the extensive field surveys that have been undertaken within the project site and vicinity. Similar to the assessment of aquatic ecology, a likelihood of occurrence assessment was undertaken for listed species identified in database searches or field surveys to determine their potential to occur within the project site. Further assessment of the project's potential to impact on terrestrial ecology values was undertaken on species assessed as likely to occur in the project site.

Baseline Ecology Setting

The vegetation in the project site comprises remnant vegetation which is, overall, in very good condition, characterised by a high species and structural diversity. Parts of the surrounding land are subject to regular fires, which has resulted in a reduction in the amount of woody debris and has potentially also affected the species composition and structure of the vegetation.

The vegetation community patterns within the project site strongly reflect the geology, soils, drainages, topography, and the impacts of frequent fires. The most extensive vegetation communities within the project site and surrounds comprise open woodlands to open forests dominated by *Eucalyptus tetrodonta* (Darwin Stringybark). Melaleuca dominated vegetation occurs within the riparian zones and wetlands. As described previously, the project was specifically designed to avoid disturbance of sensitive vegetation types, specifically monsoon vine thicket and mangroves.

No Threatened Ecological Communities (TECs), or threatened flora species were identified as occurring or potentially occurring within a 20 km radius of the project site.

The following TPWC Act listed threatened fauna species have been recorded from the project site or have been assessed as having a high or moderate likelihood of occurring:

- Northern Quoll *(Dasyurus hallucatus)* (TPWC Act status: Critically Endangered; EPBC Act status: Endangered);
- Masked Owl (northern) (*Tyto novaehollandiae kimberli*) (TPWC Act status: Vulnerable; EPBC Act status: Vulnerable); and
- Mertens' Water Monitor (*Varanus mertens*) (TPWC Act Status: Vulnerable; EPBC Act status: not listed).

Impact Assessment

The project has the potential to give rise to direct and indirect impacts on flora and fauna. These include:

- Direct impacts such as clearing of vegetation and potential habitat for the project; and
- Indirect impacts, particularly those that have the potential to increase threats to threatened species such as habitat fragmentation, edge effects, the effects of noise and vibration, vehicle strikes, lighting, dust, erosion and the introduction of invasive species.

The project involves realigning an existing, approved access corridor and consequently the assessment focusses on the additional, incremental impacts of the realignment, compared to the impacts from the approved alignment. These incremental impacts were assessed for terrestrial ecology values identified in the project site.

The largest direct impact of the project is the removal of native vegetation that also provides habitat for a wide range of flora and fauna species. The project will require clearing of an additional 14 ha of vegetation, in addition to the 10 ha that would have been cleared within the existing approved access corridor. Clearing is predominantly of Eucalypt open forest and woodlands, which are widespread across Groote Eylandt. Some clearing of riparian vegetation will also be required, given that the project involves two waterway crossings. The area to be cleared has been minimised where possible, in consultation with the ALC and Traditional Owners through the siting and design of the crossings.

The clearing of habitats for the project will remove specific habitat features utilised by fauna species for foraging, sheltering, roosting, and breeding. However, extensive areas of land containing similar habitat and habitat features occur within the surrounding region, and it is anticipated that the flora and fauna species utilising the habitat that will be cleared will continue to persist in adjacent areas where suitable habitat is present.

Indirect impacts may arise from the project that have the potential to impact the remaining vegetation and surrounding habitats used by terrestrial flora and fauna species. However, these impacts are expected to be similar to those that would have arisen from the construction of the haul road within the existing, approved access

corridor. As such, it is unlikely any additional, incremental indirect impacts associated with realignment of the access corridor will significantly impact on terrestrial ecology.

In addition, there are also a number of management measures and procedures currently in place that are used at the existing mine to manage environmental impacts. In particular, such measures include measures to manage the key threats of introducing weed or pest species such as the Cane Toad to the island. These measures will also apply to the project and will assist to reduce the potential for these indirect impacts to arise from the project.

The impacts of the project were also specifically assessed for the listed species either present or with a moderate or high likelihood of occurring in the project site. The assessments of significance concluded that the incremental impacts of the project will not give rise to significant impacts. This was due to the small additional clearing required to be undertaken (less than 14 ha) which amounts to a very small proportion of the available habitat for each species that will remain on the island. In addition, the proponent has undertaken a significant planning process to realign the access corridor and design the haul road to minimise potential environmental impacts. The proponent also has a suite of impact avoidance and mitigation measures in place that will assist to reduce potential impacts on these threatened species. The measures include a Permit to Clear process, clearing procedures, weed management measures and quarantine measures in place to prevent the introduction of Cane Toads. Overall, it was concluded that given the measures to avoid and minimise the incremental impacts of the project, no significant impacts on terrestrial flora and fauna are predicted.

CULTURE AND HERITAGE

The assessment of the project's potential to impact on culture and heritage included consideration of sacred sites and archaeology. It draws on information from several specialist sacred sites studies and archaeological reports.

Sacred Sites

The ALC's anthropology department work with the Traditional Owners on Groote Eylandt to research and record traditional culture, and identify areas where access is restricted for cultural reasons (ALC, 2019b). In 2016, the proponent engaged the ALC anthropology department to undertake a sacred sites assessment and prepare a report that provides clear documentation of the sacred sites located in the Western Leases (and areas in close proximity), in order to ensure that future activities do not give rise to any impacts on sacred sites. The project is located partially within the study area of the sacred site assessment. This work was completed in 2019. The work included identifying and locating sacred sites and describing the required protection measures (including designation of buffer zones) that Traditional Owners believe are suitable for the management of the sacred sites, in perpetuity. A large number of sacred sites were documented in the assessment, including sites in proximity to the existing, approved access corridor.

The sacred sites assessment, along with the proponent's extensive consultation with the ALC and Traditional Owners, has informed the location and design of the project, which avoids all known sacred sites and associated buffer zones.

In the coming months, the proponent intends to lodge an application for an Authority Certificate for the Western Leases, which will include the project site. An Authority Certificate provides conditions for any works undertaken on or near sacred sites. Although it is not a legal requirement to be in possession of an Authority Certificate, having an Authority Certificate and undertaking the work in accordance with the requirements of the certificate indemnifies the holder against prosecution under the Sacred Sites Act for damage to sacred sites in the area of the Authority Certificate.

Archaeology

Public registers were searched to determine if there are any objects or places present in the project site that are protected on public registers. In addition, an archaeological report detailing a survey conducted within the south west portion of Groote Eylandt (including the full extent of the project site) was consulted to determine if any archaeological sites have been discovered in proximity to the project site.

The registers and archaeological report did not identify any Indigenous or non-Indigenous archaeological sites that may be impacted by the project. Nevertheless, a procedure for unexpected finds will be adopted as a precautionary measure.

ENVIRONMENTAL MANAGEMENT

Given the proponent has been undertaking mining and exploration activities on Groote Eylandt for over 50 years, the proponent has a suite of management measures and procedures that are used at the existing mine to manage environmental impacts. These management measures and procedures will also apply to the project, where relevant. These measures and procedures include clearing procedures, rehabilitation activities, and the management of erosion and sedimentation, acid sulphate soils, invasive species, wastes and hazardous materials. These measures will assist to manage the potential impacts that may arise from the project.

CONCLUSION

The overall conclusion of the referral is that the project is not predicted to have a significant effect on the environment. There is a high level of confidence in this conclusion because of the extensive design process the proponent has undertaken over several years to select an optimal realignment for the access corridor and to design the associated haul road to minimise environmental and cultural impacts. This process included identification and investigation of a number of alternative access corridor alignments, followed by an iterative engineering design process to optimise the haul road design and waterway crossings. The process included extensive consultation with the ALC and the Traditional Owners. Consultation aimed to ensure the Traditional Owners were informed of the constraints and potential impacts of alternatives and to progressively advise them of the progress in developing a suitable design. This culminated in the ALC, on behalf of the Traditional Owners signing a Haul Road Agreement in July 2020, consenting to the project.

This referral assessed the environmental factors and objectives that were most relevant to the proposed activities. The following proposal specific factors were identified:

- Hydrological Processes;
- Inland Water Environmental Quality;
- Aquatic Ecosystems;
- Terrestrial Ecosystems; and
- Heritage and Culture.

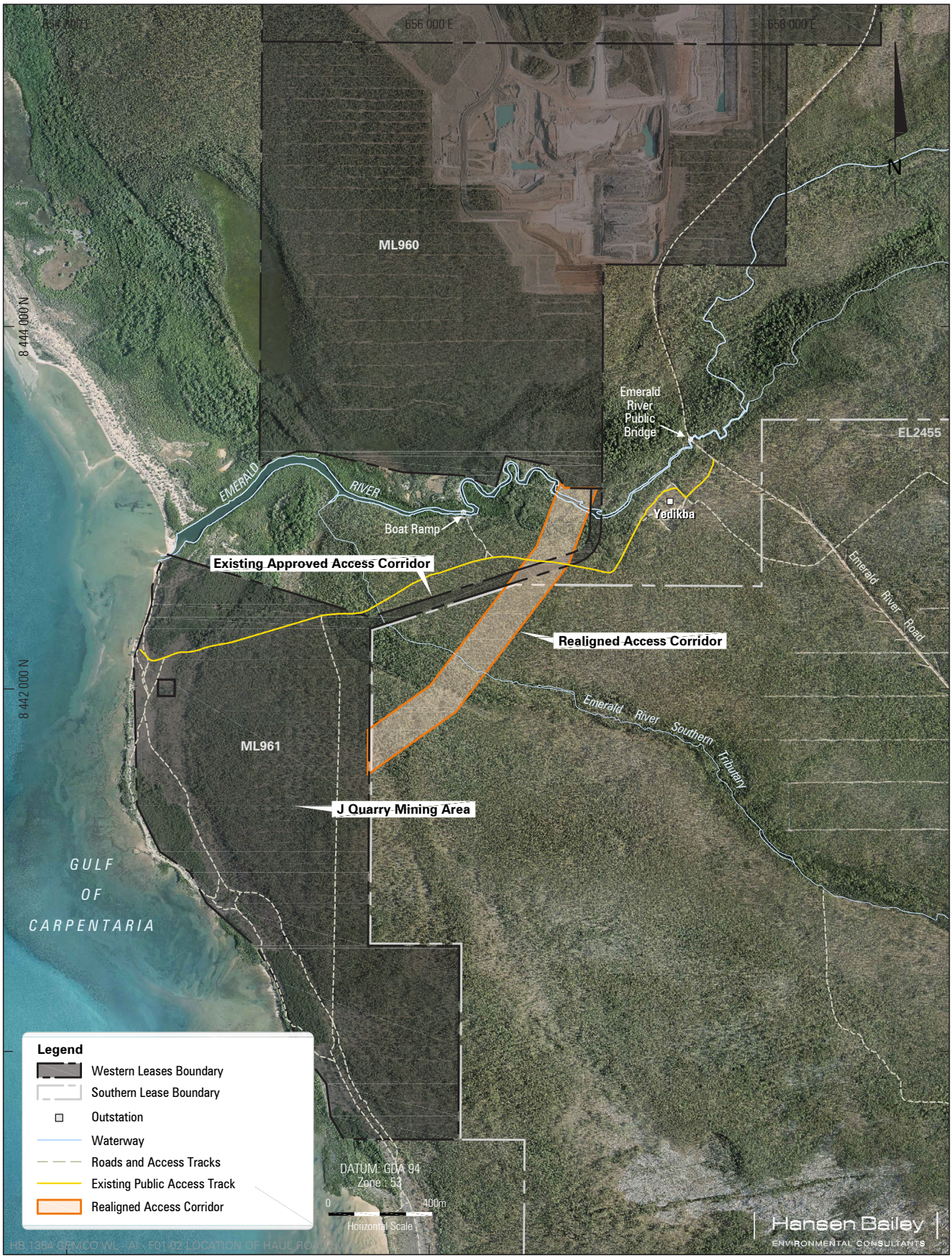
The impact assessments undertaken to investigate these environmental factors concluded that the realignment of the access corridor is not predicted to have a significant impact on these environmental factors. The overall conclusion of the referral is, therefore, that the project is not predicted to have a significant effect on the environment.

FIGURES

J QUARRY HAUL ROAD REALIGNMENT

Location Plan

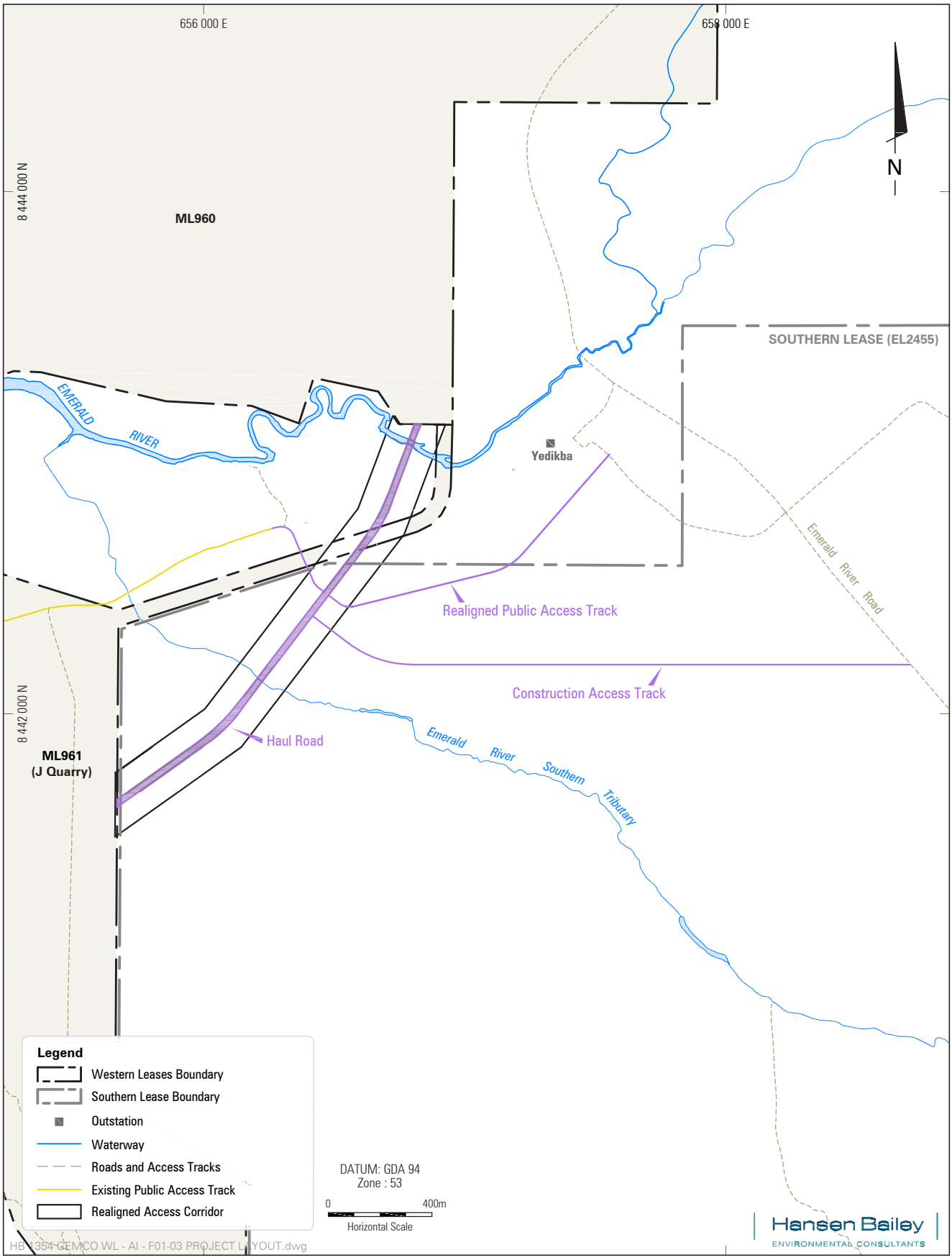
FIGURE 1



J QUARRY HAUL ROAD REALIGNMENT

Location of Realigned Access Corridor

FIGURE 2

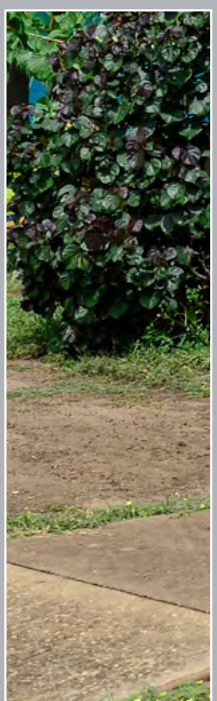


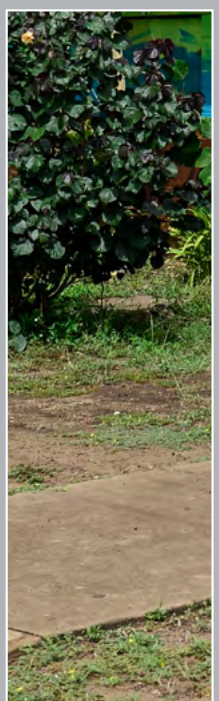
J QUARRY HAUL ROAD REALIGNMENT

Project Layout

FIGURE 3

Table of Contents





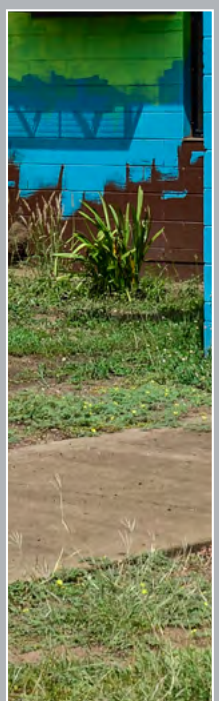


TABLE OF CONTENTS

Tables

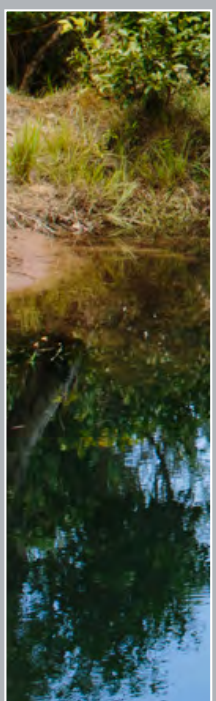
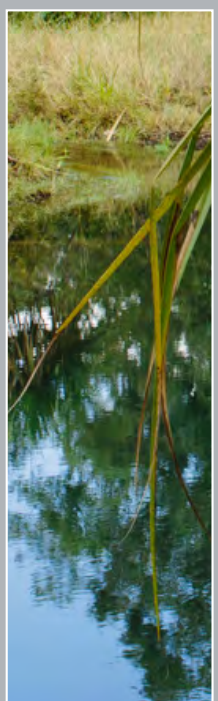
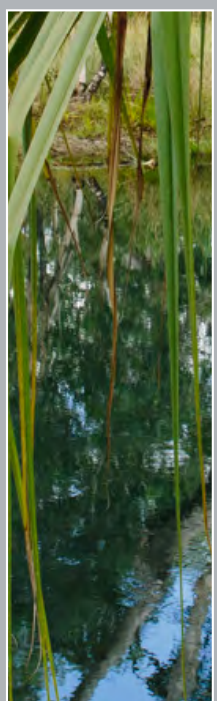
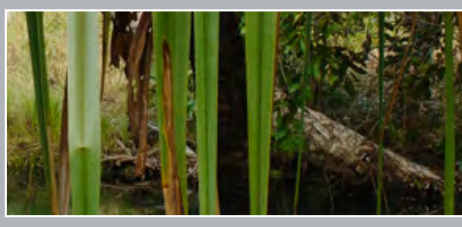
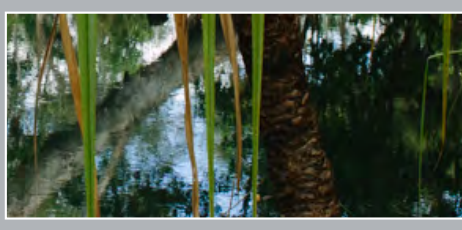
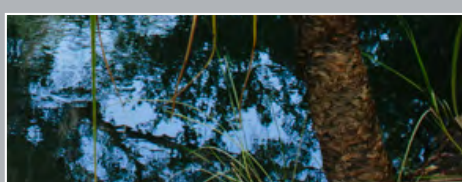
Figures

Attachments

1

Introduction



CONTENTS

Tables

Figures

Attachments

1 INTRODUCTION

1.1 INTRODUCTION

The Groote Eylandt Mining Company Pty Ltd (GEMCO) (the "proponent") is proposing to realign an existing approved access corridor that connects existing mining leases within the Western Leases mining operations. The existing approved access corridor provides for the future development of a haul road that would connect the existing mine to the approved J Quarry mining area, located to the south of the Emerald River. A referral under the *Environment Protection Act 2019* (EP Act) (this document) has been prepared to assess the potential impacts of the realignment of the access corridor and the construction of a haul road within the realigned corridor. The referral will be submitted to the Northern Territory Environment Protection Authority (NT EPA) for assessment.

This introduction provides an overview of the project and a description of the proponent. It also provides a description of the key regulatory approvals and the environmental approval requirements. The structure of this document and the study team who have contributed to the document are also discussed.

1.2 PROJECT OVERVIEW

The proponent operates a manganese mine on Groote Eylandt in the Gulf of Carpentaria, approximately 650 km south-east of Darwin (Figure 1-1). The mine is the main development on the island and has been operating for over 50 years. Operations at the mine involve mining manganese ore by open cut mining methods. Once the ore has been sized and washed, it is transported to the proponent's port facility at Milner Bay (Figure 1-1). Manganese ore is sold to both domestic and export markets.

Mining occurs in multiple mineral leases, known as the Western Leases (Figure 1-1). The Western Leases were progressively granted in the 1960s and 1970s. The proponent's existing operations in the Western Leases are located on the northern side of the Emerald River. In 2023, mining is scheduled to progress into the southernmost mineral lease (ML) 961, which contains a future mining area known as J Quarry, located on the southern side of the Emerald River (Figure 1-2). ML 961 includes an access corridor connecting J Quarry to the mineral leases north of the Emerald River. A recent survey has revealed the presence of a sacred site in close proximity to the existing access corridor and it will, therefore, be necessary to realign the access corridor to provide a suitable buffer around the sacred site.

Gaining access to the J Quarry mining area requires the construction of a new haul road in the approved access corridor. The haul road would require a bridge across the Emerald River and a crossing of an ephemeral tributary of the Emerald River, referred to as the Southern Tributary (Figure 1-2).

The project involves the realignment of the access corridor and the associated development of a haul road within the corridor. The key elements of the project are shown in Figure 1-3 and include:

- Construction of a haul road that links the existing Western Leases mining operations north of the Emerald River to J Quarry. The road includes a bridge over the Emerald River and also traverses the Southern Tributary.
- Construction of an access track to enable construction equipment to access the area to the south of the Emerald River.
- Realignment of an existing public access track to enable safe public access to the western coast of Groote Eylandt. The realignment includes construction of a single lane light vehicle underpass beneath the haul road.

As shown in Figure 1-3, the realigned access corridor is located beyond the proponent's existing mineral leases. The project requires approval for activities that are beyond the existing mineral leases. Activities within the Western Leases, including mining in J Quarry and construction and operation of the haul road within the access corridor, are authorised under existing approvals.

1.3 THE PROPONENT

The proponent has two shareholders, South32 Limited (60%) and Anglo Operations (Australia) Pty Ltd (40%):

- South32 is an independent global metals and mining company. The company is listed on the Australian, Johannesburg and London Stock Exchanges, and is headquartered in Perth. South32 is globally diverse, with interests in five countries, including Australia and South Africa. South32 has high-quality operations in aluminium, bauxite, coal, lead, nickel, silver, zinc and manganese.
- Anglo Operations (Australia) Pty Ltd is a wholly owned subsidiary of Anglo American Plc, a mining group based in the United Kingdom that is listed on the London Stock Exchange. Anglo American Plc is one of the world's largest mining companies and has a diverse portfolio of interests in coal, iron ore, manganese, base metals, precious metals, and minerals.

Key contact details for the proponent and Hansen Bailey, its environmental consultant for this environmental assessment, are provided in Table 1-1.

Table 1-1 Contact Details

CONTACT DETAILS	PROPONENT	ENVIRONMENTAL CONSULTANT
Company Name	Groote Eylandt Mining Company Pty Ltd (GEMCO)	Hansen Bailey
Primary Contact Person	Mr Mike Chapman	Ms Laura Knowles
Title	Project Study & Approvals Manager	Principal Environmental Scientist
Postal Address	GEMCO, Rowell Highway, Alyangula NT 0885	GPO BOX 3285, Brisbane QLD 4001
Phone	+61 8 8987 4444	+61 7 3226 0900
Email	mike.chapman@south32.net	lknowles@hansenbailey.com.au

1.4 REGULATORY APPROVALS

1.4.1 Overview

Table 1-2 lists the key regulatory approvals required for the project. The approval process under the EP Act is also described in the following sections.

Table 1-2 Key Regulatory Approvals

APPROVAL	LEGISLATION	AGENCY	STATUS
NORTHERN TERRITORY APPROVALS			
Environmental Approval	*Environment Protection Act 2019* (NT) (EP Act)	Northern Territory Environment Protection Authority (NT EPA)	Under the EP Act, if a project has the potential to have a significant impact on the environment, a referral must be made to the NT EPA to confirm if an approval is required and, if required, the appropriate approval pathway. This referral describes the environmental assessment and will be submitted to the NT EPA to determine if an approval is required under the EP Act.
Mining Management Plan	*Mining Management Act 2001* (NT)	Department of Primary Industry and Resources (DPIR)	Mining activities in the Western Leases are described in a Mining Management Plan (MMP) that forms the basis for an Authorisation under the *Mining Management Act 2001.* The existing MMP describes the proposed mining activities and details the environmental management measures to be adopted. Mining activities associated with the project (i.e. the realignment of the access corridor and associated development of the haul road and construction access track), will be required to be included in an amended MMP. The Authorisation of the amended MMP will not be granted until the NT EPA has undertaken any necessary environmental assessment under the EP Act.
Access Authority	*Mineral Titles Act 2010* (NT)	DPIR	The access corridor located beyond GEMCO's mineral leases requires an Access Authority. An Access Authority was approved on 12 October 2020 (Access Authority 32517).
FEDERAL GOVERNMENT APPROVALS			
EPBC Act Approval	*Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)	Department of Agriculture, Water and the Environment (DAWE)	The EPBC Act requires approval to be obtained for activities that are likely to have a significant impact on Matters of National Environmental Significance (MNES). Threatened Species and Communities, and Migratory Species are the only two MNES that may be relevant to the project. An assessment of significance has been undertaken using the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* prepared by the Department of the Environment (2013), and provided in the *Aquatic Ecology Report* (Appendix C) and the *Terrestrial Ecology Report* (Appendix D). It has concluded that the project is unlikely to have a significant impact on these MNES and approval under the EPBC Act is therefore not required.

APPROVAL	LEGISLATION	AGENCY	STATUS
Landowner consent	*Aboriginal Land Rights (Northern Territory) Act 1976* (Cth) (ALRA)	Federal Minister for Indigenous Affairs	The ALRA is Commonwealth legislation which provides Aboriginal landowners with legal title to traditional lands. Freehold land granted under ALRA is referred to as Aboriginal land. Groote Eylandt is Aboriginal land under ALRA and the Anindilyakwa Land Council (ALC) is the land council responsible for this land. The proponent reached an agreement with the ALC, on behalf of the Traditional Owners, allowing the realignment of the access corridor and associated development of the haul road. The agreement is in the form of a Haul Road Agreement, under ALRA, which was signed on 15 July 2020.

1.4.2 EP Act Environmental Approval Process

Overview of Process

The EP Act and *Environment Protection Regulations 2020* (NT) (EP Regulations) establish a framework for assessing potential environmental impacts of development projects (termed "actions''). The NT EPA is the administering authority for the EP Act. Actions with the potential to have a significant effect on the environment require an impact assessment to be undertaken under the EP Act. Such actions must be assessed and approved by the Northern Territory Minister for the Environment (the Minister) before proceeding. The main steps involved in obtaining an environmental approval under the EP Act are described below, with details of the project activities conducted to date.

Step 1 – Preliminary Planning

The proponent has undertaken detailed preliminary planning of the revised alignment of the access corridor and the associated haul road design. This was undertaken in order to understand the potential environmental impacts that may arise from the project and to select the most appropriate location and design. Environmental investigations in terrestrial and aquatic ecology, cultural heritage, archaeology, flood modelling and geomorphology informed the planning process. Extensive consultation with Traditional Owners has also occurred as part of the planning process.

The process culminated in the proponent's self-assessment of the proposed action, which concluded that significant adverse impacts on the environment are unlikely to arise from the project. As part of the self-assessment process, the proponent consulted with government agencies regarding the project, including holding a pre-lodgement meeting with the NT EPA on 13 October 2020 with the following attendees:

- Lisa Bradley, Director Environmental Assessment, Environment Division, Department of Environment, Parks and Water Security (DEPWS)[1];
- Kylie Fitzpatrick, Manager Environmental Assessment, Environment Division, DEPWS;
- Graeme Gillespie, Director Terrestrial Ecosystems, Flora and Fauna Division, DEPWS; and
- David Rhind, Development Assessment Coordinator, Flora and Fauna Division, DEPWS.

At the pre-lodgement meeting, the proponent confirmed they will be lodging a referral in order to obtain legal certainty as to whether an environmental approval is required under the EP Act for the project.

[1] The NT EPA is an independent authority, comprising a small number of board members. The Environment Division of DEPWS provide services to the NT EPA.

Step 2 – Preparation and Lodgement of Referral

A referral has been prepared under the EP Act (this document). It includes detailed specialist information relating to environmental factors that have the potential to be impacted by the project. Hansen Bailey has prepared this referral on behalf of the proponent. It has been prepared to provide sufficient information to enable the NT EPA to determine if the project is expected to give rise to significant impacts and hence whether it will require approval under the EP Act. This referral has been prepared in accordance with the referral information requirements described in the NT EPA Guideline *Referring a Proposed Action to the NT EPA, Environmental impact assessment guidance for proponents* (NT EPA, 2020b).

As per the guideline, this referral focuses on addressing environmental factors and objectives that are most relevant to the proposed activities. Section 3 – Review of Environmental Factors outlines the environmental factors and describes which factors and objectives are relevant to the project (i.e. termed "proposal specific factors"). The following proposal specific factors were identified:

- Hydrological Processes, discussed in Section 4 – Surface Water;
- Inland Water Environmental Quality, discussed in Section 4 – Surface Water;
- Aquatic Ecosystems, discussed in Section 5 – Aquatic Ecology;
- Terrestrial Ecosystems, discussed in Section 6 – Terrestrial Ecology; and
- Heritage and Culture, discussed in Section 7 – Culture and Heritage.

These sections conclude that the project is not predicted to have a significant impact on the proposal specific factors. The overall conclusion of the referral is, therefore, that the project is not predicted to have a significant effect on the environment.

The EP Act (s. 42) also sets out five key objectives that must be considered during the environmental impact assessment process, namely consideration of:

- The principles of ecologically sustainable development (defined in s. 17);
- The environmental decision-making hierarchy (s. 26);
- The waste management hierarchy (defined in s. 27);
- Ecosystem-based management; and
- The impacts of a changing climate.

These objectives and how they have been considered in this environmental impact assessment are included in Attachment 1-1.

Step 3 – NT EPA Reviews Referral

The NT EPA will conduct a preliminary review of the referral to determine whether it contains sufficient information to inform stakeholders of the proposed action and whether it has the potential to have a significant impact on the environment. This review can take up to 15 business days. The NT EPA may also request additional information to be provided, if needed. The preliminary review will culminate in the NT EPA either accepting or rejecting the referral.

Step 4 – Public Exhibition of Referral

If the NT EPA accepts the referral, it is placed on public exhibition for 20 business days. Government agencies and the public can make submissions on the referral during this period.

Step 5 – Decision on Assessment Approach

Within 30 business days from the end of the public exhibition period, the NT EPA will determine whether the proposed action requires approval under the EP Act due to the potential for significant impacts on the environment, and if so, the assessment approach required. Alternatively, the NT EPA may decide at this stage that the proposed action does not require an approval under the EP Act. The NT EPA may also decide that the proposed action presents an unacceptable impact to the environment, in which case an environmental approval will be refused. A notice of decision will be provided to the proponent, supported by a statement of reasons.

If an environmental approval is required, there are four possible environmental assessment approaches. These are summarised in Table 1-3.

Table 1-3 EP Act Environmental Assessment Approaches

ASSESSMENT APPROACH	DETAILS
Assessment on Referral Information	The proposed action may have a potentially significant impact on the environment. Impacts can be assessed based on information contained in the referral, as well as any public submissions.
Assessment by Supplementary Environmental Report (SER)	The proposed action may have a potentially significant impact on the environment, and an additional environmental report is required to respond to matters raised by public submissions and/or to provide some limited additional information relating to specific aspects of potential significance that are requested by the NT EPA.
Assessment by Environmental Impact Statement (EIS)	The proposed action may have a potentially significant impact on the environment, and there are a number of matters and/or complexity or uncertainty requiring further investigation. An EIS is the most intensive level of assessment.
Assessment by Inquiry	The proposed action may have a potentially significant impact on the environment, and traditional assessment approaches are not suitable for the proposed action (e.g. if cultural issues prevent impacted communities from being able to engage in a paper-based assessment approach). A panel, appointed by the NT EPA, will undertake an inquiry that addresses an approved Terms of Reference.

1.5 REPORT STRUCTURE

This document is structured as follows:

Volume 1

Section 1	Introduction	Section 7	Culture and Heritage
Section 2	Project Description	Section 8	Environmental Management
Section 3	Review of Environmental Factors	Section 9	Glossary
Section 4	Surface Water	Section 10	Abbreviations
Section 5	Aquatic Ecology	Section 11	References
Section 6	Terrestrial Ecology		

Volume 2

Appendix A	Hydrology and Hydraulics Assessment Report
Appendix B	Geomorphic Impact Assessment Report
Appendix C	Aquatic Ecology Report
Appendix D	Terrestrial Ecology Report

1.6 STUDY TEAM

This document has been prepared by Hansen Bailey in association with technical specialists. Table 1-4 lists the document components and study team members involved in researching, writing and reviewing each section.

The proponent would like to gratefully acknowledge the assistance of the Traditional Owners of Groote Eylandt and the ALC, particularly in the undertaking of cultural heritage surveys that contributed to this referral.

Table 1-4 Study Team

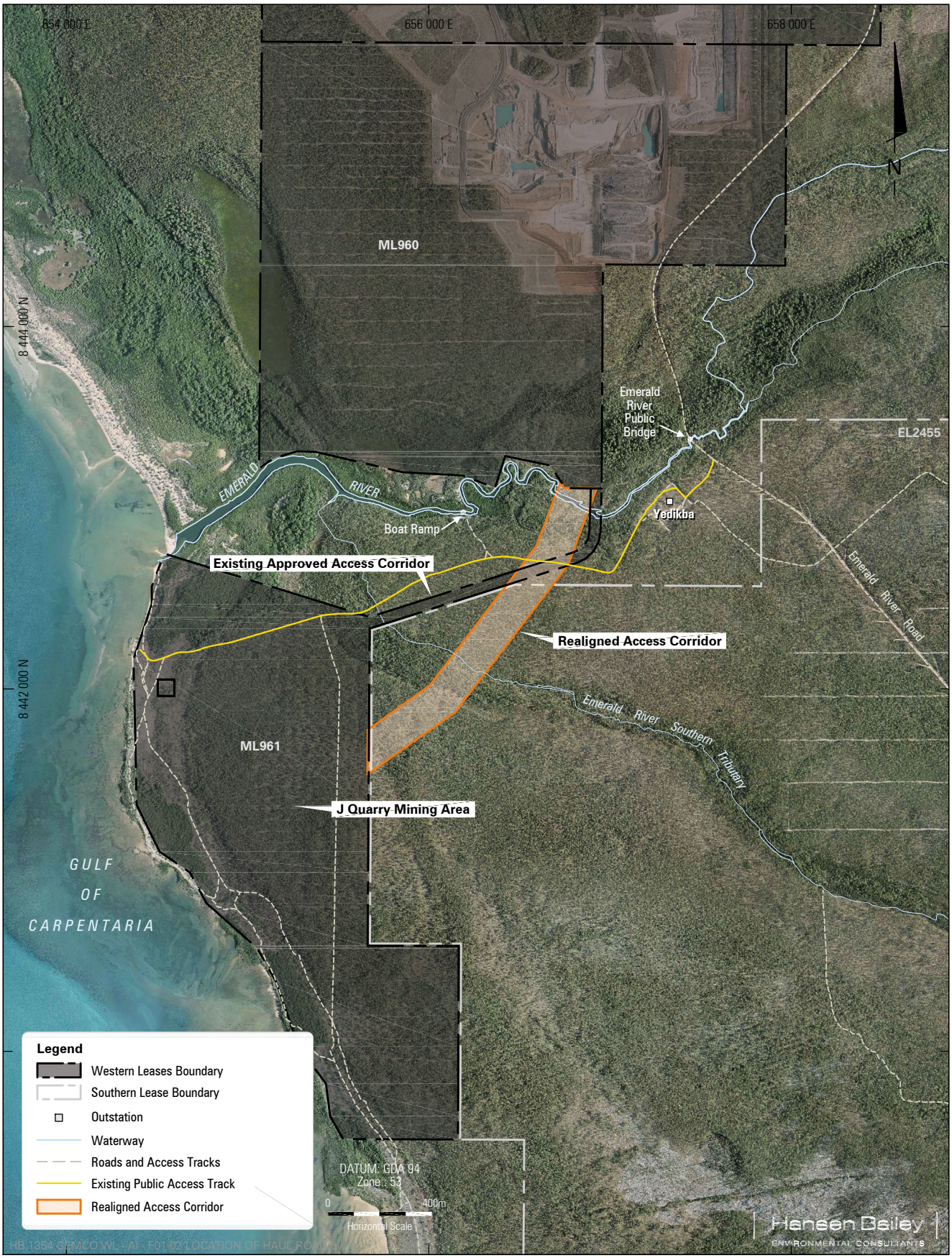
DOCUMENT COMPONENT		TEAM MEMBER	COMPANY
DOCUMENT PREPARATION AND MANAGEMENT			
Project Director		Peter Hansen	Hansen Bailey
Project Manager		Lisa Sunderland	Hansen Bailey
Contributors		Laura Knowles Jesse Campbell	Hansen Bailey
SPECIALIST REPORTS			
A	Hydrology and Hydraulics Assessment Report	Drew Crossley	Red Earth Engineering
B	Geomorphic Impact Assessment Report	Greg Roads	WRM Water & Environment
C	Aquatic Ecology Report	Matthew Knott	C&R Consulting
D	Terrestrial Ecology Report	David Robertson	Cumberland Ecology

FIGURES

J QUARRY HAUL ROAD REALIGNMENT

Location Plan

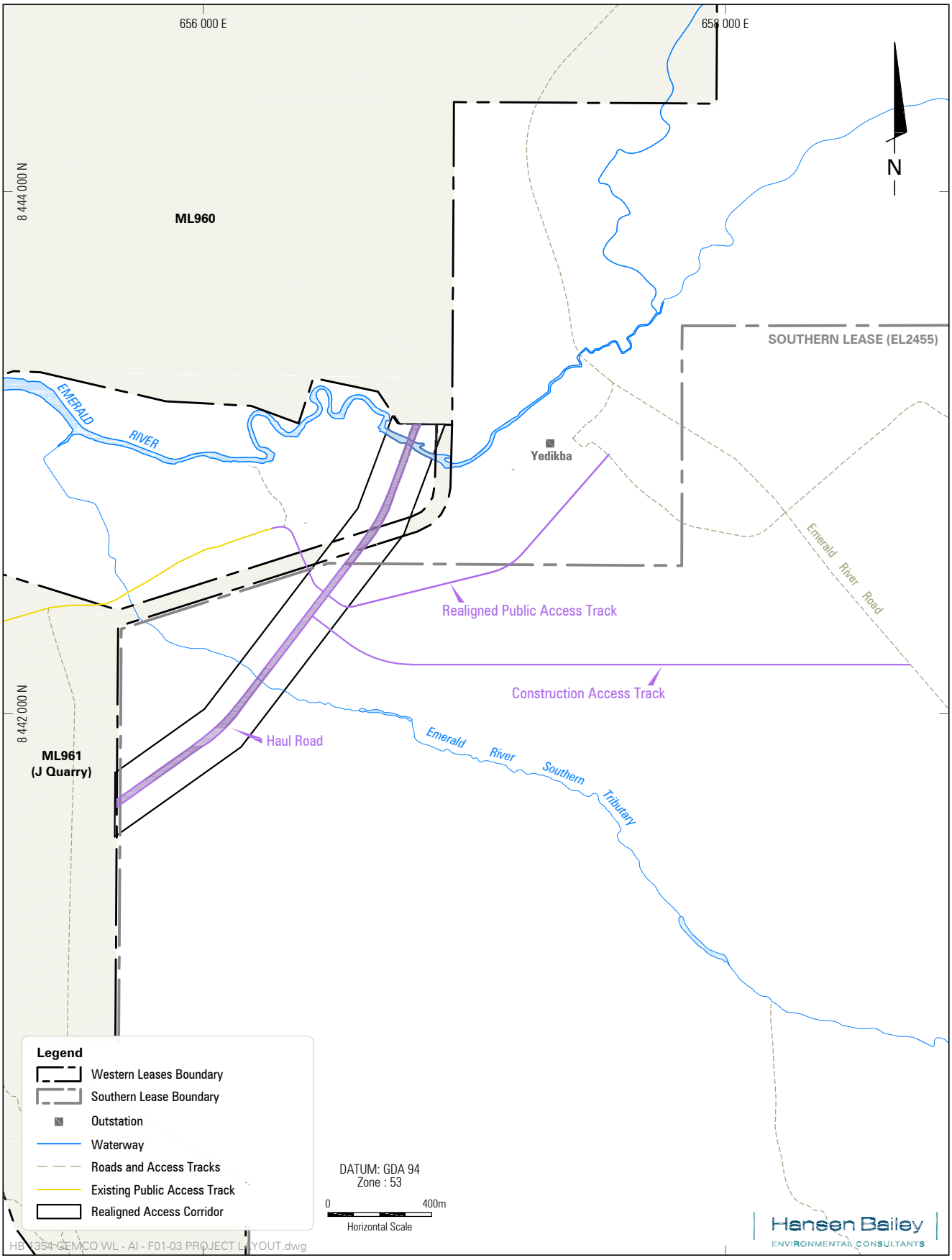
FIGURE 1-1



J QUARRY HAUL ROAD REALIGNMENT

Location of Realigned Access Corridor

FIGURE 1-2



J QUARRY HAUL ROAD REALIGNMENT

Project Layout

FIGURE 1-3

ATTACHMENTS

1-1 EP Act Environmental Impact Assessment Objectives

1.1 INTRODUCTION

The *Environment Protection Act 2019* (NT) (EP Act) indicates that the purpose of the environmental impact assessment process is to ensure that:

"all actions that may have a significant impact on the environment are assessed, planned and carried out taking into account:

(i) the principles of ecologically sustainable development;

(ii) the environmental decision-making hierarchy;

(iii) the waste management hierarchy;

(iv) ecosystem-based management; and

(v) the impacts of a changing climate" (s. 42).

This attachment outlines the way in which the project has been designed to address these aspects.

1.2 PRINCIPLES OF ECOLOGICALLY SUSTAINABLE DEVELOPMENT

The EP Act defines Ecologically Sustainable Development (ESD) as being "*development that improves the total quality of human life, both now and in the future, in a way that:*

a. maintains the ecological processes on which all life depends; and

b. recognises the need for development to be equitable between current and future generations" (s. 4).

The principles of ESD are also outlined in sections 17 - 24 of the EP Act. Table 1 presents the principles of ESD and contains a discussion of the way in which the project meets these principles.

Table 1 Principles of Ecologically Sustainable Development

ESD PRINCIPLE	RELEVANCE TO PROJECT
Decision-making principle – ■ Decision making processes should effectively integrate both long term and short term environmental and equitable considerations. ■ Decision making processes should provide for community involvement in relation to decisions and actions that affect the community.	The assessment of impacts has taken into account both long and short-term impacts. Many impacts are short-term, construction impacts, and can be mitigated through the implementation of the management measures described in this referral. Other impacts are longer-term and associated with the operational use of the haul road. Measures that are currently successfully used at the existing mine are proposed to be adopted to manage operational impacts of the haul road. As described in Section 2 – Project Description, the proponent has undertaken a rigorous decision-making process, over several years, to select an optimal realignment for the access corridor and to design the associated haul road to minimise environmental and cultural impacts. This process included extensive consultation with the Anindilyakwa Land Council (ALC) and the Traditional Owners. Consultation was undertaken to gain an understanding of stakeholders' concerns and issues in relation to the project, and to identify constraints on the siting and design of the project. Stakeholders were provided with feedback on the outcomes of environmental studies, including constraints relating to biodiversity and hydrology, and were informed of the

ESD PRINCIPLE	RELEVANCE TO PROJECT
	potential impacts of alternatives. Stakeholders were kept abreast of the progress made in developing a suitable design. This consultation culminated in the ALC, on behalf of the Traditional Owners, signing a Haul Road Agreement under the *Aboriginal Land Rights (Northern Territory) Act 1976* (NT) (ALRA), consenting to the realignment of the access corridor and development of the associated haul road, the bridge design, construction access track, and realigned public access track.
Precautionary principle – ■ 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. ■ Decision making should be guided by: ■ A careful evaluation to avoid serious or irreversible damage to the environment wherever practicable; and ■ An assessment of the risk-weighted consequences of various options.	The environmental impact assessment has concluded that the project is not predicted to have a significant impact on the environment. As such, the project is not considered to pose a threat of serious or irreversible environmental damage. In addition, the environmental impact assessment has been undertaken by suitably qualified, experienced specialists and is based on operational experience gained at the existing mine, over the last 50 years. It considers the application of mitigation measures, many of which are measures that the proponent successfully uses to manage environmental impacts at the existing mine. As such, there is a high degree of certainty regarding the potential environmental impacts that may arise from the project and, in particular, the effectiveness of the proposed mitigation measures. Section 2 – Project Description also describes the decision-making process that the proponent has undertaken over several years to select an optimal realignment of the access corridor and to design the haul road to minimise environmental and cultural impacts. This process included identifying alternative corridor alignments and undertaking a detailed options assessment and pre-feasibility study process to select a preferred realignment option. This process was informed by various cultural, environmental and engineering studies that were completed to inform the selection of the preferred alignment. Once the access corridor realignment was selected, an iterative engineering process was undertaken that included consideration of the optimal design of the waterway crossings to minimise impacts on existing sediment transport characteristics and water quality in the waterways. Further impact assessment work was undertaken to inform the engineering design including hydraulic modelling and geomorphic impact assessments. This process confirms the proponent's careful evaluation of potential impacts that informed the realignment of the access corridor and the haul road design.
Principle of evidence-based decision making – ■ Decisions should be based on the best available evidence in the circumstances that is relevant and reliable.	The environmental impact assessment has been informed by detailed technical assessments that have drawn on the best available information to identify the environmental values present in the project site and to assess the potential for the project to impact these values.
Principle of intergenerational and intragenerational equity – ■ The present generation should ensure that the health, diversity and productivity of the	Given that the project is not predicted to give rise to a significant impact on environmental or cultural values, it will not impact the health, diversity and productivity of the environment for future generations. Upon cessation of mining, the haul road and construction access track will no longer be required by the proponent. At this time and in

ESD PRINCIPLE	RELEVANCE TO PROJECT
environment is maintained or enhanced for the benefit of future generations.	accordance with the Haul Road Agreement with the ALC (on behalf of the Traditional Owners), the proponent will consult with Traditional Owners regarding the long-term future of this infrastructure. It is expected that these roads will either be permanently closed and rehabilitated, or ownership will be transferred to Traditional Owners to enable access to country. Either of these options considers the principle of intergenerational and intragenerational equity by ensuring the final land use of the roads is maintained (i.e. as vegetated areas used for ecological purposes) or enhanced by providing access to country for the benefit of future generations of Traditional Owners. The realigned access track will remain in place for the benefit of Traditional Owners, facilitating access to country, particularly to the western side of Groote Eylandt.
Principle of sustainable use – ■ Natural resources should be used in a manner that is sustainable, prudent, rational, wise and appropriate.	Not applicable.
Principle of conservation of biological diversity and ecological integrity – ■ Biological diversity and ecological integrity should be conserved and maintained.	As described in detail in Section 2 – Project Description, the preferred realignment of the access corridor was selected based on the following objectives: ■ There would be no disturbance of nearby sacred sites; ■ There would be no disturbance of the Emerald River main channel, which is both culturally and environmentally sensitive; and ■ There would be no disturbance of significant vegetation types such as vine thicket and mangroves, due to cultural and environmental sensitivities. In addition, the haul road design has been developed to optimise the location of the haul road within the access corridor in order to reduce the clearing width, as well as to design the haul road to minimise impacts on the Emerald River floodplain and flood flows. The engineering design process also included consideration of the optimal design of the waterway crossings to minimise impacts on existing sediment transport characteristics and water quality in the waterways. This planning process confirms the proponent's approach to considering biological diversity and ecological integrity throughout the design and planning process.
■ Principle of improved valuation, pricing and incentive mechanisms ■ Environmental factors should be included in the valuation of assets and services. ■ Persons who generate pollution and waste should bear the costs of containment, avoidance and abatement. ■ Users of goods and services should pay prices based on the	All relevant environmental factors have been considered in the environmental impact assessment undertaken for the project. The cost to rehabilitate the haul road and construction access track will be included in the security estimate for the existing mine, accounting for these activities as part of the asset. The potential to generate pollution and waste has been considered in the environmental impact assessment outlined in Section 4 – Surface Water and Section 8 – Environmental Management. The haul road design specifically addressed the potential for surface water quality impacts from haul road runoff, and drainage infrastructure has been designed to capture and treat water prior to release into the surrounding vegetation. This system will limit the potential for

ESD PRINCIPLE	RELEVANCE TO PROJECT
full life cycle of costs of providing the goods and services, including costs relation to the use of natural resources and the ultimate disposal of wastes. ■ 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.	suspended sediment to impact adjacent vegetation and downstream waterways. The project is not expected to generate large volumes of waste. Any wastes generated by the project will be disposed in accordance with the existing mine's procedures and management of wastes. Measures such as spill management procedures will also be adopted to minimise the risk of generating pollution or wastes.

1.3 ENVIRONMENTAL DECISION-MAKING HIERARCHY

The EP Act notes the following in regards to the 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.

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 environmental quality is identified and provided for to the extent practicable" (s. 26).

As described in Section 2 – Project Description, the proponent has undertaken a rigorous decision-making process, over several years, to select an optimal realignment for the access corridor and to design the associated haul road to minimise environmental and cultural impacts. This process aimed to avoid adverse impacts on the environment, to the greatest extent possible. This was achieved by selecting the preferred alignment based on the following objectives:

- There would be no disturbance of nearby sacred sites;
- There would be no disturbance of the Emerald River main channel, which is both culturally and environmentally sensitive; and
- There would be no disturbance of significant vegetation types such as monsoon vine thicket and mangroves, due to cultural and environmental sensitivities.

The haul road and waterway crossing designs were also subject to an iterative engineering design process to reduce potential environmental and cultural impacts, to the greatest extent possible. Section 2 – Project Description provides further detail on this process. Where necessary, additional measures were also proposed to mitigate and manage potential impacts. These are described in each of the relevant sections of the referral.

1.4 WASTE MANAGEMENT HIERARCHY

The EP Act notes the following in regards to the 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" (s. 26).

Section 8 – Environmental Management outlines that the project is not expected to create a significant volume of wastes and that all wastes generated will be managed in accordance with the waste management system at the existing mine. The waste management system is based on the regulatory requirements, values and principles of the Northern Territory's *Waste Management and Pollution Control Act 1988* (NT), *Waste Management and Pollution Control (Administration) Regulations 1998* (NT), and the *Waste Management Strategy for the Northern Territory 2015-2022* (NT EPA, 2015). The waste management system adopts the principles of the waste management hierarchy as far as practicable, considering the remote setting of Groote Eylandt.

1.5 ECOSYSTEM-BASED MANAGEMENT

The EP Act defines ecosystem-based management as the following: "*management that recognises all interactions in an ecosystem, including ecological and human interactions*" (s. 4).

The environmental impact assessment for the project has considered the ecological and human interactions present within the project setting. In particular, the existing land uses surrounding the site were considered in Section 2 – Project Description. The planning process to realign the access corridor and design the haul road and waterway crossings also included extensive consultation with the ALC and Traditional Owners regarding the potential for environmental and cultural impacts from the project. The consideration of these human interactions has resulted in the realignment of the public access track, which ensures that Traditional Owners and members of the local community can continue to safely access the western coast of Groote Eylandt and the boat ramp located on the Emerald River, downstream of the proposed bridge crossing.

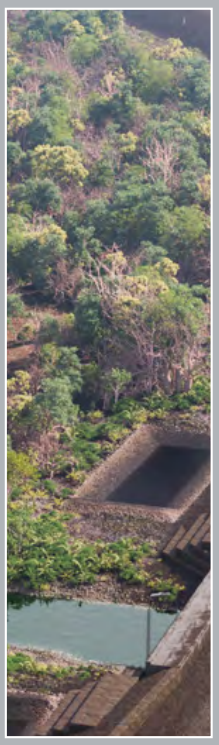
1.6 THE IMPACTS OF A CHANGING CLIMATE

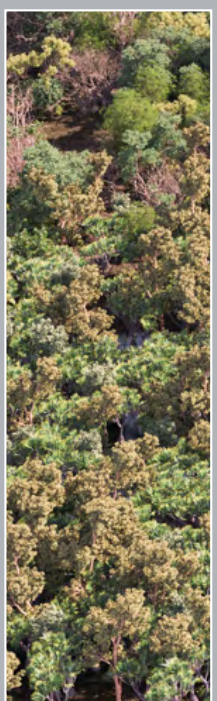
The environmental impact assessment undertaken for the project has considered the impacts of a changing climate in the following ways:

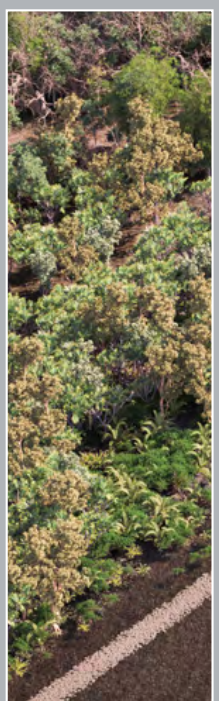
- Section 4 – Surface Water explains how the haul road has been designed to minimise impacts on the Emerald River floodplain. This was undertaken in consideration of a range of potential flood modelling scenarios. Potential changes in climate variability and the occurrence of extreme weather events have been accounted for within the various modelling scenarios.
- Section 3 – Review of Environmental Factors explains that the proponent has a number of measures already in place for the mine site to mitigate, reduce, control or manage greenhouse gas emissions through energy efficiency. The proponent will continue to adhere to reporting obligations under the *National Greenhouse and Energy Reporting Act 2007* (Cth).

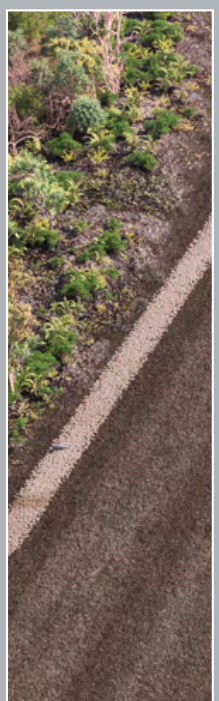
2

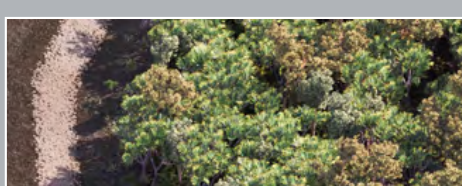
Project Description











CONTENTS

Figures

2 PROJECT DESCRIPTION

2.1 INTRODUCTION

This section provides an overview of the J Quarry Haul Road Realignment (the project), including the local and regional setting relevant to the project and the detailed planning process undertaken to select the realigned access corridor and the associated haul road design. Project construction activities and environmental management controls are also discussed along with the significance of the project in the context of the proponent's long-term mining operations on Groote Eylandt.

As detailed in Section 1 – Introduction, manganese mining has been occurring on Groote Eylandt since the 1960s in multiple mineral leases known as the Western Leases (Figure 2-1). Groote Eylandt Mining Company's (GEMCO's) existing operations in the Western Leases are located on the northern side of the Emerald River. In 2023 mining is scheduled to progress into a future mining area, termed J Quarry, located on the southern side of the Emerald River within mineral lease (ML) 961. ML 961 includes an access corridor which connects J Quarry to the existing Western Leases mining areas, north of the Emerald River (Figure 2-2). The commencement of mining in J Quarry requires a haul road to be constructed in this access corridor to enable ore from J Quarry to be transported to stockpiles at the concentrator at the existing mine. Activities within the Western Leases, including mining in J Quarry and construction and operation of the haul road within the access corridor, are authorised under existing approvals.

A recent survey identified the presence of a sacred site near the existing access corridor. The proponent is therefore seeking to realign the access corridor to provide a suitable buffer around the sacred site. A proposed realignment of the access corridor has been selected. However, the realignment is partly outside the Western Leases (i.e. beyond the area in which existing approvals are in place). The proposed corridor realignment is shown on Figure 2-2.

This referral assesses the potential impacts associated with realigning the access corridor. It is restricted to considering activities located beyond the Western Leases, given that activities within the Western Leases are authorised under existing approvals.

The following elements are considered as part of the project and shown on Figure 2-3:

- Construction of a haul road within the realigned access corridor. Similar to the existing approved access corridor, the realigned haul road will traverse the perennial Emerald River and the ephemeral Emerald River Southern Tributary (known as the Southern Tributary). A bridge will be constructed over the Emerald River and culverts will be constructed in the channel of the Southern Tributary.
- Construction of a track providing access to the southern side of the Emerald River during the construction phase (termed construction access track).
- Realignment of an existing public access track to enable safe public access to the western coast of Groote Eylandt. The realignment includes construction of an underpass beneath the haul road.

The project site for the purposes of the environmental assessment is the area to be disturbed by these project elements.

2.2 SETTING

2.2.1 Regional Setting

The Western Leases are located on Groote Eylandt in the Gulf of Carpentaria, approximately 650 km south-east of Darwin (Figure 2-1). Groote Eylandt is largely undeveloped, and much of the island is still used for traditional practices such as hunting and gathering. The mine is the main development on the island and has been operating for over 50 years. There are three townships on Groote Eylandt, namely Alyangula, Angurugu and Umbakumba (Figure 2-1). Angurugu is the closest township to the project site and is located approximately 10 km to the north of the site. The three townships have a combined population of approximately 2,500 people (Australian Bureau of Statistics, 2017). There are also several small, rural Aboriginal settlements (termed “outstations”) on Groote Eylandt. Outstations typically have varying levels of use, from occasional visitation to sporadic residency.

Groote Eylandt, and the surrounding marine area, has significant ecological value. In addition, the threatened terrestrial fauna species present on the island are relatively protected from key threatening processes that exist on the mainland (such as Cane Toads). Section 6 – Terrestrial Ecology provides further detail on the ecological value of Groote Eylandt.

The Traditional Owners of the Groote Eylandt Archipelago are an amalgamation of two cultures, the Warnindilyakwa, and the Nunggubuyu (ALC, 2020). The Traditional Owners are made up of 14 clan groups, divided into two moieties, united by a common culture of kinship, ceremony and language. Both cultures speak Anindilyakwa as their first language, and the land, people and culture are also referred to by this term.

The Groote Eylandt Archipelago has been declared an Indigenous Protected Area (IPA). An IPA is an area of Indigenous-owned land or sea where Traditional Owners have entered into an agreement with the Federal Government to promote biodiversity and cultural resource conservation (Department of Agriculture, Water and the Environment, n.d.). IPAs form part of the National Reserve System, established by the Federal Government to conserve unique landscapes, plants and animals. The Groote Eylandt Archipelago was declared the Anindilyakwa IPA in 2006, and is administered by the Anindilyakwa Land Council (ALC). The ALC Rangers are funded by the Federal Government through the IPA. A key focus of the ALC Rangers is to ensure that the unique culture and environment of the Groote Eylandt Archipelago is conserved for future generations.

2.2.2 Natural Features

The project site and immediate surrounds are characterised by areas of flat to undulating sand plains. Elevations range from 0 to 26.5 m Australian Height Datum (AHD) within the project site.

The project site traverses the Emerald River and the Southern Tributary (Figure 2-3). The Emerald River catchment is shown in Figure 2-4. The Emerald River has its headwaters located to the east of the project site, starting in rocky outcrops of the geological basement commonly referred to as “white rock”. As the river traverses the landscape towards the coast, the relatively flat, low-lying topography forms heavily vegetated shallow gradient valleys converging onto coastal plains. This topography promotes the establishment of off-channel wetlands during the wet season when flood flows expand across the coastal plains. The Emerald River is primarily spring-fed, maintaining flows all year round. At the project site, the river is a mix of estuarine and freshwaters. Freshwater lies over saline waters, creating a saltwater wedge that pushes upstream with the incoming tide, while underneath the freshwaters flow downstream.

The Southern Tributary starts as a defined gully in its upper reaches before forming a wide overland floodplain that eventually connects with the main channel of the Emerald River, near the mouth of the river, downstream of the project site (Figure 2-4). The Southern Tributary can maintain water in small billabongs for several months following the end of the wet season, however, it is ephemeral in the vicinity of the project site.

The project site comprises natural bushland dominated by Eucalyptus and Melaleuca open woodlands and forests, as well as riparian woodlands along the Emerald River and the Southern Tributary. The most common eucalypts are Darwin Stringybarks (*Eucalyptus tetrodonta*) and Darwin Woollybutt (*Eucalyptus miniata*), but a wide variety of

other native plants and vegetation communities occur. Melaleuca-dominated vegetation also occurs within riparian zones. A number of permanent and seasonal wetlands occur within the vicinity of the project site including sedge wetlands and Paperbark dominated wetlands.

2.2.3 Land Ownership and Land Tenure

The whole of Groote Eylandt is Aboriginal land under the *Aboriginal Land Rights (Northern Territory) Act 1976* (Cth) (ALRA). The ALC is responsible for managing this Aboriginal land. Section 2.4 includes further information regarding the extensive consultation undertaken with the ALC and Traditional Owners regarding the project, culminating in the signing of a Haul Road Agreement under ALRA. The haul road agreement consents to the realignment of the access corridor, and the development of the haul road, construction access track, and realigned public access track.

2.2.4 Land Use

The area surrounding the project site is largely undeveloped and heavily vegetated. The primary access to the area is via the Emerald River Road, an unsealed public road, which is located to the east of the project site (Figure 2-2). An existing public access track, which connects to the Emerald River Road, traverses the project site and is used by the Traditional Owners to access the mouth of the Emerald River and other key cultural and recreational areas along the western coastline of Groote Eylandt. It also provides access to an area on the Emerald River, to the west of the project site, from which small recreational boats are launched (Figure 2-2).

Yedikba Outstation includes a few small buildings and is located approximately 450 m from the project site (Figure 2-2). The outstation is used by the Traditional Owners for recreational purposes. A number of sacred sites also occur in proximity to the project site and are culturally significant to the Traditional Owners. The location of these sites is confidential and at the request of the Traditional Owners has not been disclosed in this referral.

2.2.5 Mineral Titles

No single tenement covers the full extent of the project site. The proponent has been granted an Access Authority (Access Authority 32517) under the *Mineral Titles Act 2010* (NT) for the full extent of the realigned access corridor shown in Figure 2-2, apart from the small section of the realigned access corridor that lies within ML 961. This small section is retained as part of ML 961.

In addition to the area within the Access Authority, project site also traverses portions of the following two existing mineral tenements, as shown on Figure 2-3:

- A small section of the existing access corridor, located in ML 961 (part of the Western Leases), held by the proponent; and
- Part of Exploration Licence (EL) 2455, held by the proponent and referred to as the Southern Lease.

2.3 SELECTION OF REALIGNED ACCESS CORRIDOR AND HAUL ROAD DESIGN

The proponent has undertaken an extensive process over several years to select an optimal realignment for the access corridor and to design the associated haul road to minimise environmental and cultural impacts. This process included identification and investigation of seven alternative access corridor alignments, developed through a detailed options assessment and pre-feasibility study process.

Each alternative access corridor alignment was evaluated against the following cultural, environmental and engineering constraints:

- Cultural constraints in the vicinity of the existing approved access corridor were identified. The identification of cultural constraints was based on a cultural heritage survey undertaken within and adjacent to the Western Leases. The cultural heritage survey was undertaken by the ALC's anthropologist and included extensive consultation, including on country meetings with the Traditional Owners. This work was documented in a Sacred Sites Instructions Report which provides clear documentation of sacred sites and the required protection measures that Traditional Owners believe are suitable for the management of sacred sites in perpetuity. Section 7 – Culture and Heritage provides further information on sacred sites.
- Environmental constraints were identified. The identification of environmental constraints was based on several fieldwork programs to confirm the baseline environment and included consultation with the ALC. Baseline work included vegetation mapping, terrestrial and aquatic ecology field surveys, review of LiDAR imagery, drone and topographic data and bathymetric surveys.
- Engineering considerations were identified. Engineering considerations included: locating the Emerald River crossing at the narrowest point on the river, crossing perpendicular to the riverbank; consideration of visibility and sight lines for haul trucks, safety aspects and optimal road inclines and speed limits; as well as consideration of the mineralisation within the Western Leases and Southern Lease to ensure the haul road would not sterilise potential future resources. Costs were also considered.

A multi criteria assessment was then undertaken to select a preferred access corridor alignment based on the risk profile of each alternative alignment. The preferred realignment (shown in Figure 2-2) was selected based on the following objectives:

- There would be no disturbance of nearby sacred sites;
- There would be no disturbance of the Emerald River main channel, which is both culturally and environmentally sensitive; and
- There would be no disturbance of significant vegetation types such as monsoon vine thicket and mangroves, due to their cultural and environmental sensitivities.

Once the preferred access corridor alignment was selected that met these objectives, the proponent then undertook an iterative engineering design process for the haul road and waterway crossings. This design process sought to optimise the location of the haul road within the access corridor in order to reduce the clearing width, as well as to design the haul road to minimise impacts on the Emerald River floodplain and flood flows. The engineering design process also included consideration of the optimal design of the waterway crossings to minimise impacts on existing sediment transport characteristics and water quality in the waterways. Further impact assessment work was undertaken to inform the engineering design, including the following:

- An assessment of the hydraulic and sediment transport characteristics of the Emerald River and floodplain including flood modelling. This work was undertaken to ensure the Emerald River and Southern Tributary crossings were optimally designed to minimise impacts on waterways, surface water quality and riparian vegetation. The hydrologic and hydraulic modelling work is described in Section 4 – Surface Water.
- An assessment of the geomorphological impacts of the project on the Emerald River, the Southern Tributary and the associated Emerald River floodplain. This work was undertaken to refine the design of the waterway crossings to minimise potential impacts and to identify mitigation measures required to address potential impacts such as scouring. This work is described in Section 4 – Surface Water.

This iterative planning process culminated in the selection of the haul road design. The design is described in further detail in Section 2.5.

The entire engineering planning and design process was undertaken over several years and included extensive consultation with the ALC and the Traditional Owners. Consultation aimed to ensure the Traditional Owners were

informed of the constraints and potential impacts of alternatives and to progressively advise them of the progress in developing a suitable design. In December 2019, the ALC issued the proponent a letter of 'in-principle agreement' indicating their agreement to the access corridor realignment. Subsequent to the letter and as detailed in Section 2.2.3, the ALC, on behalf of the Traditional Owners signed a Haul Road Agreement under ALRA in July 2020, consenting to the realignment of the access corridor and development of the associated haul road, construction access track and realigned public access track. The consultation undertaken is discussed further in Section 2.4.

2.4 STAKEHOLDER ENGAGEMENT

The proponent has undertaken extensive stakeholder engagement in relation to the project. This has included engagement with the ALC, as well as direct engagement with the clan groups that speak for the country within the local area. This consultation is discussed in the following section. There has also been consultation with key government regulators. Consultation with regulators is discussed in Section 1 – Introduction.

Three meetings were held in February and March 2019 between the proponent, the ALC and Traditional Owners to discuss the progression of exploration and mining in areas south of the Emerald River. It was explained during initial meetings that this area would be accessed using the existing access corridor linking ML 960 to ML 961. At these meetings, the Traditional Owners expressed concern that the development of a haul road within the existing access corridor would impact a recently identified nearby sacred site. Traditional Owners also expressed concern regarding potential impacts on the Emerald River, which is culturally sensitive.

The proponent has since been in regular discussions with the ALC and Traditional Owners regarding the realignment of the access corridor and the associated design of the haul road. These discussions included seven face to face meetings held between June 2019 and August 2020, aided by the use of visual animation tools such as animations depicting the construction and operation of the haul road.

The proponent has also consulted the ALC in relation to the realigned public access track. As discussed in Section 2.2.4, the existing public access track is utilised by the local community to access cultural and recreational areas along the western coast of Groote Eylandt and the Emerald River boat ramp. The realignment of this track and the underpass design will ensure locals can continue to safely access these areas. It is also noted the realignment of this track to avoid directly passing the Yedikba Outstation was proposed by Traditional Owners and has been included in the project description by the proponent.

The consultation described above has culminated in a Haul Road Agreement being signed under ALRA between the proponent and the ALC on 15 July 2020. The Haul Road Agreement describes the conditions under which project activities may be undertaken. This includes environmental conditions such as ensuring culturally and environmentally sensitive areas are avoided. The agreement also details the compensation to be provided to Traditional Owners for the construction, maintenance and use of the haul road, and describes the process for engaging with Traditional Owners.

In addition to the above specific consultation for the project, quarterly meetings are held between the proponent and the ALC, termed Mining Liaison Committee Meetings. Traditional Owner representatives from each clan are also invited to be part of this committee. In these meetings, the proponent provides an update on mining and exploration activities generally and can raise issues relating to the project, as necessary. Such meetings will continue to be held during construction and operation of the project.

2.5 PROJECT DESCRIPTION

2.5.1 Overview of the Project

The key elements of the project include construction of a haul road, development of a construction access track and realignment of an existing public access track. Figure 2-3 shows the location of these project elements. The total clearing footprint comprises approximately 24 ha. The development of a haul road within the existing,

approved access corridor would have involved clearing approximately 10 ha of vegetation and would also have required realignment of the existing public access track and a construction access track. Consequently, the project involves additional clearing of less than 14 ha of native vegetation. The additional clearing is required for the project as the original alignment granted in the 1970s did not account for modern day haul road requirements such as safety berms, surface water infrastructure to manage runoff and the size of modern-day haul trucks.

2.5.2 Haul Road Design

The haul road design is shown on Figure 2-5. The haul road itself will be a dual lane (nominally 30 m wide), unsealed road, designed for use by mine vehicles only. Similar to haul roads at the existing mine, the haul road will be constructed with compacted laterite and middlings. The road is designed generally at grade with two low-level causeways in floodplain areas. This design minimises the impact the haul road will have on flood behaviour. The potential impacts of the haul road on flood behaviour are discussed in Section 4 – Surface Water.

The haul road has been designed with an adjacent drainage system that is designed to limit the potential for suspended sediment to impact adjacent vegetation and downstream waterways. The haul road surface is designed with a central crown to ensure there is suitable drainage from the road surface, which is considered to be a key factor of safety for the project. Runoff from the road will be captured by drains which feed into sediment ponds, located strategically along the haul road. Sediment dams will be subject to detailed design however are expected to accommodate a 20% Annual Exceedance Probability (AEP) event. Treated water from the sediment ponds will be released into surrounding vegetation. Clean water diversion drains (or bunds depending on local relief) will also be constructed to convey clean water away from the haul road formation. An indicative cross section of the haul road drainage system (showing both drain and bund options) is shown in Figure 2-6.

Similar to the existing approved corridor, the haul road crosses two waterways – the Emerald River and the Southern Tributary. The haul road design includes a bridge to cross the perennial Emerald River and culverts within the channel of the ephemeral Southern Tributary (Figure 2-5). These are discussed in the following sections.

Emerald River Bridge Crossing

The haul road design includes a bridge to cross the perennial Emerald River. The bridge has been designed to minimise impacts on the Emerald River by spanning the river channel without piers or encroaching abutments. Figure 2-7 provides an indicative view of the bridge. The bridge abutments are set back from the main river channel to avoid disturbance of the main channel. The abutments will be constructed of steel tubular driven piles with a reinforced concrete abutment. Erosion protection will be installed around the abutments in the form of either rock gabion baskets or sheet piles. The bridge will also include safety bunds, a dewatering pipeline, guide posts and solar powered lighting for the safety of truck operators.

The bridge deck will span approximately 36 m (with an approximate width of 34 m) and will be constructed using steel girders overlain by a concrete deck and a wearing course. This large span design allows bank full flood flows to pass beneath the bridge with negligible impact on flood levels, velocities and sediment transport capacity. There is also sufficient clearance to enable small boats to pass underneath under normal flow conditions. The potential impacts of the bridge on the Emerald River are discussed further in Section 4 – Surface Water.

A low-level causeway will be constructed on the southern side of the Emerald River (Figure 2-5). The causeway will allow flood flows that break the river banks to pass downstream. Detailed design of the causeway will be undertaken prior to construction, however it is expected to consist of a lower layer up to 1 m thick that is made up of geofabric and middlings. Cement stabilised fill will then be placed on top of the bridging layer at a thickness of up to 1.5 m. The fill layer will then be topped with 200 m of middlings as a wearing course. A rip rap rock apron will also be installed on either side of the causeway for erosion protection.

Southern Tributary Crossing

The haul road alignment will also traverse the Southern Tributary. The Southern Tributary crossing will consist of culverts in the Southern Tributary channel and southern floodplain with a low-level causeway in between (Figure 2-5). Detailed design of the crossing will be undertaken prior to construction, however it is expected that the proposed culverts are a series of 1,200 x 1,200 mm box culverts, which will allow low flows to pass through. Within the southern floodplain, a series of 1,300 mm diameter pipe culverts are proposed to be excavated below ground level. The pipe culverts will provide a secondary flood channel and ensure water doesn't pond on the causeway. Figure 2-8 provides an indicative view of the Southern Tributary crossing. Detailed design of the culverts will be undertaken prior to construction which will take into account relevant fish passage guidelines and requirements.

During larger flood events, water from the Southern Tributary will also flow to the causeway. Erosion protection (in the form of rip rap) will be installed in minor areas predicted to have the potential to be subject to scour. The potential impacts of the culverts on the Southern Tributary are discussed further in Section 4 – Surface Water.

2.5.3 Realignment of Public Access Track

There is an existing public access track that provides local access from the Emerald River Road to the western coastline of Groote Eylandt and a boat ramp on the Emerald River (Figure 2-2). The existing public access track traverses both the existing approved access corridor and the realigned access corridor. The public access track will be realigned to ensure the public can continue to access the western coastline safely (Figure 2-3).

The realigned public access track will be similar to the existing track, and will comprise a single lane (nominally 10 m wide) unsealed track. The track will be cleared and graded to follow the natural ground elevation. No drainage infrastructure is required. The portion of the existing public access track that will no longer be used will be decommissioned and rehabilitated.

Where the track crosses the haul road, an underpass beneath the haul road will be constructed. The underpass is designed as a single lane, reinforced concrete box underpass (Figure 2-8). This will ensure separation between public vehicles and mine haul traffic.

2.5.4 Construction Activities

Construction of the project will involve:

- Vegetation clearing and burning;
- Topsoil stripping;
- Foundation preparation;
- Bridge construction; and
- Drainage installation.

Construction will be undertaken using standard techniques and involve the use of mobile equipment including but not limited to cranes, pile drivers, dozers, scrapers, graders and water carts. Erosion and sediment controls will be adopted as an integral part of construction activities, and are further described in Section 4 – Surface Water.

Earthworks construction materials will be sourced from within the disturbance footprint of the haul road as well as borrow areas within the Western Leases. Middlings will also be used for the haul road wearing surface and will be sourced from the existing mine. This is typical of haul roads at the existing mine. Concrete will be sourced from an existing concrete batching plant location on Groote Eylandt that is managed by one of the proponent's suppliers.

Construction of the haul road and bridge will require access from the southern side of the Emerald River. During construction, access will be provided via the existing Emerald River Road and the existing bridge (Figure 2-2). An existing exploration track will be extended and widened up to 10 m to provide direct access to the project site on

the southern side of the river. The track will be cleared and graded to follow the natural ground elevation. No drainage infrastructure is required. The alignment of the construction access track is shown in Figure 2-3. This track may be intermittently used post-construction to provide light vehicle access to the haul road for maintenance activities.

2.5.5 Environmental and Cultural Controls

Training

The proponent has established induction and training procedures in relation to environmental management. All personnel (including contractors) who conduct vegetation clearing will be trained in the identification of the threatened species that may be encountered in the area, including specific habitat features of these species (such as tree hollows). Spill response training is also completed by all personnel at the time of induction and regularly thereafter.

All personnel are required to complete a half day training course on cultural awareness prior to the commencement of the construction. The cultural awareness training is run by the ALC and Traditional Owners and includes information on cultural sensitivities and restricted areas, as well as guidelines for interactions with Traditional Owners.

Erosion and Sediment Controls

Construction will be undertaken predominantly in the dry season, which limits the potential for issues with erosion and sediment control. As the project is located in a tropical setting, erosion has the potential to occur through direct rainfall impact loosening soil particles, as well as overland flow washing soil particles away. An Erosion and Sediment Control Plan will therefore be prepared for the construction of the project. The plan will include the following control measures that are proposed to manage potential erosion:

- All exposed batters will be vegetated;
- Riprap will be placed on the upstream and downstream shoulders of the causeway sections of the haul road to reduce erosion of the road surface;
- Silt fencing will be installed, as appropriate, in the vicinity of construction work around waterways; and
- A polymer coating will be regularly applied to causeway surfaces to reduce the breakup of the road surface during overtopping events.

Permit to Clear Process

The proponent's Permit to Clear process will be adopted prior to the commencement of any construction activities. The process is described in Section 8 – Environmental Management. The Permit to Clear process includes undertaking pre-clearance surveys to delineate the precise location of clearing and to identify the presence of weeds in the area to be cleared. Clearing will be kept to the minimum possible required to safely construct the haul road, construction access track, and realigned public access track.

Weed and Pest Management

Weed management of the areas to be disturbed will be conducted in accordance with the Weed Management Plan (WMP) currently in place for the existing mine. The WMP is supported by a suite of procedures that are designed to manage and control weeds on the proponent's mining and exploration tenements. These documents include measures to ensure that disturbance does not introduce weeds. All construction equipment and support vehicles will be required to undertake weed inspections and wash down at the mine site, prior to commencing construction activities. Further detail is provided in Section 8 – Environmental Management.

GEMCO also has in place a management plan and quarantine program to prevent the introduction of Cane Toads to Groote Eylandt. This is critical to maintaining populations of threatened species such as the Northern Quoll (*Dasyurus hallucatus*). The management plan includes preventative measures such as quarantine procedures

relating to barging of equipment, inspections of barges and vehicles, Cane Toad fencing at the port and the use of a Cane Toad detection dog at the port. There are also monitoring measures and, in the event of a Cane Toad being found, reporting and disposal procedures. Further detail is provided in Section 8 – Environmental Management.

Rehabilitation

Conservatively, this assessment assumes that the haul road and construction access track are permanent disturbances because the long-term future use of this infrastructure post-mining depends on agreement with Traditional Owners and is uncertain. In the event Traditional Owners require the haul road and construction access track to be permanently closed, rehabilitation will be undertaken. Further detail is provided in Section 8 – Environmental Management.

The unused portion of the existing public access track will be closed and rehabilitated once the realigned public access track is constructed and suitable for public use. Rehabilitation will include ripping and seeding the track and applying topsoil to encourage regeneration of vegetation. The track will be inspected following rehabilitation to confirm vegetation is regenerating and to identify any erosion issues or presence of weeds.

2.5.6 Utilities

Diesel

Construction vehicles and equipment will be refuelled at the existing mine fuelling facilities or in park up areas located within the existing tenements, prior to commencement of daily construction activities. However mobile refuelling may be required for dozers, cranes, and other construction vehicles and equipment that remain at the project site during construction, such as small diesel generators used for night-lighting. In the event mobile refuelling is required, diesel will be transported and stored in 5000 L tanks on support trucks.

Water

The water demands for the project are minimal. Water for dust suppression of the haul road will be applied when dusty conditions are present. Water will be sourced from the existing mine site and will use mine site contractor water trucks, when necessary.

Lighting

The haul road may be in use during the night. As such, solar powered light poles will be constructed on either end of the bridge to provide additional visibility. The underpass of the realigned public access track will also be lit. Any lighting will be designed to ensure it limits sky glow and considers potential impacts on nocturnal wildlife.

2.5.7 Waste Management

All rubbish and consumables used as part of the construction activities will be collected and returned to the existing mine for disposal. Any spillage of hydraulic oils, diesel or other hydrocarbons and spent hydraulic fluids will be removed, disposed and reported in accordance with the existing mine procedures. Waste management is described further in Section 8 – Environmental Management.

2.5.8 Timing

Current scheduling anticipates construction could commence from January 2022 or earlier, subject to environmental approvals being in place. Construction will be undertaken predominantly during the dry season and is expected to be completed within 10 months, depending on the timing and extent of the wet season.

The haul road will be used to transport ore from J Quarry to the concentrator at the existing mine site. Consistent with current mining operations, the haul road may be in use up to 24 hours a day, seven days a week.

2.5.9 Workforce and Accommodation

The peak workforce required to construct the haul road is approximately 90 people. This will include existing mine employees, civil works contractors and existing mine site contractors. Specialist bridge contractors will be hired to construct the bridge.

Contractors undertaking construction activities are anticipated to be a combination of existing residents of Groote Eylandt and non-residents, employed on a fly-in and fly-out basis. Accommodation will be provided in the proponent's existing accommodation facilities, located near Alyangula. Contractors will be sourced from the existing contractor workforce as well as from the other states as required.

2.5.10 Alternatives

As detailed in Section 2.3, a detailed risk-based approach, informed by fieldwork and extensive consultation with Traditional Owners, has been undertaken to select the realigned access corridor and to design the haul road (including bridge, culverts and causeways) to minimise environmental and cultural impacts. The following key alternatives were considered as part of this process:

- Use of the existing Emerald River Road and bridge crossing;
- Several alternative access corridor alignments; and
- An alternative haul road design as an embankment across the Emerald River floodplain.

The use of the existing Emerald River Road and bridge crossing was considered in the planning process. However, this alternative was not pursued as the existing Emerald River Road and bridge crossing is used by the public to access the southern portion of the island and a new road would have been required to provide safe separation of haul trucks and private vehicles. A new bridge would also be required to account for the considerable weight of the fully loaded, large haul trucks. The land around the existing bridge was also considered to be constrained for the required width due to a recreational swimming hole being located immediately downstream of the existing bridge, a significant wetland on the upstream side, and the proximity to Yedikba Outstation.

The selection of the preferred access corridor alignment is described in Section 2.3.

Section 2.3 also describes the iterative design process undertaken for the haul road. This process included initially designing the haul road as an embankment across a large part of the Emerald River floodplain. This initial design would have provided optimum flood immunity for the haul road and optimum efficiency for haul trucks. However, hydraulic and scour modelling of this initial design identified significant potential for scour in the bed of the Emerald River due to the embankment obstructing flows across the floodplain. Alternative lower impact haul road designs were subsequently investigated to avoid this predicted scouring.

Compared to all alternatives, the preferred alignment and haul road design was considered more acceptable for either environmental, cultural or engineering aspects.

2.6 SIGNIFICANCE OF THE ACCESS CORRIDOR REALIGNMENT

As noted in Section 2.5.9, there is limited direct employment associated with the construction of the haul road. The key significance of the realignment of the access corridor is that it allows for the continuation of scheduled mining in approved mining areas. The mine has been operating for over 50 years and is an integral part of the economy of Groote Eylandt. The mine provides significant socio-economic benefits to the Traditional Owners, as well as the regional economy of the Northern Territory. The haul road is not able to be constructed in the existing access corridor due to cultural reasons and therefore the realignment of the access corridor is important to the continuation of the proponent's operations on Groote Eylandt.

The continuation of the proponent's mining operations has the following economic and social benefits:

- Continued provision of approximately 1,100 jobs including 855 South32 employees and 212 agency contractors. These jobs include roles for Traditional Owners;
- Royalties for distribution to Traditional Owner groups via the ALC;
- Royalties, government taxes and business opportunities which significantly contribute to both the local economy and the regional economy of the NT;
- Education, training and apprenticeship opportunities for local residents, including Traditional Owners;
- Provision of social infrastructure and services, specifically health services, to the communities on Groote Eylandt;
- Procurement opportunities for businesses on Groote Eylandt and, in particular, Indigenous enterprises; and
- Coordination of community events by GEMCO.

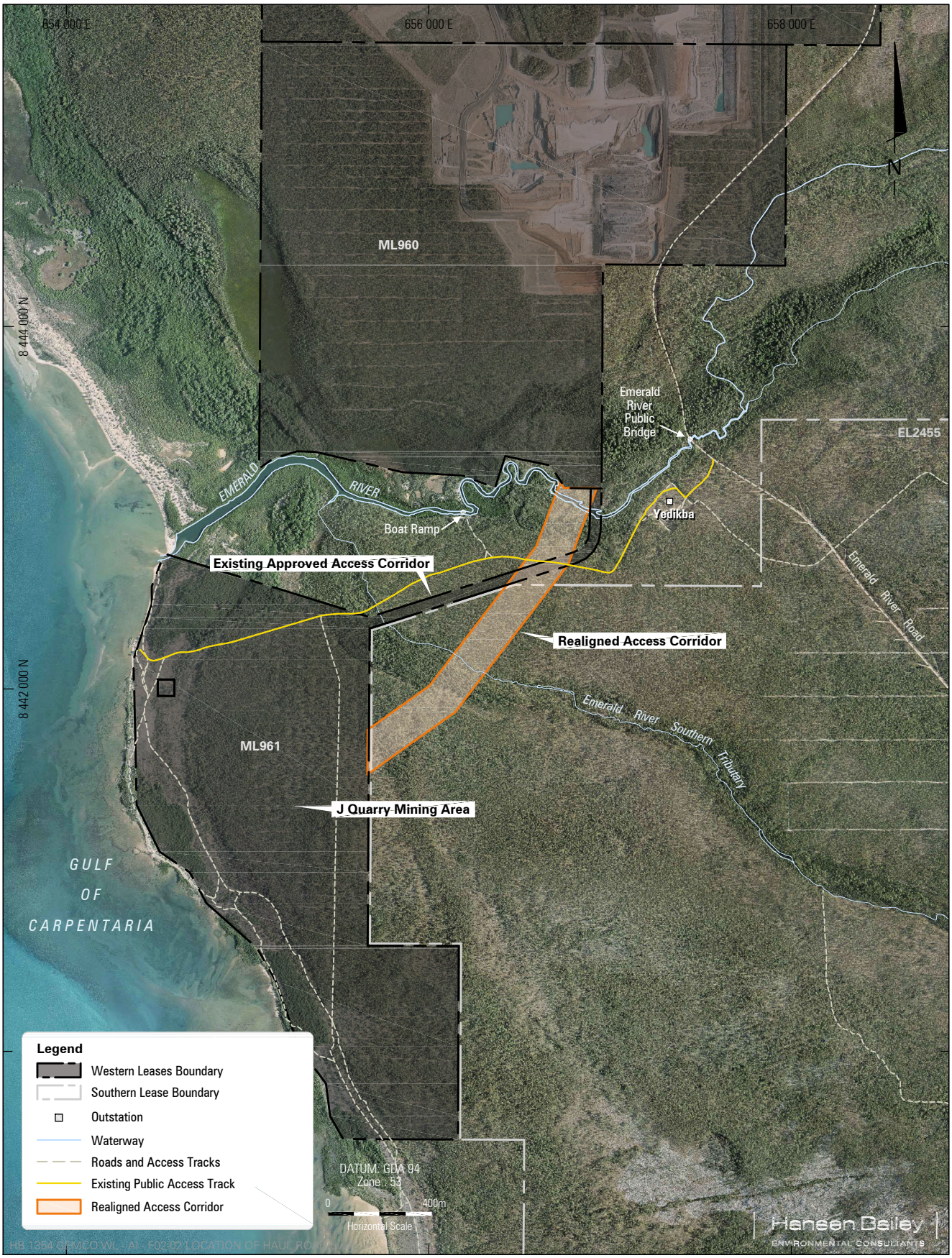
The continuation of these benefits is dependent on the continued operation of the mine, and manganese resources in the southernmost mineral lease (ML 961) are a key part of the life of mine plan for the existing mine. Mining in J Quarry is anticipated to enable operations to continue for a further four years. The realignment of the access corridor also represents the proponent's commitment to continuing a successful long-term relationship with the Traditional Owners.

FIGURES

J QUARRY HAUL ROAD REALIGNMENT

Location Plan

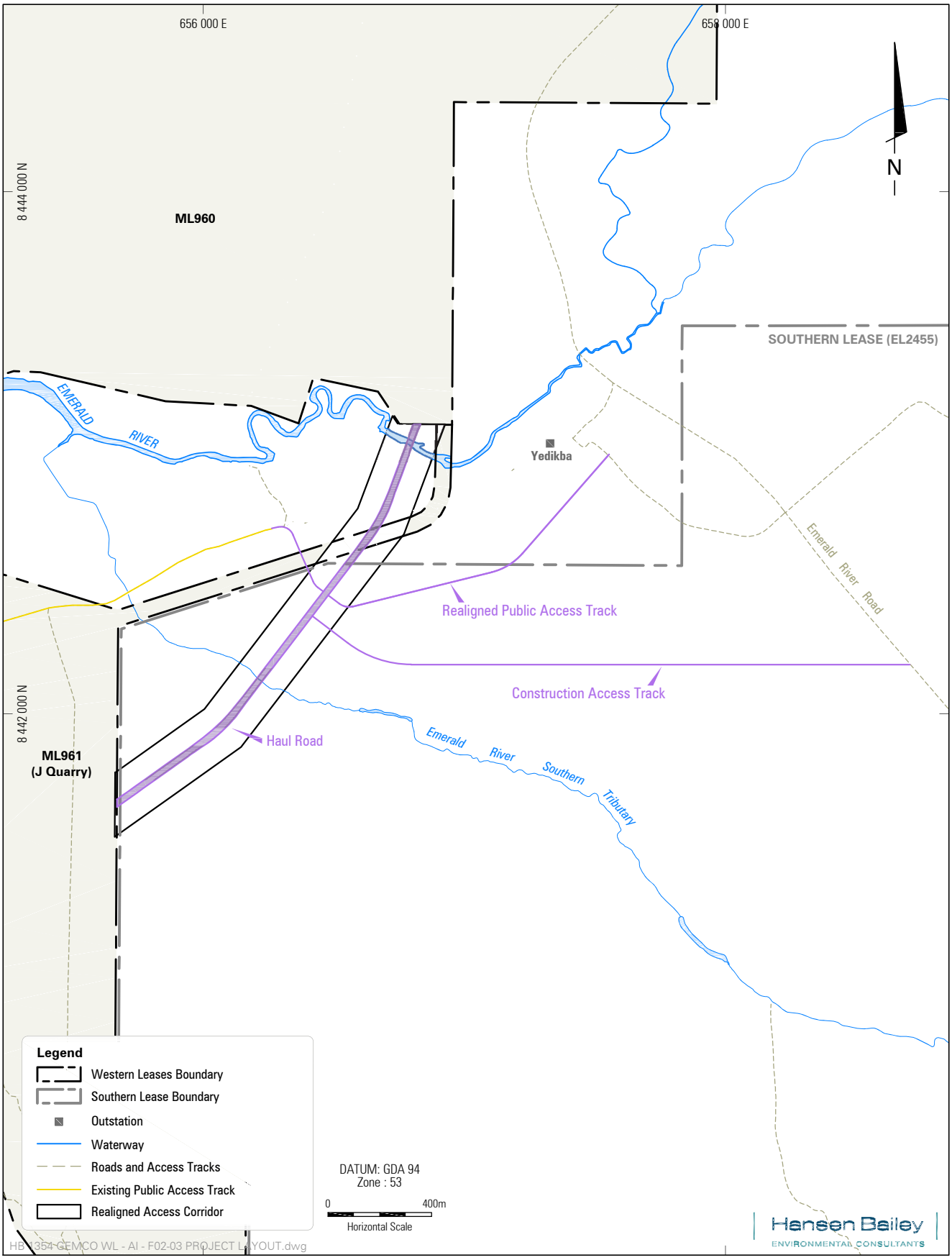
FIGURE 2-1



J QUARRY HAUL ROAD REALIGNMENT

Location of Realigned Access Corridor

FIGURE 2-2



J QUARRY HAUL ROAD REALIGNMENT

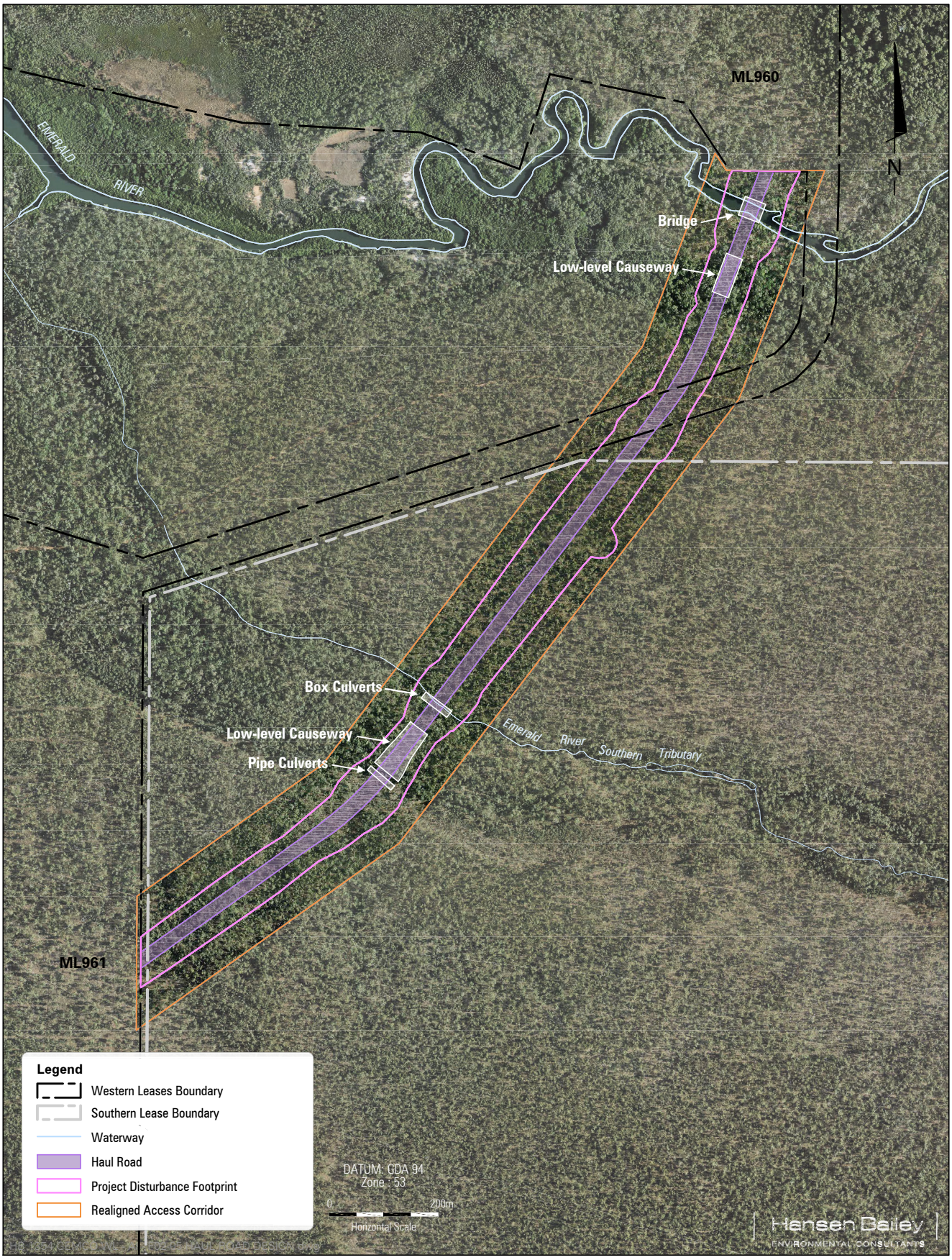
Project Layout

FIGURE 2-3

J QUARRY HAUL ROAD REALIGNMENT

Local Catchment Setting

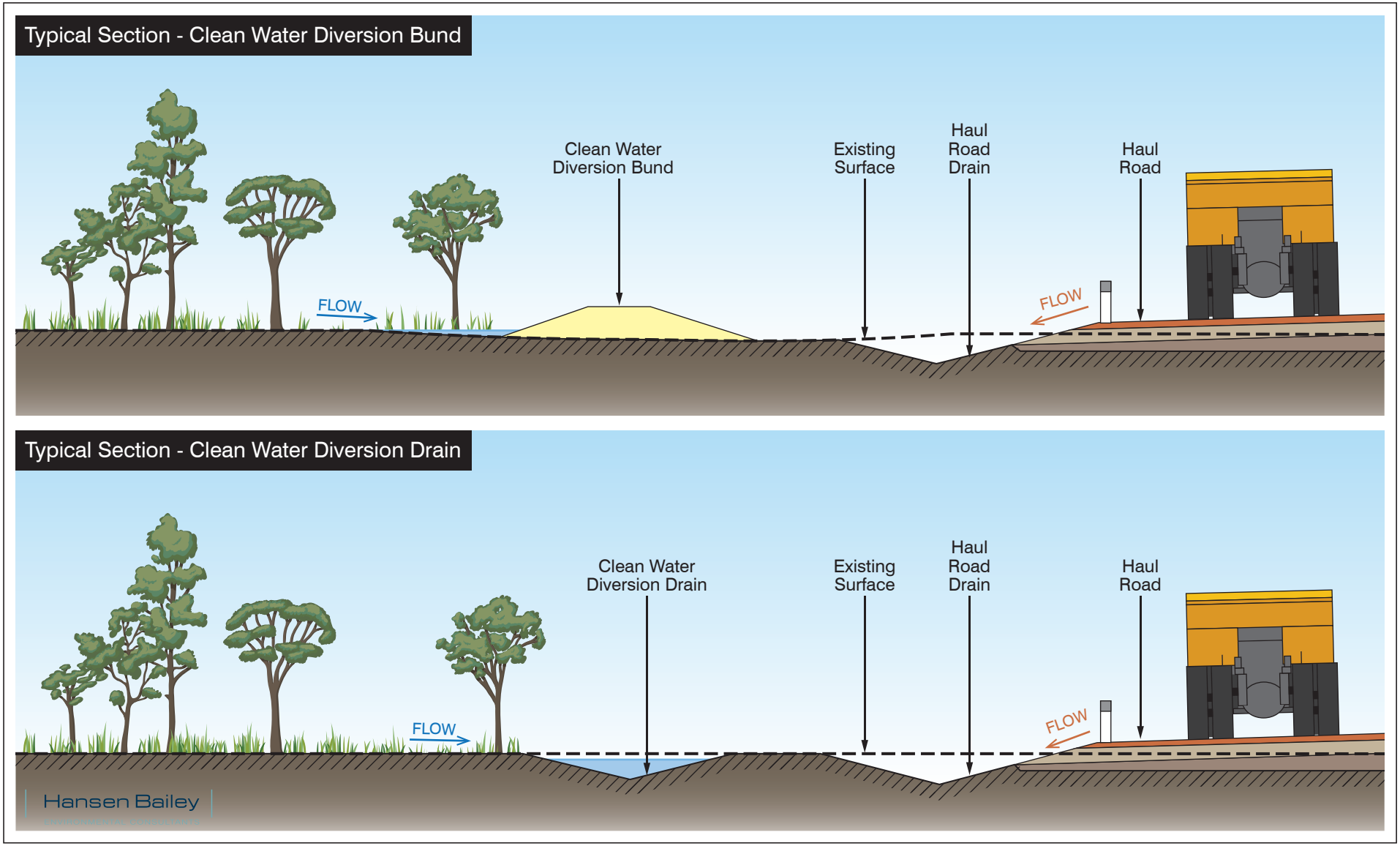
FIGURE 2-4



J QUARRY HAUL ROAD REALIGNMENT

Indicative Haul Road Design

FIGURE 2-5



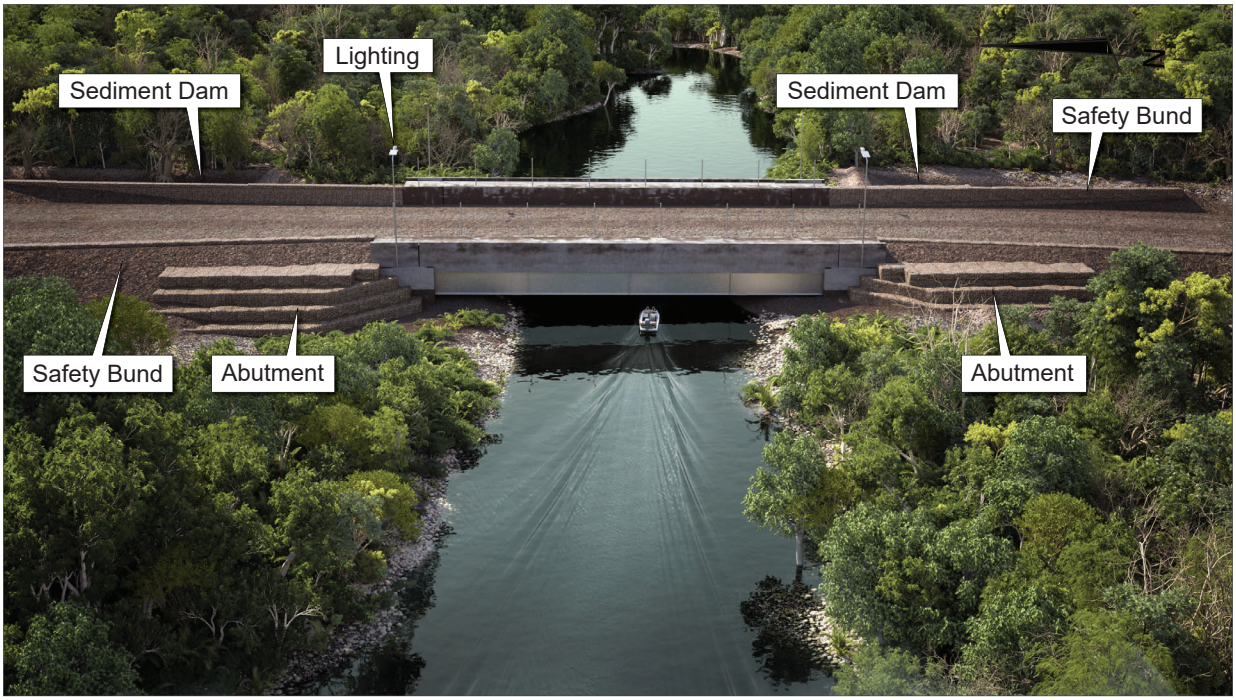
J QUARRY HAUL ROAD REALIGNMENT

Conceptual Cross Section of the Haul Road Drainage System

FIGURE 2-6

(a) Indicative View of Haul Road over the Emerald River

(b) Indicative View of Bridge over the Emerald River



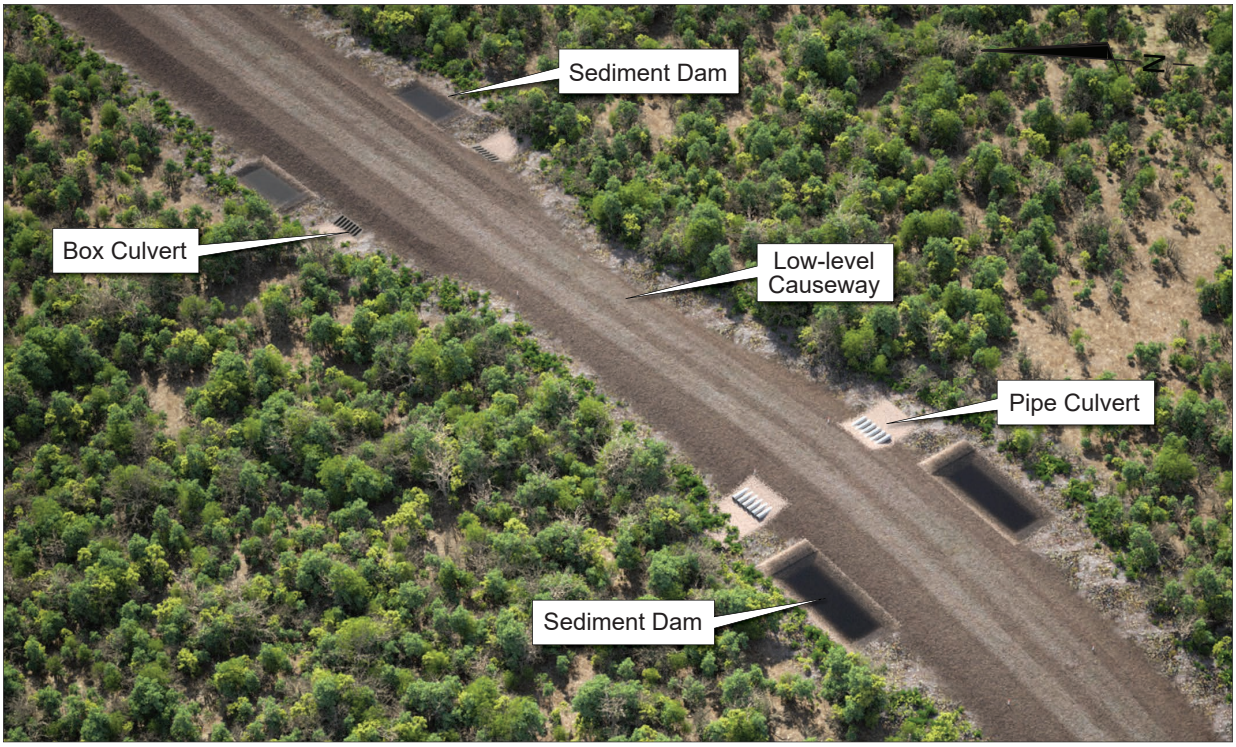
Source: Truescape 2020

J QUARRY HAUL ROAD REALIGNMENT

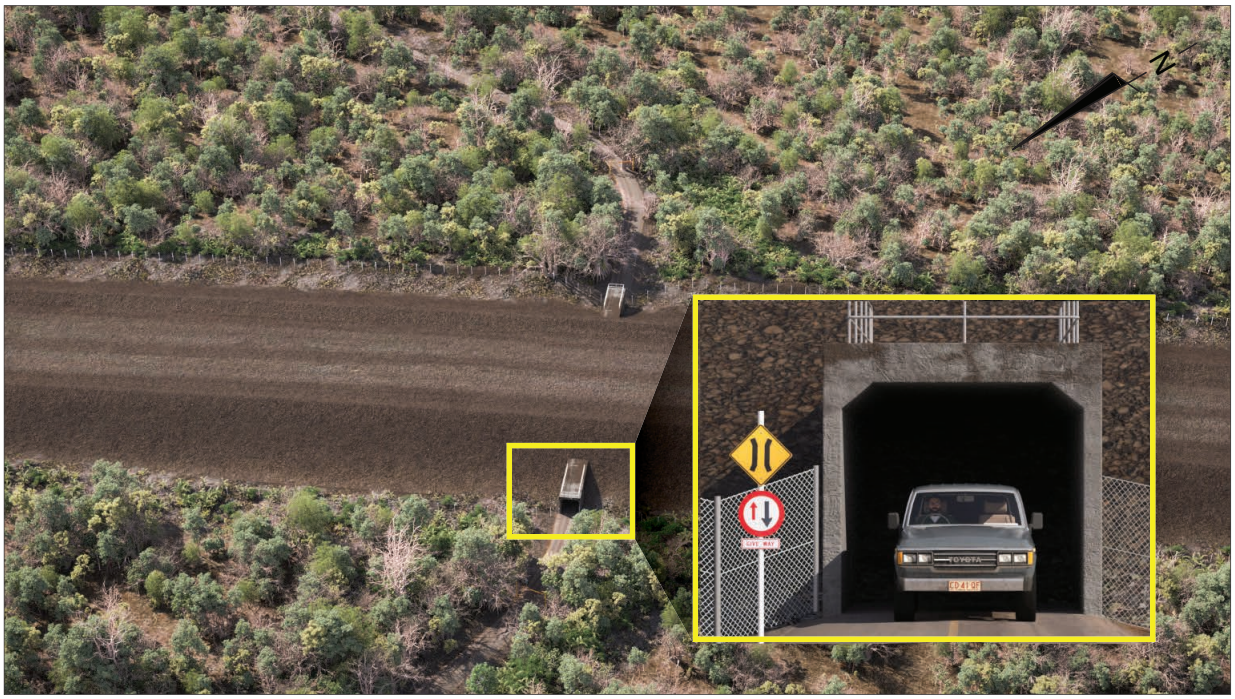
Indicative View of Haul Road and
Bridge over the Emerald River

FIGURE 2-7

(a) Indicative View of Southern Tributary Crossing



(b) Indicative View of Realigned Public Access Track and Underpass



Source: Truescape 2020

SOUTH32

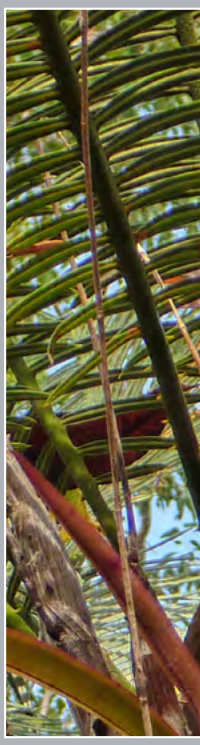
J QUARRY HAUL ROAD REALIGNMENT

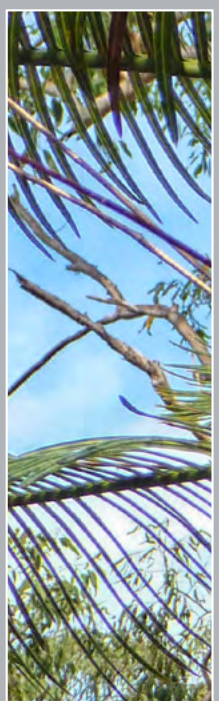
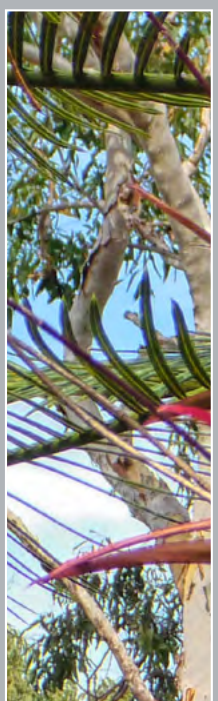
Indicative View of Southern Tributary Crossing, Realigned Public Access Track and Underpass

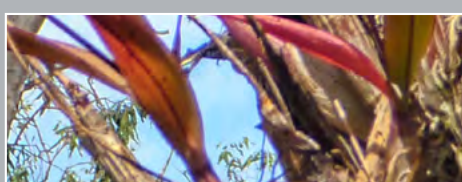
FIGURE 2-8

3

Review of Environmental Factors

CONTENTS

Tables

3 REVIEW OF ENVIRONMENTAL FACTORS

3.1 INTRODUCTION

Environmental factors are broad components of the environment (e.g. flora and fauna, soil) that may be impacted by a proposed action. This section describes the process that was adopted to identify the environmental factors relevant to the J Quarry Haul Road Realignment (the project). It includes a review of the full suite of environmental factors identified by the Northern Territory Environment Protection Authority (NT EPA) in its guideline *NT EPA Environmental factors and objectives, Environmental impact assessment guidance* (NT EPA, 2020a).

3.2 METHODOLOGY

The NT EPA has produced a guideline on environmental factors and objectives (NT EPA, 2020a), which is designed to provide a systematic way to categorise information about the environment to enable effective environmental impact assessment and reporting. Environmental factors are aspects of the environment that may be impacted by a proposed action. The guideline identifies a total of 14 environmental factors, characterised under five themes, namely Land, Water, Sea, Air, and People (NT EPA, 2020a). Environmental objectives have been developed for each environmental factor and potential impacts must be considered relative to these objectives.

Table 3-1 provides a full list of environmental factors and an assessment of the likelihood that each may be significantly impacted by the project. Environmental factors that are not considered likely to be impacted by the proposed action are not required to undergo further environmental assessment.

The consideration of environmental factors was based on the following:

- An understanding of the baseline environment in the vicinity of the project site, which was informed by:
  - Terrestrial ecology field surveys undertaken in the vicinity of the project site, as well as a literature review and database searches, as documented in the *Terrestrial Ecology Report* (Appendix D).
  - Vegetation mapping of the realigned access corridor, based on mapping prepared by the (now) Northern Territory Department of Environment, Parks and Water Security. This area was ground-truthed by qualified ecologists and botanist as part of fieldwork undertaken on behalf of the proponent.
  - The Small Mammal Research Project, which was a large-scale research project related to the distribution of threatened small mammals and included fieldwork within, and in the vicinity of the project site.
  - An aquatic ecology survey of the waterways within the project site, as well as a literature review and database searches, as documented in the *Aquatic Ecology Report* (Appendix C).
  - An assessment of the hydraulic and sediment transport characteristics of the Emerald River floodplain, as documented in the *Hydrology and Hydraulics Assessment Report* (Appendix A), as well as a geomorphic assessment of the waterways to be impacted by the project, as documented in the *Geomorphic Impact Assessment Report* (Appendix B).
  - Archaeological and anthropological surveys undertaken within, and in the vicinity of the project site, as well as a literature review and database searches as described in Section 7 – Culture and Heritage.

- Review of recent (2017) high quality mapping data, including drone imagery, LiDAR and recent aerial photography of the area.
- Consultation undertaken with the Anindilyakwa Land Council (ALC), Traditional Owners and regulators. As described in Section 2 – Project Description, there has been an extensive consultation program undertaken over several years to ensure that the access corridor avoided nearby sacred sites and to discuss the design criteria and elements of the haul road and bridge. The ALC, on behalf of the Traditional Owners, has signed a Haul Road Agreement under the *Aboriginal Land Rights (Northern Territory) Act 1976* (Cth) (ALRA), consenting to the realignment of the access corridor and development of the associated haul road, construction access track, and realigned public access track. In addition, Traditional Owners have been involved in a number of fieldwork programs described above and provided valuable insights regarding the environmental factors that they consider to be important.

3.3 REVIEW OF ENVIRONMENTAL FACTORS

Table 3-1 provides a full list of environmental factors, an assessment of the potential impacts from the project and confirmation of the environmental factors that required further assessment.

Table 3-1 Review of Environmental Factors

OBJECTIVES	POTENTIAL IMPACT	FURTHER CONSIDERATION WARRANTED
LANDFORMS		
Conserve the variety and integrity of distinctive physical landforms so that environmental values are protected.	The realigned access corridor is located on predominantly flat terrain with no distinctive physical landforms, hence no impacts on distinctive physical landforms are predicted. The haul road will generally be constructed at grade, so will have a limited landform profile. Some localised areas of fill will be required, such as to the north and south of the Emerald River to ensure suitable engineering clearance of the bridge over the Emerald River and to provide adequate cover for drainage infrastructure. This will increase the road elevation to a maximum of approximately 5 m above the current ground surface at these locations. Due to the remote location of the haul road (being more than 10 km from the nearest community) and the dense vegetation cover, it is not anticipated that the haul road profile would be visible from any local communities. The haul road profile will, therefore, not significantly change the topography, and hence no significant impacts on landforms are predicted. The realigned public access track and the construction access track will be constructed at grade and will have no impact on the existing landform profile.	No.
TERRESTRIAL ENVIRONMENTAL QUALITY		
Protect the quality and integrity of land and soils so that environmental values are supported and maintained.	Topsoil and subsoils will be disturbed as part of preparing the haul road foundation and constructing footings for the bridge. Once vegetation has been cleared, topsoil will be stripped and stockpiled for use in rehabilitating the existing public access track or transported to the mine site for use in mine rehabilitation.	No.

OBJECTIVES	POTENTIAL IMPACT	FURTHER CONSIDERATION WARRANTED
	Subsoils will be used in haul road construction or if they are geotechnically unsuitable, they will be transported to the mine site for use and/or disposal. Borrow materials (e.g. for the haul road embankments and pavement) will be sourced from within the Western Leases. Geotechnical and geochemical testing of all borrow materials has been undertaken and has confirmed that the material is suitable for use and will not give rise to potential contamination along the haul road alignment. Acid sulfate soils (ASS) are naturally occurring sediments and soils containing iron sulfides or sulfidic materials, often located in low-lying coastal areas, predominately below 5m reduced level (in Australian Height Datum). ASS are harmless when not disturbed. However, if ASS are exposed or drained, they come into contact with oxygen, which causes the pyrite in the soil to oxidise. This process turns pyrite into sulfuric acid, which can cause damage to the environment and to other structures. The acid also releases metals like aluminium and iron. Qualitative screening and quantitative analytical testing have been undertaken and confirmed there are potential acid sulfate soils (PASS) in the vicinity of the Emerald River and the Southern Tributary. PASS are soils that contain iron sulfides or sulfidic materials, which have not been oxidised. Where possible, PASS materials will not be disturbed. However there will be some small areas (e.g. for piling works, construction of the bridge abutments or installation of the culverts) were PASS materials may be disturbed. This will be undertaken in accordance with an Acid Sulfate Soils Management Plan which will be developed for use during construction to manage disturbance of PASS. The plan will include mitigation and management measures (i.e. application of lime to PASS). Liming is common practice and effective at managing the risks of PASS. Acid sulphate soils are discussed further in Section 4 – Surface Water.	
TERRESTRIAL ECOSYSTEMS		
Protect the NT's flora and fauna so that environmental values including biological diversity and ecological integrity are maintained.	The development of the haul road, construction access track and realigned public access track involves clearing native vegetation along the length of each alignment which has the potential to give rise to impacts on terrestrial flora and fauna. Although mitigation and management measures will be implemented to limit potential impacts, further assessment of the potential impacts on terrestrial ecology is warranted.	Yes. Refer Section 6 – Terrestrial Ecology.

OBJECTIVES	POTENTIAL IMPACT	FURTHER CONSIDERATION WARRANTED
HYDROLOGICAL PROCESSES		
Protect the hydrological regimes of groundwater and surface water so that environmental values are maintained.	The haul road will traverse the Emerald River and its floodplain, including the Southern Tributary. An assessment of the potential impacts on the surface water values of the Emerald River geomorphology and flood regime has been undertaken. The construction of the haul road, construction access track and realigned public access track is unlikely to interfere with the groundwater regime and groundwater is not considered further.	Yes. Refer Section 4 – Surface Water.
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.	The construction and use of the haul road has the potential to impact surface water quality through erosion and sedimentation, as well as potential spills of hydrocarbons and manganese ore. An Erosion and Sediment Control Plan will be developed for use during construction to limit potential impacts. The plan will include measures to manage potential water quality issues such as vegetating exposed batters and placement of rip rap to reduce erosion and limit suspended sediment entering waterways. The haul road is also designed with drainage systems to manage haul road runoff. The drainage system includes the capture of haul road runoff in drains that are directed to sediment dams. Once operational, the haul road will be maintained in accordance with the proponent's standard haul road maintenance practices, including monitoring of erosion and regular de-silting of sediment dams and drains. The proponent also has existing management procedures relating to hydrocarbon spill prevention. Such measures include avoiding mobile refueling where possible, as well as supplying mobile equipment operating in the vicinity of waterways with a spill kit and training operators in its application. The haul road and bridge over the Emerald River have been designed for safety to minimise the risk of vehicle collisions and accidents that may result in the spillage of ore. Mitigating controls include the alignment, grade and angle of the haul road which assist to optimise visibility for drivers. The bridge also has safety bunds which will accommodate a collision. In the unlikely event there is a truck accident that results in spillage of manganese ore, the proponent will ensure that the associated cleanup will be undertaken to the satisfaction of the Traditional Owners and regulators.	Yes. Refer Section 4 – Surface Water.

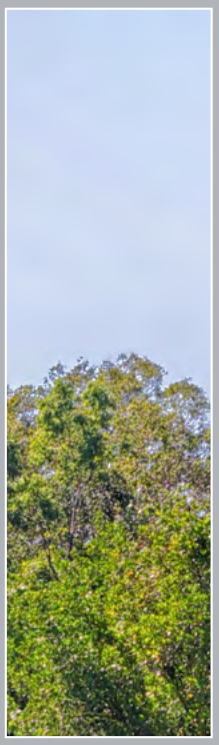
OBJECTIVES	POTENTIAL IMPACT	FURTHER CONSIDERATION WARRANTED
	The construction of the haul road, construction access track and realigned public access track is unlikely to impact the quality of groundwater and this is not considered further.	
AQUATIC ECOSYSTEMS		
Protect aquatic habitats and flora and fauna to maintain the environmental values including biological diversity of aquatic flora and fauna and the ecological functions they perform.	The haul road requires a bridge to cross the Emerald River and culverts to traverse the Southern Tributary. Potential impacts on the aquatic flora and fauna within the Emerald River have been limited by designing the bridge with a 36 m wide span to avoid any structures being constructed in the bed of the river. The design of the culverts will take account of measures to limit impacts on fish passage. Although mitigation and management measures will be implemented to limit potential impacts, further assessment of the potential impacts on aquatic ecology is warranted.	Yes. Refer Section 5 – Aquatic Ecology.
COASTAL PROCESS		
Protect the geophysical and hydrological processes that shape coastal morphology so that the environmental values of the coast are maintained.	The project does not involve activities on the coastline or in the marine environment that could impact on coastal morphology. No clearing of mangroves or coastal vegetation is required for the project. The haul road bridge crossing of the Emerald River is located more than 3 km upstream from the coastline. Section 4 – Surface Water explains that there are no significant impacts predicted on the geomorphology of the Emerald River at or downstream of the bridge crossing, and consequently no impacts on the geophysical or hydrological coastal processes are predicted.	No.
MARINE ENVIRONMENTAL QUALITY		
Protect the quality and productivity of water, sediment and biota so that environmental values are maintained.	The project does not involve activities on the coastline or in the marine environment that could impact on marine water quality.	No.
MARINE ECOSYSTEMS		
Protect marine habitats and flora and fauna so that biological and functional diversity and ecological integrity are maintained.	The project does not involve activities in marine habitats that could impact on biological and functional diversity of downstream marine ecosystems.	No.
AIR QUALITY		
Protect air quality and minimise emissions and their impact so that environmental values are maintained.	Realigning the access corridor will not give rise to any additional air quality impacts. The nearest township is Angurugu and is located more than 10 km from the existing access corridor. The realigned access corridor is a similar distance (although slightly further away) and as such, no additional impacts are expected.	No.

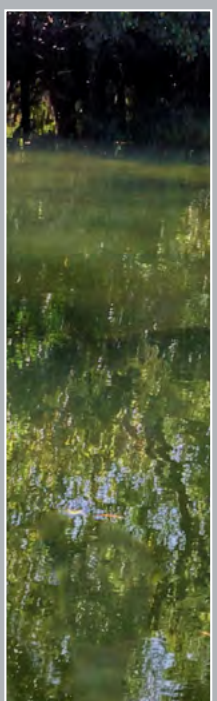
OBJECTIVES	POTENTIAL IMPACT	FURTHER CONSIDERATION WARRANTED
	In addition, given this distance, residents are unlikely to be affected by dust from the construction or operation of the haul road within the realigned access corridor. The Yedikba Outstation is located near to the project site and is used by Traditional Owners for recreational use. The outstation is also located in proximity to existing mining activities in the Western Leases and the proponent regularly engages with the ALC, who has responsibility for the outstation, in relation to any issues relating to the outstation. This approach would continue for any potential issues that may arise from the project.	
ATMOSPHERIC PROCESSES		
Minimise greenhouse gas emissions so as to contribute to the NT Government's aspirational target of achieving net zero greenhouse gas emissions by 2050, and adapt to a changing climate to protect ecological integrity and maintain the welfare and amenity of people.	Realigning the access corridor will not give rise to any additional greenhouse gas emissions. The proponent has a number of measures in place to mitigate, reduce, control or manage greenhouse gas emissions through energy efficiency, including: ■ Regular assessment, review and evaluation of greenhouse gas reduction opportunities; ■ Procurement policies that require the selection of energy efficient equipment and vehicles; ■ Monitoring and maintenance of equipment in accordance with manufacturer recommendations; and ■ Optimisation of diesel consumption through logistics analysis and planning. The proponent will also continue to adhere to reporting obligations under the *National Greenhouse and Energy Reporting Act 2007* (Cth) (NGER Act).	No.
SOCIETY AND ECONOMY		
Maintain or enhance the social and economic values for current and future generations of Territorians.	The access corridor has been realigned to ensure there is a suitable buffer around known sacred sites. Extensive consultation has been undertaken with the ALC and Traditional Owners in relation to the realignment of the access corridor and the design of the haul road. This has occurred over a number of years and included face to face and on-country meetings. Meetings were aided by the use of tools such as visual animations. The ALC, on behalf of the Traditional Owners, have recently signed a Haul Road Agreement that allows for the realignment of the access corridor. In addition, during this consultation, the Traditional Owners requested a realignment of the public access track. The proponent has realigned the track and designed the haul road crossing as an underpass beneath the haul road to ensure public vehicle interactions with mine site vehicles	No.

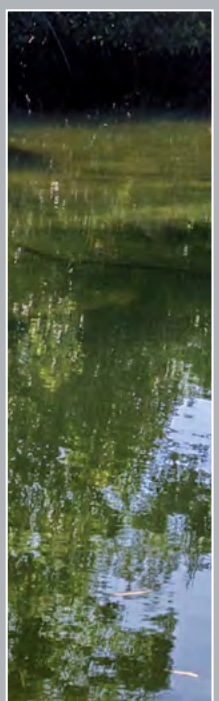
OBJECTIVES	POTENTIAL IMPACT	FURTHER CONSIDERATION WARRANTED
	are avoided, and to ensure there is ongoing access to country. The construction of the haul road will be undertaken by the existing mine workforce and specialist bridge contractors and is unlikely to create a significant number of roles for Traditional Owners that would result in an economic impact on the local communities. However, Traditional Owners impacted by the project will obtain financial benefit for the project to compensate for use of country, in accordance with the Haul Road Agreement between the proponent and the ALC. These funds will be used to upgrade infrastructure used by Traditional Owners. This compensation is paid in addition to the royalties that will be paid for mining in J Quarry. Further assessment of the social or economic values is not warranted.	
CULTURE AND HERITAGE		
Protect the rich cultural and heritage values of the Northern Territory.	The proponent engaged the ALC to complete a sacred sites assessment for the Western Leases which identified the presence of sacred sites in proximity to the northern end of the project site. This triggered the need to realign the haul road corridor to ensure impacts on nearby sacred sites are avoided. In addition to avoiding known sacred sites, a suite of other controls will be put in place to ensure that the haul road will not give rise to adverse impacts on archaeological finds. Given the significance of sacred sites, further discussion of potential impacts on culture and heritage is warranted.	Yes. Refer Section 7 – Culture and Heritage.
HUMAN HEALTH		
Ensure that the risks to human health are identified, understood and adequately avoided and/or mitigated.	Potential impacts from the interaction between the public and mine site vehicles has been avoided by limiting the haul road to mine site vehicles only and the construction of an underpass beneath the haul road for the public access track. Furthermore, the construction and operation of the haul road does not involve the use of chemicals or other substances that could give rise to potential impacts on human health. Potential impacts on the health and safety of the workforce involved in the haul road development and use will be managed in accordance with the proponent's existing occupational health and safety (OHS) procedures and OHS legislation applicable to mining activities.	No

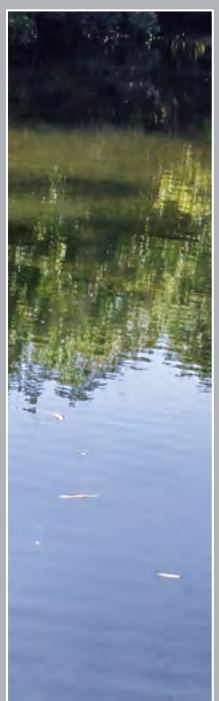
4

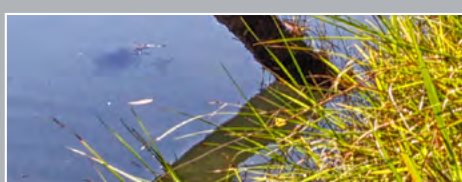
Surface Water











CONTENTS

Figures

4 SURFACE WATER

4.1 INTRODUCTION

This section provides a description of the surface water setting of the J Quarry Haul Road Realignment (the project), the potential impacts on surface water, and the design elements and strategies that are proposed to manage these impacts. This assessment draws on specialist studies undertaken for the project including an assessment of the hydraulic and sediment transport characteristics of the Emerald River floodplain (*Hydrology and Hydraulics Assessment Report* (Appendix A)) and a geomorphic assessment of the watercourses to be impacted by the project (*Geomorphic Impact Assessment Report* (Appendix B)).

4.2 SURFACE WATER SETTING

This section describes the existing surface water setting of the project. It provides an overview of the catchment setting and a description of the drainage characteristics, environmental values and water quality.

4.2.1 Catchment Setting

The project site is located on Groote Eylandt, situated in the Gulf of Carpentaria. The central areas of the island are characterised by elevated rocky outcrops that form hills and escarpments. The rocky outcrops limit the vegetation and soil cover within this central portion of the island. Between these hills and escarpments, the low-lying topography forms densely vegetated, gently sloping valleys that open into flat, coastal plains. These central hills and escarpments define the surface water catchments across the majority of the island. The relief of the landscape in the area surrounding the project site is shown in Figure 4-1.

The project site is located in the Emerald River catchment (Figure 4-1). The haul road corridor traverses both the Emerald River and a tributary of the Emerald River, referred to as the Southern Tributary. The project site and catchment setting are environmentally and culturally sensitive. The Emerald River is primarily spring-fed, maintaining flows all year round and is known to be sensitive from a cultural perspective. Water quality is generally very good, typical of a pristine environment. The project site is located at the freshwater/saline interface of the Emerald River. The Southern Tributary starts as a defined gully before forming a wide overland floodplain that eventually connects with the main channel of the Emerald River, near the mouth of the river (Figure 4-1). The system is largely ephemeral, with no large permanent pools or off-channel wetlands/lagoons found to persist in the upper reaches following the wet season. The Southern Tributary is ephemeral in the vicinity of the project site.

Regionally, the surface geology is naturally enriched in metals and depleted in minerals, and exhibits low soil erosion rates. This results in naturally low suspended sediment loads and elevated dissolved metal concentrations in waterways.

The catchment is undeveloped and largely undisturbed. A small, rural outstation, known as Yedikba Outstation, is located immediately upstream of the project site and is used by Traditional Owners for recreational activities (e.g. swimming) (Figure 4-1). The Emerald River Road is an unsealed, public road and is used to access Yedikba Outstation, as well as the southern part of Groote Eylandt (Figure 4-1). The Emerald River Road crosses the Emerald River approximately 900 m upstream of the project site. Regional land uses include the existing mine and exploration activities (including exploration tracks and periodic drilling activities). The approved, but as yet undeveloped, Eastern Leases Project is located approximately 6.5 km upstream of the project site, partially within the upper portion of the Emerald River catchment.

4.2.2 Surface Water Use and Environmental Values

The project site is indicative of Groote Eylandt, being located in a relatively pristine setting, with no significant sources of contamination or disturbance. The surface water resources in the vicinity of the project site currently support a range of environmental values including aquatic ecosystems and human uses. These environmental values are described as follows:

- High conservation value aquatic ecosystems. A detailed aquatic ecology assessment of the project site and catchment setting was undertaken as part of the *Aquatic Ecology Report* (Appendix C). This assessment indicates that the project site and its surroundings are considered to be largely ecologically undisturbed and of high conservation value.
- Human consumption (i.e. drinking water). Yedikba Outstation is located in the vicinity of the project site. The outstation is not permanently occupied, with the level of use ranging from occasional visitation to sporadic residency. Although a water supply bore is located at the outstation, untreated drinking water supply is understood to be sourced primarily from the Emerald River.
- Recreational use, including swimming, fishing and aesthetic values. The section of the Emerald River north of Yedikba Outstation and near the Emerald River Road bridge is a popular swimming hole with Traditional Owners and locals (Figure 4-1).
- Cultural values. The Emerald River is known to be culturally significant.

No farming or agricultural activities have been undertaken within the project site or surrounding area. These environmental and cultural values have been considered in developing the project design and assessing the potential impacts of the project.

The proponent has undertaken water quality monitoring in the Emerald River catchment since 2006. This includes monitoring at sites located downstream of the proposed Emerald River bridge crossing. Water sampling is undertaken monthly and includes in-situ and analytical testing of various parameters such as temperature, pH, dissolved oxygen, electrical conductivity, turbidity, total and dissolved metals / metalloids, and major anions and cations. As such, there is a good understanding of the baseline water quality conditions.

4.3 PROJECT PLANNING AND DESIGN

The project planning process identified the Emerald River as being culturally and environmentally sensitive. It was therefore a design priority to minimise potential impacts on this waterway and the Southern Tributary. As discussed in Section 2 – Project Description, the project design involved an iterative process whereby the haul road was initially designed as an embankment across a large part of the Emerald River floodplain. This initial design would have provided optimum flood immunity for the haul road. However, hydraulic modelling and scour modelling of this initial design identified significant potential for scour in the bed of the Emerald River. Alternative lower impact haul road designs were subsequently investigated to avoid these impacts.

The preferred haul road design is described in detail in Section 2 – Project Description. There are a number of design features that were adopted to minimise impacts on the Emerald River and its floodplain, including the following:

- The haul road is designed as an embankment on the northern side of the Emerald River with a large span (36 m) bridge over the Emerald River. The large span bridge minimises geomorphic impacts on the Emerald River by spanning the river channel without piers or encroaching abutments. This design avoids the need for any construction or disturbance within the main river channel.
- To the south of the river, the haul road is designed to be generally at grade with two low-level causeways on the floodplain. This design minimises the impact of the road on flood flows across the floodplain.

- The haul road has been designed to manage the potential for suspended sediment in road formation runoff to impact adjacent vegetation and downstream waterways. The haul road surface is designed with a central crown to ensure drainage of the road pavement surface. Runoff from the road will be captured by formation drains that will direct drainage to sediment ponds. Treated water from the sediment ponds will discharge to surrounding vegetation. Clean water diversion drains (or bunds depending on local relief) will also be constructed to convey clean water away from the haul road formation.
- The haul road crossing of the Southern Tributary has been designed as a series of culverts in the tributary main channel and on the southern floodplain, with a low-level causeway in between. This design allows low flows to flow underneath the haul road via the culverts and larger flows to flow over the causeway, minimising impacts on flood flows in the floodplain.
- Culverts in the Southern Tributary will be designed in detail prior to construction. The design will take into account relevant fish passage guidelines and requirements. Further detail on culvert design is provided in Section 5 – Aquatic Ecology.

4.4 WATERWAY ASSESSMENT METHODOLOGY

In order to assess the potential impacts of the project on surface water, hydraulic modelling was conducted as part of the haul road design to assess the effects on flood flow and flood velocities on the Emerald River and its floodplain. This information was then utilised to conduct an assessment of the geomorphologic impacts of the project. The methodology for these studies is briefly described in the following sections.

4.4.1 Hydraulic Modelling

An assessment of the hydraulic and sediment transport characteristics of the Emerald River in the vicinity of the project was undertaken. The modelling was undertaken using the TUFLOW two-dimensional hydraulic model which simulated hydraulic behaviour within the channels and floodplain of the Emerald River and its tributaries on a 6 m grid. Further details of the model configuration and results are provided in the *Hydrology and Hydraulics Assessment Report* (Appendix A).

4.4.2 Geomorphology Impact Assessment

The results of the hydraulic modelling described above were used to assess the potential geomorphologic impacts of the project. This included a comparison of hydraulic modelling results under existing conditions and with the proposed haul road. The assessment included review of flood levels and flood velocities as well as sediment characteristics and indicative sediment transport rates for the Emerald River and Southern Tributary. The potential for scour under the Emerald River bridge was also evaluated. Further details are provided in the *Geomorphic Impact Assessment Report* (Appendix B).

4.5 IMPACT ASSESSMENT

The potential impacts of the haul road on surface water include the following:

- Potential changes to flood behaviour including flood levels and flow velocities, as well as potential changes to the geomorphology of the Emerald River and/or Southern Tributary; and
- Potential impacts on surface water quality as a result of erosion and sedimentation or contamination from spills and construction activities.

These potential impacts are described in the following sections.

4.5.1 Impacts on Flood Behaviour and Waterway Geomorphology

Emerald River Bridge

The bridge has been designed to minimise geomorphic impacts on the Emerald River by spanning the river channel without piers or encroaching abutments. The large bridge span avoids the need for any construction or disturbance within the main river channel. This design allows bank full flood flows to pass beneath the bridge with negligible impact on flood levels, velocities and sediment transport capacity. Minor scouring (0.05 m) may occur at the abutment of the Emerald River bridge under lower flow conditions (a 50% Annual Exceedance Probability (AEP) event).

In larger flow events, the haul road embankment will divert floodwater onto the southern floodplain and across the causeway, allowing flood flows to overtop the haul road with minimal afflux (0.4 m for the 2% AEP event). This is predicted to reduce peak flood velocities along the main river channel both upstream and downstream of the bridge. Peak velocities within the Emerald River channel under the bridge are predicted to increase, which could potentially cause localised contraction scour depths of up to 0.9 m under a 2% AEP event. Scouring is not expected to extend past the bridge extent because of the reduced velocities upstream and downstream of the bridge. Any scour is likely to occur gradually and, therefore, sediment deposition along the downstream reach is not expected. Filling of any scour pool beneath the bridge is likely to occur over time, during successive small, flood events, when lower flow velocities are present. Overall, given the relatively low maximum scour depths, the haul road crossing is not expected to have a significant impact on the geomorphology or sediment transport rates of the Emerald River.

Southern Tributary

Similar to the Emerald River bridge and low-level causeway design, the tributary crossing design will divert flood waters from the Southern Tributary channel to the causeway. This will reduce tributary channel velocities and channel flow and isn't expected to have a significant impact on the waterway. The reductions would extend to the Emerald River confluence because the flows diverted to the southern floodplain do not drain back to the Southern Tributary channel. This also results in increased flows and flow velocities along the southern floodplain. There is a higher potential for floodplain scour along the southern bank of the Southern Tributary immediately upstream of the culvert crossing and across the causeway section of the haul road where velocities exceeding 2 m/s are predicted for the 10% and 2% Annual Exceedance Probability (AEP) events. Erosion protection (in the form of rip rap) is proposed to be installed in the elevated velocity areas in these locations to prevent scouring.

Erosion protection will also be placed in the excavated outlet channel downstream of the southern floodplain culverts to reduce the potential for scour. The overbank velocity increases along the southern floodplain are generally less than 0.1 m/s, which is negligible.

4.5.2 Impacts on Surface Water Quality

The project has the potential to impact surface water quality through erosion and sedimentation, as well as contamination. These potential impacts are discussed in the following sections.

Erosion and Sedimentation

Erosion and sedimentation of the Emerald River and Southern Tributary may potentially occur as a result of the following project activities:

- Construction activities including clearing of vegetation; and
- Runoff from the haul road.

Clearing of vegetation to create new roads and tracks will create bare areas which have the potential to increase the risk of sheet erosion. During wet periods, large volumes of rain may wash away disturbed earth relatively easily, particularly if located on a slope. Erosion and sedimentation impacts are most likely to occur during the construction phase of the project, and potentially have some ongoing impacts during the operational phase.

Runoff from the haul road has the potential to affect surface water quality in the receiving waters in the event it contains elevated levels of suspended sediment and is directly released to the environment. This may result in sedimentation that can impact the aquatic environment. This potential impact will be managed by capturing runoff in drains which feed into sediment ponds. Treated water from the sediment ponds will be discharged into surrounding vegetation.

The following design features and mitigation measures will be adopted to reduce the potential for erosion and sedimentation to occur:

- Utilising best practice soil erosion and sediment control measures during construction (i.e. deploying silt curtains, sediment fences, etc.) and timing works to avoid periods with a high likelihood of significant rainfall.
- Revegetating all exposed batters and/or lining batters with natural matting products (coconut fibre matt or mulch) in order to prevent erosion.
- Incorporating drainage structures, such as sediment dams, as part of the design of the road. The sediment dams will collect runoff from the haul road and allow sediment to drop out of suspension before the runoff is passively released.
- Installing diversion drains to limit clean water from entering the disturbance area. This reduces the volume of water that must be treated for suspended sediments prior to release.
- Regularly covering the causeway with a protective polymer which will assist to reduce erosion.
- Developing and implementing an Erosion and Sediment Control Plan for construction.

Given the proposed mitigation and management measures, it is considered unlikely that erosion and sedimentation impacts will significantly affect the water quality of the Emerald River or Southern Tributary.

Contamination

Project activities with the potential to give rise to surface water contamination include:

- Refuelling of on-site equipment using mobile refuelling trucks;
- Disturbance of potential acid sulphate soils (PASS);
- Construction materials entering waterways; and
- Dust from haul trucks.

Mobile refuelling may be required for dozers, cranes and small generators during construction. Mobile refuelling has the potential to contaminate surface waters in the event of a spill. The proponent will adopt the following management measures to reduce this potential risk, as far as practicable:

- Vehicles and equipment will be refuelled at the mine site, where possible;
- In instances when mobile refuelling is required, the proponent's mobile refuelling procedures will be adopted to prevent and control any spills that may occur; and
- Spill cleanup kits will be available on support trucks and staff will be adequately trained in the use of these spill cleanup kits.

Qualitative screening and quantitative analytical testing undertaken for the project confirmed there are potential acid sulfate soils (PASS) in the vicinity of the Emerald River and the Southern Tributary. PASS are soils that contain iron sulfides or sulfidic materials, which have not been oxidised. Testing suggests that materials less than 4 m deep from the Emerald River may require lime treatment if disturbed, and materials less than 0.25 m deep from the Southern Tributary may also require lime treatment, if disturbed. Where possible, PASS materials will not be disturbed. The bridge has been designed to span the Emerald River channel without piers or encroaching abutments, minimising the need for excavation in the bed or banks of the river. Excavation of some materials in

the Southern Tributary channel will be required to install the culverts. An Acid Sulfate Soils Management Plan which will be prepared and implemented for the construction phase. The plan will include mitigation and management measures including the necessary lime dosing of any excavated soils to reduce the potential to oxidise any areas of PASS that are disturbed during construction. Liming is common practice and effective at managing the risks of PASS.

Due to the proximity to the Emerald River, there is a potential for construction materials to potentially enter the waterway. The proponent intends to manage this issue by installing an inspection walkway and netting/screen under the bridge superstructure to capture any materials from potentially falling into the river.

Haulage of mined ore along the haul road has the potential to deposit dust from ore in waterway crossings or on nearby vegetation or exposed surfaces. The proponent implements a suite of mitigation measures on haul roads in the existing mine site that aim to reduce dust from haulage. These measures would also be applied to the operation of the haul road and include:

- Operating water carts to water haul roads, as necessary;
- Maintaining and managing haul truck speeds; and
- Maintaining haul roads with regular grading and topdressing of the wearing course using middlings.

The proponent has indicated that, given the experience at the existing GEMCO mine, it is considered unlikely that dust from haul roads would significantly affect surface water quality. In addition, the design of the haul road drainage system discussed in Section 4.3 will assist to manage the potential for sediment and silt to build up on the roads and verges and potentially become sources for dust emissions. The design of the bridge, in particular the height and width of the safety bund, is also considered to be sufficient to prevent, contain and avoid spillage of waste materials from entering the river. The bridge has also been designed with sufficient grade and fall to ensure that any runoff reports directly to the sediment dams adjacent to the bridge.

Given these measures it is considered unlikely that potential contamination from project activities will significantly affect the surface water quality of the Emerald River or Southern Tributary.

4.5.3 Cumulative Impacts

There are no other significant developments that are proposed in the vicinity of the impacted waterways that have the potential to result in cumulative surface water impacts with the project. Approved mining activities within the Western Leases have controls in place for erosion and sediment control. The approved, but as yet undeveloped, Eastern Leases Project includes a bridge over the headwaters of the Emerald River, approximately 6.5 km upstream from the project site. The span is proposed to be wider than the river channel and the foundations are therefore located outside the high-bank of the river channel. The crossing will therefore allow unimpeded stream flows under normal rainfall and low flow conditions up to the 50% AEP (1 in 2 year) flow event. This crossing has also been designed as a causeway that allows high flows to pass over the haul road. Erosion and sediment controls will also be put in place to manage potential impacts. These measures, along with the considerable distance upstream from the J Quarry haul road crossing, mean there is limited potential for any significant cumulative impacts with the proposed upstream crossing of the Emerald River.

In addition, the existing Emerald River Bridge is located approximately 900 m upstream of the project site. It is a low-level structure that does not have any significant effect on flows of the Emerald River and, therefore, would not contribute to any cumulative impacts with the project.

FIGURES

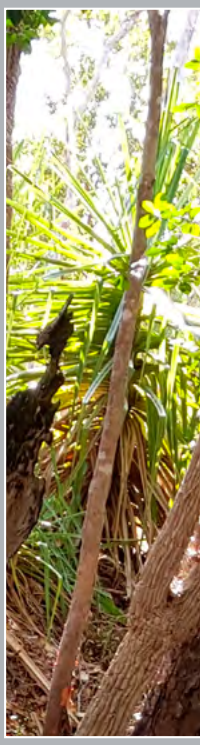
J QUARRY HAUL ROAD REALIGNMENT

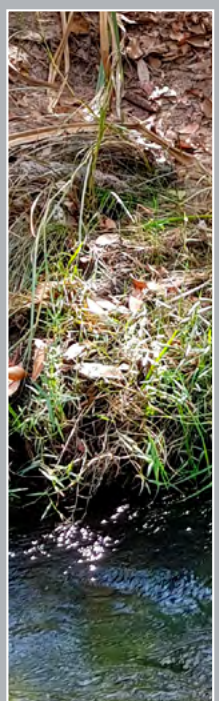
Local Catchment Setting

FIGURE 4-1

5

Aquatic Ecology





CONTENTS

Figures

5 AQUATIC ECOLOGY

5.1 INTRODUCTION

This section provides a summary of the key findings of the *Aquatic Ecology Report* (Appendix C) prepared by C&R Consulting for the J Quarry Haul Road Realignment (the project). It describes the methodology for the assessment, the aquatic biodiversity of the project site and the potential impacts of the project. The design features of the project that were adopted to minimise impacts on the aquatic environment are also discussed. An assessment of terrestrial ecology is provided in Section 6 – Terrestrial Ecology.

5.2 OVERVIEW OF PROJECT SITE

The project site is located in the catchment of the Emerald River and traverses the Emerald River and a tributary of the Emerald River referred to as the Southern Tributary. The Emerald River has headwaters to the east of the project site, starting in rocky outcrops of the geological basement commonly referred to as “white rock”. As the river traverses the landscape towards the gulf, the relatively flat, low-lying topography forms heavily vegetated shallow gradient valleys converging onto coastal plains. Large marine wetland areas in the downstream reaches of the Emerald River are located behind coastal dune systems. The local relief within the catchment is shown in Figure 5-1.

The land within and surrounding the project site comprises natural bushland, and no farming or agricultural activities are undertaken in the vicinity of the project site. The Emerald River itself is undeveloped, other than a small bridge for the Emerald River Road, an unsealed public road located upstream of the project site, and a public boat ramp used to launch small recreational boats located downstream of the project site (Figure 2-2).

The proposed haul road crossing of the Emerald River is located more than 3 km upstream of the mouth of the river, in the freshwater/saline interface of the waterway. Natural rock bars, upstream of the proposed crossing, form a horizontal waterfall effectively limiting the encroachment of estuarine waters any further upstream. During the wet season, the lower freshwater reaches typically flood across the landscape into a series of overflow channels and ephemeral off-channel wetlands/marsh lands.

The Southern Tributary starts as a defined gully before forming a wide overland floodplain that eventually connects with the main channel of the Emerald River, near the mouth of the river. The system is largely ephemeral with only a few small pools known to persist in its upper reaches following the end of the wet season. There are no large permanent pools or off-channel wetlands/lagoons in the upper reaches. The Southern Tributary is ephemeral in the vicinity of the project site.

5.3 REGULATORY REQUIREMENTS

5.3.1 Key Northern Territory Legislation

Territory Parks and Wildlife Conservation Act

The *Territory Parks and Wildlife Conservation Act 1976* (NT) (TPWC Act) is the principal legislation that provides for the protection and conservation of the Northern Territory’s biodiversity. The TPWC Act classifies threatened flora and fauna (including aquatic species) into a number of conservation categories, including Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened and Least Concern. These categories are based on the recognition of how threatened a species is, and what action needs to be taken to protect it. The TPWC Act also provides for the classification and control of feral animals; permits for taking wildlife and entering land; and

designation and management of protected areas and private sanctuaries. The TPWC Act is administered by the Northern Territory Department of Environment, Parks and Water Security (DPEWS). Aquatic species such as marine turtles are listed as threatened (and therefore protected) under this Act.

Although fish species are listed under the TPWC Act, they are not protected under this Act. Threatened fish species are protected under regulations of the *Fisheries Act 1988* (NT) (the Fisheries Act). Aquatic species listed under the TPWC Act and the Fisheries Act have been included in this assessment.

Fisheries Act

The Fisheries Act, which is administered by the Department of Industry, Tourism and Trade, is the primary legislation that provides for the protection, conservation and management of fish, fish habitat and aquatic life in the Northern Territory. The purpose of the Fisheries Act is to maintain the sustainable utilisation of fisheries and fishery resources, to regulate the sale and processing of fish and aquatic life, and for related purposes. This includes overseeing licensing, permits and offences related to fisheries. There are no activities proposed to be undertaken on the project site that would require a licence or permit to be obtained under the Fisheries Act, and no approvals under this Act are required for the project.

5.3.2 Key Federal Government Legislation

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) prescribes the Commonwealth Government's role in environmental assessment, biodiversity conservation and the management of protected Matters of National Environmental Significance (MNES). MNES include listed threatened species and migratory species. The Department of Agriculture, Water and the Environment (DAWE) is the administering authority for the EPBC Act.

Under the EPBC Act, any action (which includes a development, project or activity) that is considered likely to have a significant impact on MNES is termed a controlled action and is subject to assessment and approval under the EPBC Act. Threatened and migratory species listed under the EPBC Act have been included in this assessment.

5.4 METHODOLOGY

The methodology for the aquatic ecology impact assessment included a desktop study, field surveys and data analysis. These are discussed in the following sections.

5.4.1 Desktop Assessment

A desktop assessment of the aquatic ecology of the Emerald River was undertaken. The desktop assessment aimed to obtain information on the potential presence and distribution of aquatic species (particularly those listed under the TPWC Act and EPBC Act), and to determine potential habitat values. This aided in determining the background (existing) aquatic ecological processes occurring across the project site as well as in upstream and downstream areas. This information was used to assist in determining the potential connectivity of the project site to other areas.

The desktop study involved:

- Database searches including the InfoNet search facility which targets species listed under the TPWC Act and the EPBC Act Protected Matters Search Tool (PMST).
- Review and interpretation of recent high-resolution aerial photography and topographic information.
- Review of relevant literature for information on aquatic habitat, water and sediment quality, and aquatic flora and fauna species.

5.4.2 Field Surveys

An aquatic ecology field survey of the Emerald River system was undertaken toward the beginning of the 2018 dry season (17th – 20th July 2018). Survey timing was heavily influenced by access constraints and safety concerns as well as the requirements for surveying protected aquatic fauna. Timing of the survey was compliant with the requirements stipulated within the *Survey guidelines for Australia's threatened fish* (DSEWPaC, 2011) and the *Northern Territory AusRivAS Sampling and Processing Manual* (Lloyd & Cook, 2002) (AusRivAS Manual).

The survey was undertaken to inform the selection of the access corridor alignment and as such the precise location of the haul road was not known at the time of the survey. Therefore, the field survey aimed to provide an indication of the different habitat types present within the Emerald River system by sampling within a range of estuarine and freshwater sites. A total of six survey sites were assessed for aquatic ecology values in the Emerald River system. The location of survey sites is shown in Figure 5-2. Site ERMP-AQ-03 is located immediately upstream of the proposed haul road crossing of the Emerald River. Site ERMP-AQ-05 is located on the Southern Tributary, downstream of the proposed haul road crossing. The survey methods used at these two locations, which are most representative of the project site, are described in the following sections. The full methodology for all sites is included in the *Aquatic Ecology Report* (Appendix C). Some sites were dry at the time of sampling, including ERMP-AQ-05, so the full suite of survey methods was not able to be completed.

Aquatic Habitats

Aquatic habitat assessments were conducted at each survey site in accordance with the AusRivAS Manual. Nine physical habitat characteristics were assessed and given a rating based on their condition. The overall habitat bioassessment score was then categorised to provide an overall assessment of the habitat condition present at each site.

Drone surveys were also undertaken to detail benthic substrates, channel morphology and habitat types present throughout each entire reach.

Water Quality

The proponent has undertaken water quality monitoring in the Emerald River catchment since 2006. This includes monitoring at sites located downstream of the proposed Emerald River bridge crossing. Water sampling is undertaken monthly and includes in-situ and analytical testing of various parameters such as temperature, pH, dissolved oxygen, electrical conductivity, turbidity, total and dissolved metals / metalloids, and major anions and cations. As such, there is a good understanding of the baseline water quality conditions.

In addition, water quality measurements were recorded at each survey site using a hand-held meter. Parameters that were measured included temperature, electrical conductivity, pH and dissolved oxygen. Grab samples were also collected and analysed for a suite of standard parameters known to influence aquatic community structure. Water quality data was analysed, tabulated and compared to the relevant guideline values, including the ANZECC and ARMCANZ *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (2000).

Sediment Quality

Sediment sampling was undertaken at each survey site in accordance with the best practice methods outlined in the Australian Standard AS5667.1 (*Guidance on Sampling of Bottom Sediments*) and the CSIRO published *Handbook for Sediment Quality Assessment* (Simpson *et al.,* 2005). Samples were analysed for a suite of quality characteristics. Sediment quality data was analysed, tabulated and compared to the ANZECC and ARMCANZ *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (2000) which were reviewed in Simpson *et al.* in 2013.

Aquatic Flora

Aquatic flora surveys were conducted at each survey site along a 100 m reach (i.e. 50 m upstream and 50 m downstream of each sampling location). This assessment detailed the presence/absence of all native and exotic aquatic flora and their form, as well as the percent cover of each species at each site. As transects could not be effectively surveyed in high tannin waters and/or deep habitats, transects generally targeted shallower waters.

Riparian vegetation was also assessed by evaluating the stand structure, growth form and the floristic assemblage present. At each site the vegetation type was recorded noting the dominant species within the tallest, middle, and lowest stratums. An estimate of the projective foliage cover was conducted at each site as well as an estimate of the vegetative groundcover. These estimations of cover combined with the dominant species data were used to assign a vegetation classification (e.g. sedgeland, woodland, forest, etc.) at each of the monitoring sites. This was a site-specific assessment undertaken at each monitoring location and was not a broad scale determination of vegetation communities for the area.

Photographs of different macrophyte and riparian species present at each site were taken. Specimens of any species that could not be identified in the field were photographed and sent to specialists for identification.

Aquatic Macroinvertebrates

Aquatic macroinvertebrates were sampled at each survey site, where water was present at the time of the survey. Survey techniques varied between estuarine and freshwater sites due to the potential presence of the Estuarine Crocodile (*Crocodylus porosus*). The methods used at ERMP-AQ-03 (an estuarine site) are described below.

Estuarine survey sites were sampled using a petite ponar grab sampler to collect a relatively standardised sample (~ 2.5 – 3 kg, wet weight) over a known area (15 cm x 15 cm). Three replicate samples were collected from each site. Each sample was sieved in a 1 mm sieve within the field before being preserved in a solution of 70% ethanol for transportation back to the laboratory for identification.

Macroinvertebrate data from the estuarine site was analysed using a range of indices to describe the macroinvertebrate communities inhabiting the project site, including taxonomic richness, PET (i.e. Plecoptera, Ephemeroptera, and Trichoptera) taxa richness, the Shannon-Wiener Diversity Index and a range of statistical analyses using the PRIMER v6 statistical package.

Other Aquatic Species

Methods to survey fish and larger macroinvertebrates also varied between freshwater and estuarine sites. The methods used at ERMP-AQ-03 (an estuarine site) are described below.

Estuarine fish communities were surveyed using gill nets (of various mesh size), cast nets and visual surveys dependent on the habitat targeted (e.g. deep pool, shallow run, etc.). Large macroinvertebrate species were targeted using baited crab traps. Captured fish were counted, identified, measured (to determine life history stage), and photographed. A general assessment of fish health was also noted. Any specimens unable to be identified within the field were photographed or euthanised and sent to the Northern Territory Museum and Art Gallery for identification by a qualified taxonomist. Data was used to assess species richness, total abundance, abundance of listed aquatic species, abundance of exotic species, abundance of each life history stage present (e.g. juvenile, intermediate or adult) and mean fork length.

Visual surveys were undertaken at each survey site to assess turtle communities. This included walking visual surveys (while electrofishing) or boat-based visual surveys to target all species of turtles potentially inhabiting the area. Data from turtle surveys was analysed for species richness, total abundance, abundance of listed aquatic species, abundance of exotic species, and abundance of each life history stage present (e.g. juvenile, intermediate or adult).

Due to health and safety concerns for personnel, a detailed, targeted field survey for Estuarine Crocodiles was not undertaken, but incidental observations of Estuarine Crocodiles were made.

5.4.3 Likelihood of Occurrence Assessment

A likelihood of occurrence assessment was undertaken for listed species identified in database searches or field surveys to determine their potential to occur within the project site. The likelihood of occurrence was based on the known habitat preferences of these species, and the availability and condition of habitats within the project site which were evaluated considering site characteristics identified during the field surveys. The results of the assessment were used to inform the impact assessment and management measures that will be required for the project.

5.4.4 Assessment of Significance

Assessments of Significance were undertaken for threatened or migratory fauna species listed under the EPBC Act that are present or have a moderate or high potential to occur in the project site. Assessments of Significance are threshold tests of significance prepared according to the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013) (the Significant Impact Guidelines). Assessment in accordance with the Significant Impact Guidelines were undertaken to gauge the significance of predicted impacts to threatened and migratory species. The guidelines are designed specifically to determine whether an activity is considered under the EPBC Act to have a significant impact on the species.

5.5 RESULTS

As noted in Section 5.4.2, two survey sites are most representative of the project site, namely ERMP-AQ-03, which is located immediately upstream of the proposed haul road crossing of the Emerald River, and ERMP-AQ-05, which is located on the Southern Tributary downstream of the proposed haul road crossing. The results from these sites are described in the following sections. The Southern Tributary survey site (ERMP-AQ-05) was dry at the time of sampling so results for this site were limited. The complete results for all sampled sites are included in the *Aquatic Ecology Report* (Appendix C).

5.5.1 Aquatic Habitats

Surveys at ERMP-AQ-03 showed aquatic habitats are in good condition. This is a direct result of the untouched nature of the waterways and the strong riparian values noted at the site. The substrate was dominated by fine sand and while bedrock was observed, it was not dominant, and flows were insufficient to create riffles. The lack of riffle zones and/or larger grainsized substrate is the only reason habitats at this location did not score excellent.

5.5.2 Aquatic Flora

No submerged aquatic vegetation (e.g. seagrass) were observed at ERMP-AQ-03. As such, aquatic vegetation comprised almost entirely of mangrove species observed within the riparian/intertidal zone.

At the time of survey, the Southern Tributary channel at ERMP-AQ-05 was completely dry. The groundcover within the channel was a thick layer of decomposing leaf litter. No live grass or sedge species were found within this area. The riparian zones on the eastern side of the waterway is confined to within 10 m of the bank. The riparian zone on the western side extends out over 150 m from the site. During the wet season it is likely that this entire area is inundated.

None of the aquatic flora species identified within the project site are listed under the EPBC Act. No aquatic Weeds of National Significance were sighted during field surveys.

5.5.3 Macroinvertebrates

Taxonomic richness and abundance of macroinvertebrates at ERMP-AQ-03 averaged six families, compared to an average of seventeen (17) families for the three estuarine sites sampled. This is expected to be a result of the dynamic environment experienced at this location, immediately below the rock bar/horizontal waterfall.

Based on results of statistical analyses, the freshwater influence from natural downstream flows is considered to be structuring macroinvertebrate communities within the upper estuarine sections of the Emerald River. It is suggested that the extent (downstream) of this influence will vary dependent on season, with increased freshwater outputs during the wet season likely shifting the macroinvertebrate assemblage inhabiting ERMP-AQ-03 toward a freshwater species dominated community. By the end of the dry season it is likely that more estuarine families will recruit to the area later in the year as the freshwater influence diminishes.

5.5.4 Other Aquatic Species

Twelve (12) fish species were recorded at ERMP-AQ-03, compared to a total of twenty-six (26) within the estuarine reaches of the project site. No species listed under the EPBC Act or the TPWC Act were found during the field surveys, and no introduced species or turtles were observed.

Evidence of Estuarine Crocodiles was noted at all sites within the Emerald River, with a 2.5 m specimen observed basking on the bank ~50 m upstream of ERMP-AQ-03.

5.5.5 Threatened and Migratory Species

The following species listed under the TPWC Act were assessed as having a high or moderate potential to be present within the Emerald River:

- Dwarf Sawfish (*Pristis clavata*) listed as Vulnerable under the TPWC Act and Vulnerable and Migratory Marine under the EPBC Act;
- Green Sawfish (*Pristis zijsron*) listed as Vulnerable under the TPWC Act and Vulnerable and Migratory Marine under the EPBC Act; and
- Largetooth Sawfish (*Pristis pristis*) listed as Vulnerable under the TPWC Act and Vulnerable and Migratory Marine under the EPBC Act.

Of these species, only the Largetooth Sawfish was assessed as having a high or moderate potential to be present within the Southern Tributary.

5.6 IMPACT ASSESSMENT

5.6.1 Overview

This section assesses the potential impacts of the project on the aquatic environment. It includes a description of the design features of the project that were developed to minimise impacts on aquatic ecology values. An assessment of the potential impact of the project on the aquatic ecology of the Emerald River and Southern Tributary are discussed, along with the potential impacts on threatened and/or migratory species.

This referral relates to the realignment of an access corridor that would have required a bridge over the Emerald River and a crossing of the Southern Tributary. These crossings would have had the potential to impact on aquatic ecology. However, detailed design of these crossings had not been undertaken prior to the need to realign the access corridor being identified. As such, an assessment of the incremental impacts of the realigned access corridor (and haul road waterway crossings) is not possible. Consequently, the impact assessment has assessed the potential impacts of the proposed haul road design on aquatic ecology, rather than the incremental impacts that would have arisen from the realignment.

5.6.2 Design Features of the Project

The project has been designed to minimise impacts on the Emerald River floodplain and impacted waterways, which, in turn, minimises potential impacts on the aquatic ecology values of these waterways. The potential impacts on the Emerald River, its floodplain and the Southern Tributary are discussed in Section 4 – Surface Water, which concludes that the project is unlikely to have a significant adverse impact on the Emerald River and its floodplain. The key design features that have been adopted to avoid and mitigate potential impacts are as follows:

- The haul road is designed to minimise impacts on the Emerald River floodplain by constructing the road generally at grade, with two low-level causeways. This design allows flood flows to pass over the haul road, with minimal impact on flood levels or flows. Erosion protection will also be installed in any areas predicted to be affected by localised scouring.
- The Emerald River crossing has been designed as a bridge with a large span specifically to avoid the need for structures (e.g. piers or abutments) to be constructed in the bed or banks of the river channel. This design allows bank full flood flows to pass beneath the bridge with negligible impact on flood levels, velocities and sediment transport capacity.
- The Southern Tributary crossing has been designed as a series of culverts in the tributary channel and southern floodplain, with a low-level causeway in between. This design allows low flows to pass through the culverts located in the tributary main channel and larger, flood flows to flow over the low-level causeway. This design has negligible impacts on flood levels and sediment transport capacity in the tributary main channel. Flow velocities in the main channel may be slightly reduced as the haul road will redistribute flow from the main channel to the causeway and across the southern floodplain. Overall, these changes are considered to have a negligible impact on the Southern Tributary.
- The haul road has been designed with a drainage system that limits the potential for suspended sediment to impact adjacent vegetation and downstream waterways. The road includes a central crown which allows runoff to drain from the road and be captured in drains which feed into sediment ponds. Treated water from the sediment ponds will be released into surrounding vegetation. Clean water diversion drains (or bunds depending on local relief) will also be constructed to convey clean water away from the haul road.
- Additional erosion and sediment control measures will be incorporated, including vegetating exposed batters and lining them with natural matting products (e.g. coconut fibre matt or mulch). These will be documented in an Erosion and Sediment Control Plan that will be prepared for the construction of the project.

These design features also reduce the project's potential to impact aquatic ecology. These potential impacts are discussed in the following sections.

5.6.3 Potential Impacts on Emerald River Aquatic Ecology

The potential impacts of the project that were assessed on the aquatic ecology of the Emerald River included the following:

- Impacts to aquatic habitats from the alteration of hydrology around the bridge and the removal of riparian vegetation;
- Impacts to fish passage;
- Impacts to water and sediment quality/composition; and
- Increased risk of introducing pest flora and fauna.

These impacts are discussed in the following sections.

Aquatic Habitats

The removal of aquatic habitat to construct the bridge over the Emerald River has been limited by designing the bridge with a large span. The large span does not require piers or abutments to be constructed in the main channel, meaning that direct removal of aquatic habitats in the bed or banks of the main river channel is not required for the bridge structure. In addition, there is limited potential for indirect impacts on aquatic ecology from changes to the hydrology as piers for the bridge are not required to be constructed in the main channel.

As such, impacts on aquatic habitats in the Emerald River main channel are limited to areas subject to potential scouring. Modelling identified that up to 0.9 m of sediment could be scoured from directly beneath the bridge during high flow/flood events (modelled as the 2% Annual Exceedance Probability (AEP) event) (*Geomorphic Impact Assessment Report* (Appendix B)). Any scour is likely to occur gradually and, therefore, sediment deposition along the downstream reach is not expected. Filling of the scour pool may occur over time during successive small, flood events. As this scour will be localised, it is expected to have little influence on downstream habitats.

There will be some clearing of riparian vegetation required along the Emerald River to construct the bridge. Clearing will be limited to the width of the haul road disturbance, as the bridge abutments do not encroach on the banks of the river. This will have a negligible influence on the downstream aquatic ecology values identified within this assessment.

Fish Passage

As the bridge design does not require piers to be erected within the main channel of the Emerald River, the bridge will have negligible impact on fish passage within the channel. However, during flood events fish move out onto the floodplain (where flow velocities are generally lower) to migrate upstream or downstream. Therefore, the embankments on either side of the channel can act as barriers during flood events. The inclusion of the low-level causeway on the southern floodplain will allow fish to move across the causeway, reducing potential impacts to fish passage during flood events. Rip rap on either side of the causeway will also disrupt stream flow, reducing velocity, and further aiding fish movement. With these additional mitigation measures in place, no significant impacts on fish passage are predicted in the Emerald River or its immediate floodplain.

Water and Sediment Quality

The water quality within the reaches of the Emerald River associated with the bridge transition from freshwater to estuarine throughout the year, following the cessation of flooding freshwater flows within the wet season. This transition will include the natural slow progression of estuarine waters back upstream. The construction and operation of the bridge will not affect these complex hydrological interactions, allowing natural shifts in water quality to continue throughout the year.

Therefore, the main potential impact to water and sediment quality/composition is from erosion and sedimentation which may potentially arise from runoff from cleared areas (including road surfaces) entering waterways and increasing suspended solids and sedimentation in downstream waters. The following design features and mitigation measures will be adopted to reduce the potential for erosion and sedimentation to occur:

- Utilising best practice soil erosion and sediment control measures during construction (i.e. deploying silt curtains, sediment fences, etc.) and timing works to avoid periods with a high likelihood of significant rainfall.
- Developing and implementing an Erosion and Sediment Control Plan during construction.
- Revegetating all exposed batters or lining batters with natural matting products (coconut fibre matt or mulch) in order to prevent erosion.
- Incorporating drainage structures, such as sediment dams, as part of the design of the road. The sediment dams will collect runoff from the haul road and allow sediment to drop out of suspension before the runoff is passively released.

- Installing diversion drains to limit clean water from entering the disturbance area. This reduces the volume of water that must be treated for suspended sediments prior to release.
- Covering the causeway with a protective polymer as part of routine maintenance programs which will assist to reduce erosion.

These mitigation measures will effectively reduce the potential for sediment laden runoff to enter the downstream Emerald River, limiting the potential for impacts on water quality.

Spread of Weeds and Pest Animals

During the construction and operational phases of the project, environmental management measures will be adopted to manage the risk that invasive species such as weeds and feral animals may be introduced or established by project activities. This will be achieved through the use of the proponent's existing quarantine procedure that is in place for all mining activities and is designed to prevent unwanted pests and weeds arriving on Groote Eylandt. The quarantine procedure provides guidance on how to correctly inspect barges and their cargo entering the port facility at Milner Bay. This procedure would continue to be followed for any incoming vehicles and equipment required for the project.

In addition, the proponent also has specific weed management measures and procedures in place as well as a Cane Toad Management Plan which operate across all of the GEMCO leases to address these risks. Further detail on these existing management measures is provided in Section 8 – Environmental Management.

5.6.4 Potential Impacts on Southern Tributary Aquatic Ecology

The Southern Tributary culvert array will span the tributary channel. Therefore, there is the potential for both direct and indirect impacts to the aquatic ecology values associated with the system. The following potential impacts were assessed and are discussed in the following sections:

- Impacts to aquatic habitats arising from the construction of the culverts and the associated removal of vegetation;
- Impacts to fish passage;
- Impacts to water and sediment quality/composition; and
- Increased risks from pest flora and fauna.

Aquatic Habitats

Aquatic habitats within the reaches associated with the proposed Southern Tributary crossing have the potential to be impacted by the construction of the culverts in the tributary channel. The construction of the culvert array within the tributary channel will directly impact the bed habitat occurring within the haul road disturbance footprint and will also require the clearing of some riparian vegetation. Clearing will be limited to the extent possible, for the construction of the haul road and proposed crossing. These impacts will be localised and relatively minor.

The culverts may also create hydrological affects in the Southern Tributary both upstream and downstream of the culverts. Modelling found downstream flows and velocities in the tributary will reduce as a result of the proposed crossing as flood flows will be diverted to the low-level causeway. However, the reductions are not expected to have a significant impact on the waterway (Section 4 – Surface Water). Modelling also predicted increased flows and flow velocities along the southern floodplain, which creates a higher potential for floodplain scour along the southern bank of the Southern Tributary immediately upstream of the culvert crossing and across the causeway (Section 4 – Surface Water). The overbank velocity increases along the southern floodplain are generally less than 0.1 m/s, which is considered negligible. Erosion protection (in the form of rip rap) is also proposed to be installed in the elevated velocity areas in these locations to prevent scouring.

Overall, the construction and operation of the Southern Tributary crossing is predicted to have a minor impact on aquatic habitats within the immediate vicinity of the structure. These impacts are expected to have a negligible influence on the downstream aquatic ecology values identified within the Emerald River system.

Fish Passage

Several of the fish species recorded inhabiting the Emerald River catchment must migrate for various stages of their life cycles. The construction of culverts within the Southern Tributary therefore has the potential to impact on fish passage in the tributary. The culverts will be designed to incorporate best practice mitigation measures for fish passage. There are currently no design guidelines available under Northern Territory legislation to minimise impacts from waterway barriers on fish passage. As such, the requirements of the Queensland Department of Agriculture and Fisheries' (DAF's) *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018) were adopted due to their suitability based on the location of the project site, the type of waterway, and the species of fish targeted. Mitigation measures to be adopted from the guidelines include the addition of baffles (on the outer walls), bed roughening and provision of LED lighting within the culverts.

During flood events, fish move from the Southern Tributary out onto the southern floodplain, where flows are generally lower, to migrate upstream or downstream. Therefore, the road alignment on either side of the channel can act as a barrier during flood events. The inclusion of the low-level causeway on the southern floodplain will allow fish to move across the causeway, reducing potential impacts to fish passage during flood events. Rip rap on either side of the causeway will also disrupt stream flow, reducing velocity, and further aiding fish movement. With appropriate fish passage measures adopted for the culverts, the project will have minimal influence on fish passage within the Southern Tributary.

Water and Sediment Quality

The main potential impact to water and sediment quality/composition in the Southern Tributary is associated with runoff from cleared areas (including road surfaces). Erosion and sediment control measures adopted for the Emerald River crossing will also apply to the Southern Tributary crossing. These measures are discussed in Section 5.6.3 and will effectively reduce the potential for sediment-laden runoff to enter the Southern Tributary, limiting the potential for any downstream water quality impacts that may affect aquatic ecology values.

Spread of Weeds and Pest Animals

Weed and pest control measures to be adopted for the project are described in Section 5.6.3. These measures will also apply to project activities undertaken in the Southern Tributary and will assist to prevent the introduction or spread of weeds or feral animals as a result of the project.

5.6.5 Impacts on Threatened and Migratory Species

As discussed in Section 5.6.3, there are limited potential direct impacts from the Emerald River bridge on aquatic ecology values. This is largely due to the bridge design whereby the bridge will span the breadth of the river, with no piers required in the main channel. The potential indirect effects from the bridge are also considered to be minor. As such, the potential impact of the Emerald River bridge on threatened or migratory species that may potentially inhabit this portion of the river are expected to be minimal. In addition, flood modelling and a geomorphological assessment undertaken for the project (described in Section 4 – Surface Water) suggest that the project will have negligible influence on the Emerald River downstream of the project site and/or on coastal/marine ecosystems. As such, threatened or migratory species that may potentially inhabit the Emerald River downstream of the bridge are also unlikely to be impacted by the bridge.

As discussed in Section 5.6.4, culverts are proposed to be constructed in the Southern Tributary. Therefore, direct and indirect impacts may arise for threatened or migratory species that have the potential to be present in this waterway. The Largetooth Sawfish was the only TPWC Act listed species assessed as having a high or moderate potential to be present within the Southern Tributary. An assessment of significance was undertaken for this species to determine the potential to be impacted by the construction of the culverts on the Southern Tributary.

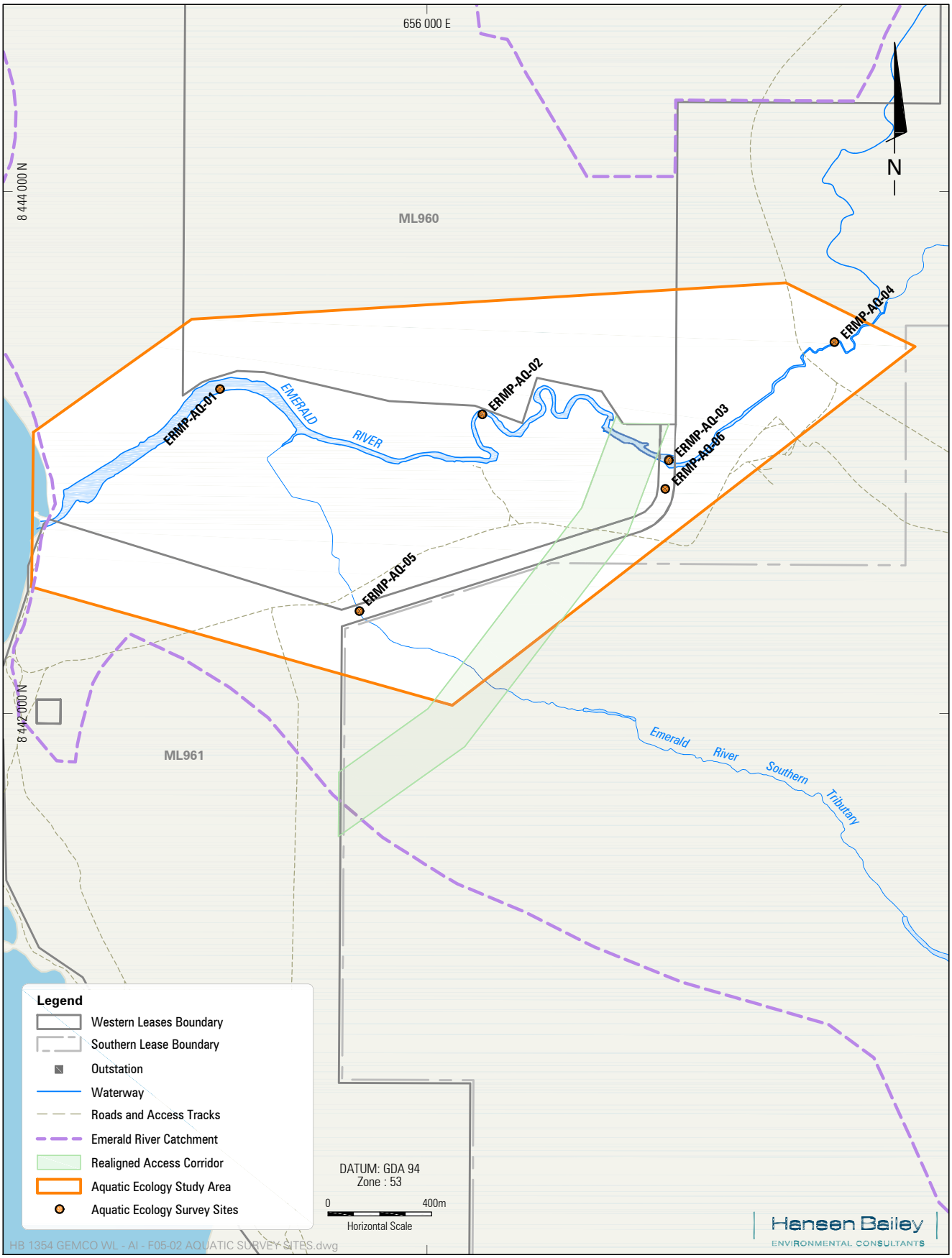
These assessments were undertaken in accordance with the Significant Impact Guidelines (refer to the *Aquatic Ecology Report* (Appendix C). The assessment concluded that the project will not have a significant impact on the species within the Southern Tributary.

FIGURES

J QUARRY HAUL ROAD REALIGNMENT

Local Catchment Setting

FIGURE 5-1



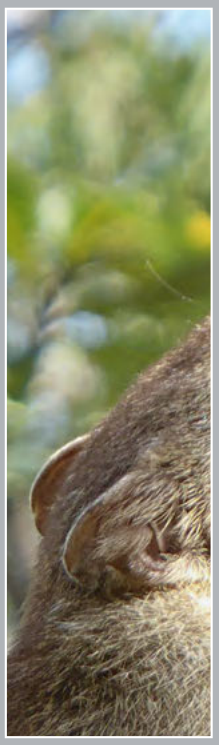
J QUARRY HAUL ROAD REALIGNMENT

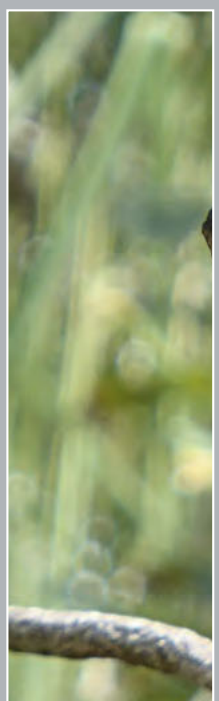
Aquatic Ecology Survey Sites

FIGURE 5-2

6

Terrestrial Ecology





CONTENTS

Tables

Figures

6 TERRESTRIAL ECOLOGY

6.1 INTRODUCTION

This section provides a summary of the key findings of the *Terrestrial Ecology Report* (Appendix D) prepared by Cumberland Ecology for the J Quarry Haul Road Realignment (the project). It describes the biodiversity values in the vicinity of the project, the potential impacts of the project, and the mitigation and management measures proposed to be adopted. An assessment of aquatic ecology is provided in Section 5 – Aquatic Ecology.

As discussed in Section 2 – Project Management, the project involves the construction of a haul road within a realigned access corridor, as well development of a construction access track and realignment of an existing public access track. The project site for the purposes of the environmental assessment is the area to be disturbed by these project elements, and is shown in Figure 6-1.

6.2 OVERVIEW OF PROJECT SITE

The land within and surrounding the project site comprises natural bushland, and no farming or agricultural activities are undertaken in the vicinity of the project site. Exploration activities associated with the existing mine and the proponent's Southern Lease exploration tenement are undertaken within the vicinity of the project site. These activities include exploration drilling and minor clearing of vegetation for drill pads and tracks.

The project site is located in the catchment of the Emerald River and traverses the Emerald River and a tributary of the Emerald River referred to as the Southern Tributary. The vegetation and habitats within the project site are almost pristine and are strongly influenced by topography and drainage. Eucalypt open forests and woodlands dominate the well-drained areas, while the swampy and riparian areas along the Emerald River and the Southern Tributary are dominated by Melaleucas. Fire also plays a significant role in determining vegetation composition as land in the vicinity of the project site is regularly burnt by the Traditional Owners. The project site provides a range of forest, woodland and wetland habitat for fauna species.

Groote Eylandt is considered to have a high conservation value due, in part, to the absence of many pest and feral animals that threaten native wildlife and habitats on the Australian mainland. Of particular significance, the Cane Toad (*Rhinella marina*), which poses a threat to many native animals on the mainland is not present on the island.

6.3 REGULATORY REQUIREMENTS

6.3.1 Key Northern Territory Legislation and Guidelines

Territory Parks and Wildlife Conservation Act

The *Territory Parks and Wildlife Conservation Act 1976* (NT) (TPWC Act) is discussed in Section 5 – Aquatic Ecology. The TPWC Act is administered by the Department of Environment, Parks and Water Security (DPEWS) and provides conservation categories for species in the Northern Territory, including terrestrial species.

Weeds Management Act

The *Weeds Management Act 2001* (NT) (WM Act), which is administered by DPEWS, makes provision for the control and eradication of declared weeds in the Northern Territory. Weeds that have been identified to have an impact on the Northern Territory's economic, environmental, cultural and social values are declared under the WM Act. Weed management measures to be implemented are discussed in Section 6.7.2.

Land Clearing Guidelines

The Northern Territory *Land Clearing Guidelines* (Department of Environment and Natural Resources, 2020) (Land Clearing Guidelines) establish standards for native vegetation clearing approved under the *Planning Act 1999* (NT) (Planning Act). The guidelines are administered by the DPEWS. The guidelines seek to manage clearing in a way that promotes the net benefit from the use of land that is cleared of native vegetation.

Mining and exploration activities are controlled by the *Mining Management Act 2001* (NT) rather than the Planning Act. As such, mining activities (such as the construction of the haul road and construction access road) are not required to formally consider the Land Clearing Guidelines. However, a separate approval application under the Planning Act will be lodged for clearing of vegetation along the realigned public access track, which is not considered to be a mining activity and is located beyond the proponent's mineral leases.

6.3.2 Key Regulatory Requirements of the Federal Government

EPBC Act

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is described in Section 5 – Aquatic Ecology. The EPBC Act is administered by the Federal Department of Agriculture, Water and the Environment (DAWE). Threatened and migratory aquatic species listed under the EPBC Act have been included in this assessment.

EPBC Act Guidance Materials

A variety of documents have been produced in accordance with the requirements of the EPBC Act to provide guidance on listed threatened and migratory species, key threatening processes that may impact those species, and survey techniques for the species.

In addition, recovery plans and conservation advice are available for many species. These documents were consulted in assessing the baseline ecology values and the potential impacts of the project on EPBC Act listed species that are described in the *Terrestrial Ecology Report* (Appendix D).

6.4 METHODOLOGY

This section describes the methodology adopted for the terrestrial ecology assessment. Investigations for the assessment included a literature review and database assessment and review of extensive field surveys that have been undertaken within the project site and vicinity. A likelihood of occurrence assessment was also undertaken for listed species identified in database searches or field surveys to determine their potential to occur within the project site. Further assessment of the project's potential to impact on terrestrial ecology values was undertaken on species likely to occur in the project site.

6.4.1 Desktop Assessment

A desktop assessment of the terrestrial ecology of Groote Eylandt and the project site was undertaken. The desktop assessment aimed to obtain background information on the historical and potential presence and distribution of species and ecological communities (particularly those listed under the TPWC Act and EPBC Act), and to determine potential habitat values. The desktop study involved:

- Database searches including the Northern Territory Natural Resource Maps search facility and the EPBC Act Protected Matters Search Tool (PMST);
- Review of mapping of threatened ecological communities in the Northern Territory;
- Review and interpretation of recent high-resolution aerial photography and topographic information;

- Review of published DEPWS vegetation mapping (DENR, 2018); and
- Review of published geological and soils mapping.

6.4.2 Field Surveys

The area in the vicinity of the project site has been extensively surveyed over recent years. The following key studies comprised detailed flora and fauna surveys that include survey sites within and in proximity to the project site:

- Cumberland Ecology (2020): *GEMCO Western Leases and Surrounds Vegetation Mapping Report*;
- Cumberland Ecology (2016): *Southern Lease Project Baseline Terrestrial Ecology Report*;
- Cumberland Ecology (2019): *GEMCO/South32 Southern Lease Small Mammal Research Project Report*;
- Cumberland Ecology (2015): *Eastern Leases Project Terrestrial Ecology Assessment Report*; and
- Heiniger and Gillespie (2017*): Survey of Threatened Mammal and Feral Cat Surveys on Groote Eylandt. Unpublished Report to the Anindilyakwa Land Council*.

This information, along with other ecological studies conducted across Groote Eylandt, provides a good understanding of the vegetation communities, fauna habitat types and likely presence of threatened and migratory species in the project site. This information formed the basis for the ecological data described in the terrestrial ecology assessment. The locations of survey sites in proximity to the project site are shown in Figure 6-2 and Figure 6-3 for flora and fauna survey sites, respectively. A complete list of ecological studies consulted for this assessment is included in the *Terrestrial Ecology Report* (Appendix D).

In addition, at the pre-lodgement meeting for the project (held on 13 October 2020), DEPWS requested that a targeted field survey of the project site be undertaken to identify any potential spoil heaps or pop holes for the Northern Hopping-mouse (*Notomys aquilo*). This species is listed as Vulnerable under the TPWC Act and the EPBC Act and is known to be present on Groote Eylandt. However, no records of the species were obtained during recent, extensive surveys that targeted the species in the proponent's Southern Lease (Cumberland Ecology, 2019) and it was concluded that there was a low probability of the species being present in the project site. DEPWS requested that the survey of spoil heaps and pop holes be undertaken as a precautionary measure. The survey methodology was agreed with Dr Graeme Gillespie (Director Terrestrial Ecosystems, Flora and Fauna Division, DEPWS) and the survey was completed in October 2020. Further details are provided in the *Terrestrial Ecology Report* (Appendix D).

A likelihood of occurrence assessment was undertaken for listed species identified in database searches or field surveys to determine their potential to occur within the project site. The likelihood of occurrence was based on the species known range, number and age of records, and habitat preferences, which were evaluated considering site characteristics identified during recent field surveys.

6.4.3 Assessment of Significance

Assessments of Significance were undertaken for threatened or migratory fauna species listed under the EPBC Act that are present or have a moderate or high potential to occur in the project site. Assessments of Significance are threshold tests of significance prepared according to the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013) (the Significant Impact Guidelines). Assessment in accordance with the Significant Impact Guidelines was undertaken to gauge the significance of predicted impacts to threatened and migratory species. The guidelines are designed specifically to determine whether an activity is considered, under the EPBC Act to have a significant impact on the species.

6.5 RESULTS

6.5.1 Vegetation Structure

The vegetation in the project site comprises remnant vegetation, and there has been no significant clearing of vegetation. Overall, the vegetation is in very good condition and it is characterised by a high species and structural diversity. Parts of the surrounding land are regularly burnt by the Traditional Owners, which has resulted in a reduction in the amount of woody debris and has potentially also affected the species composition and structure of the vegetation. Some flora species are highly sensitive to changes in fire regime, and it is likely that this may have influenced the suite of species that currently occupy the project site and the nearby area generally.

6.5.2 Vegetation Communities

The vegetation community patterns within the project site strongly reflect the geology, soils, drainages, topography, and the impacts of frequent fires. The most extensive vegetation communities within the project site and surrounds comprise open woodlands to open forests dominated by *Eucalyptus tetrodonta* (Darwin Stringybark). Melaleuca dominated vegetation occurs within the riparian zones and wetlands. As described in Section 2 – Project Description, the project was specifically designed to avoid disturbance of sensitive vegetation types such as monsoon vine thicket and mangroves.

Detailed vegetation mapping was undertaken of the project site, based on mapping undertaken by the Department of Environment and Natural Resources in 2018, which was verified during field surveys undertaken on behalf of the proponent. A detailed list of the individual Vegetation Management Units (VMUs) and combination VMUs occurring within the project site and surrounds is provided in the *Terrestrial Ecology Report* (Appendix D). Due to the complexity of vegetation mapping, the VMUs have been grouped together to form Broad Vegetation Types for this assessment, in collaboration with DENR. The broad vegetation types present in the project site are shown in Figure 6-4.

The EPBC Act PMST did not record any Threatened Ecological Communities (TECs) as occurring or potentially occurring within a 20 km radius of the project site. There is currently no mechanism for listing TECs under Northern Territory legislation. Therefore, the TPWC Act does not contain listings for TECs.

The project site contains remnant vegetation which support two habitat types that provide a range of habitats for fauna species, including threatened species. The two habitat types are shown in Figure 6-5 and include laterite woodland and forest habitat, and riparian / wetland habitat. Specific habitat features located within these habitat types provide foraging, shelter and breeding opportunities for fauna such as mammals and reptiles.

6.5.3 Flora Species

Over 190 plant species have been recorded within the project site and surrounds. The data indicates the floristic assemblage across the project site is very similar to the assemblage recorded in the Eastern Leases and Southern Lease and is well represented by Poaceae (grasses), Fabaceae (Acacias and peas), Cyperaceae (sedges) and Myrtaceae (*Eucalyptus spp.* and *Melaleuca spp.*). A full list of flora species that have been recorded within the project site and surrounds is presented in the *Terrestrial Ecology Report* (Appendix D).

No weeds were recorded in the project site and few have been recorded in the surrounding areas.

No threatened flora species were recorded in database searches within 20 km of the project site or during recent terrestrial ecology field surveys.

6.5.4 Fauna Species

In total, 57 fauna species have been recorded from the project site and surrounds during recent terrestrial ecology surveys including 28 birds, 12 mammals and 17 reptiles. A complete list of the fauna species that have been recorded is presented in the *Terrestrial Ecology Report* (Appendix D).

TPWC Act Listed Threatened Fauna Species

The following TPWC Act listed threatened fauna species are considered to have a high likelihood of occurring in the project site:

- Northern Quoll (Dasyurus hallucatus) (TPWC Act status: Critically Endangered; EPBC Act status: Endangered);
- Masked Owl (northern) (Tyto novaehollandiae kimberli) (TPWC Act status: Vulnerable; EPBC Act status: Vulnerable); and
- Mertens' Water Monitor (Varanus mertens) (TPWC Act Status: Vulnerable; EPBC Act status: not listed).

Species records within the vicinity of the project site are shown in Figure 6-5.

The Yellow-spotted Monitor (*Varanus panoptes*) (TPWC Act Status: Vulnerable; EPBC Act status: not listed) was also assessed as having a high likelihood of occurring in the project site. However, feedback in the pre-lodgement meeting for the project held on 13 October 2020 indicated the most current research suggests there is no evidence the Yellow-spotted Monitor is present on Groote Eylandt (Gillespie, G, pers comm, 13 October 2020). For this reason, the Yellow-spotted Monitor is not discussed further in this assessment.

The results of database searches indicated that one additional fauna species (Pale Field Rat (*Rattus tunneyi*)) which is listed only under the TPWC Act could potentially occur within the project site and surrounds. A likelihood of occurrence assessment was undertaken, as described in Section 6.4.2, and concluded there was a low potential for the species to be present and it is therefore not considered further in this assessment.

No potential spoil heaps or pop holes for the Northern Hopping-mouse (Vulnerable under the TPWC Act and EPBC Act) were identified during recent, targeted surveys of the project site.

EPBC Act Listed Threatened and Migratory Fauna Species

The assessment also identified the following EPBC Act listed threatened and migratory fauna species (not also listed under the TPWC Act and discussed above) that are considered to have a moderate or high likelihood of occurring in the project site:

- Ghost Bat (*Macroderman gigas*) (EPBC Act status: Vulnerable; TPWC Act status: not listed).
- Fork-tailed Swift (*Apus pacificus*) (EPBC Act status: Migratory Marine; TPWC Act status: not listed); and
- Eastern Osprey (*Pandion cristatus*) (EPBC Act status: Migratory Marine; TPWC Act status: not listed).

The results of database searches indicated that several other fauna species listed under the EPBC Act could potentially occur within the project site. A likelihood of occurrence assessment was undertaken as described in Section 6.4.2 and concluded these species had a low likelihood of occurring in the project site. These species are, therefore, not considered further in the assessment.

One species listed under the EPBC Act as migratory, namely the Salt-water Crocodile (*Crocodylus porosus*), was assessed as having a high likelihood of occurrence within the project site. The assessment of this species is discussed in Section 5 – Aquatic Ecology.

Exotic/Feral Species

Groote Eylandt represents a unique faunal refuge in that exotic and feral species such as feral cattle, horses, donkeys, pigs, goats, Water Buffalo, the Cane Toad and Rusa Deer are not established on the island.

No exotic / feral fauna species were recorded within the project site during recent surveys. However, domestic dogs/dingoes (*Canis familiaris/lupus*) and feral cats (*Felis catus*) are likely to occur. Heiniger et al. (2020) detected feral cats infrequently in the vicinity of the project site, although detections were too sparse to estimate density.

6.6 IMPACT ASSESSMENT

6.6.1 Overview

The project has the potential to give rise to direct and indirect impacts on flora and fauna. These include:

- Direct impacts such as clearing of vegetation and potential habitat for the project; and
- Indirect impacts, particularly those that have the potential to increase threats to threatened species such as habitat fragmentation, edge effects, the effects of noise and vibration, vehicle strikes, lighting, dust, erosion and the introduction of invasive species.

The project involves realigning an existing, approved access corridor and consequently the assessment focusses on the additional, incremental impacts of the realignment, compared to the impacts from the approved alignment. These incremental impacts are described in the remainder of this section and mitigation measures are discussed in Section 6.7.

6.6.2 Direct Impacts

Vegetation Clearing

The largest direct impact of the project is the removal of native vegetation that also provides habitat for a wide range of flora and fauna species. The total area of direct impact is approximately 24 ha and includes clearing for the construction of the haul road, construction access track and the realigned public access track. The area within the existing access corridor that would have been cleared to construct the haul road is approximately 10 ha. Taking this approved area of clearing into account, the project will result in an additional 14 ha of clearing.

Table 6-1 summarises the extent of vegetation of each broad vegetation type required to be cleared for the project, as well as the total disturbance area and the disturbance that would have occurred for the existing access corridor. Two dominant broad vegetation types to be cleared by the project comprise over 80% of the vegetation requiring additional clearing (Figure 6-4). These broad vegetation types are Eucalypt forest or woodlands and are widespread across Groote Eylandt. These broad vegetation types include:

- 5: Eucalypt open forests of lowlands and deeper sandy soils derived from sandstone or deeply weathered parent rocks (lateritic); and
- 11: Eucalypt woodlands and open woodlands of lowlands with sandy soils.

As discussed in Section 2 – Project Description, the alignment of the access corridor has been designed to avoid disturbance of sensitive vegetation (such as riparian vegetation), to the extent possible (Table 6-1). However, some clearing of riparian vegetation will be required, given that the project involves two waterway crossings. The area to be cleared has been minimised to the extent possible, in consultation with the ALC and Traditional Owners through the siting and design of the crossings.

Table 6-1 Clearing of Broad Vegetation Types

BROAD VEGETATION TYPE	TOTAL DISTURBANCE FOOTPRINT (ha)[1]	APPROVED DISTURBANCE (ha)[2]	ADDITIONAL PROJECT DISTURBANCE[3]	
			AREA (ha)	% WITHIN DISTURBANCE FOOTPRINT
4: Riparian and gully closed forests with mixed canopies (rainforest and *Melaleuca spp*.)	0.9	0.5	0.4	3.1
5: Eucalypt open forests of lowlands and deeper sandy soils derived from sandstone or deeply weathered parent rocks (lateritic)	13.5	6.5	6.9	48.9
7: Eucalypt open forests and woodlands of sandstone uplands	0.1	-	0.1	0.7
9: Melaleuca open forests on alluvial plains and drainage systems	0.6	0.6	0.1	0.4
11: Eucalypt woodlands and open woodlands of lowlands with sandy soils	4.7	-	4.7	33.1
13: Eucalypt woodlands on alluvial soils	1.9	1.1	0.7	5.1
16: Melaleuca woodlands on alluvial soils (wet)	1.1	0.9	0.2	1.4
18: Melaleuca open woodlands on alluvial soils (wet)	1.1	-	1.1	7.5
33: Cleared / disturbed / regrowth	<0.1	-	<0.1	0.1
34: Water	0.2	0.1	0.1	0.7
Total[4]	**24**	**10**	**14**	**100%**

1 The total disturbance footprint is the total area of vegetation required to be cleared for the construction of the haul road, construction access track and the realigned public access track.
2 The approved disturbance is the area within the existing access corridor that would have been cleared to construct the haul road.
3 The additional project disturbance is the area of total disturbance minus the area of approved disturbance.
4 In some cases totals may not equal the appropriate total number due to rounding

Habitat Clearing

The native vegetation throughout the project site provides habitat for a range of flora and fauna, including some species that are listed as threatened or migratory under the EPBC Act and/or TPWC Act. As described in Section 6.5.2, two habitat types have been identified within the project site including laterite woodland and forest, and riparian / wetland habitats (Figure 6-5). A breakdown of the clearing of these habitat types within the project site is provided in Table 6-2, as well as the total disturbance area and the disturbance that would have occurred for the existing access corridor. The most impacted broad habitat type is laterite woodland and forest habitat (12.5 ha) which comprises nearly 88% of the additional habitat to be cleared. The realignment of the access corridor will require clearing of the same habitat types as the existing access corridor.

The clearing of habitats for the project will remove specific habitat features utilised by fauna species for foraging, sheltering, roosting, and breeding. These include habitat features such as hollow bearing trees, fallen logs and debris as well as understorey vegetation. Although the project will result in the removal of habitat and habitat

features, extensive areas of land containing similar habitat and habitat features occur within the surrounding region. It is anticipated that the types of flora and fauna species utilising the habitat that will be cleared will continue to persist in adjacent areas where suitable habitat is present.

Table 6-2 Extent of Habitat Clearing

HABITAT TYPE	TOTAL DISTURBANCE FOOTPRINT (ha)[1]	APPROVED DISTURBANCE (ha)[2]	ADDITONAL PROJECT DISTURBANCE[3]	
			AREA (ha)	% WITHIN DISTURBANCE FOOTPRINT
Riparian/wetland habitats	3.6	2.0	1.6	11.5
Laterite woodland and forest habitats	20.1	7.7	12.5	87.8
Cleared	<0.1	-	<0.1	0.1
Water	0.2	0.1	0.1	0.7
Total[4]	**24**	**10**	**14**	**100**

1 The total disturbance footprint is the total area of vegetation required to be cleared for the construction of the haul road, construction access track and the realigned public access track.
2 The approved disturbance is the area within the existing access corridor that would have been cleared to construct the haul road.
3 The additional project disturbance is the area of total disturbance minus the area of approved disturbance.
4 In some cases totals may not equal the appropriate total number due to rounding

6.6.3 Indirect Impacts

Indirect impacts may arise from the project that have the potential to impact the remaining vegetation and surrounding habitats used by terrestrial flora and fauna species. These include habitat fragmentation, edge effects, dust, noise, lighting, erosion and sedimentation, vehicle strike, and the potential to introduce weed or pest species. However, these impacts are expected to be similar to those that would have arisen from the construction of the haul road within the existing, approved access corridor. As such, it is unlikely any additional, incremental indirect impacts associated with realignment of the access corridor would significantly impact on terrestrial ecology. Further detail on the assessment of indirect impacts is provided in the *Terrestrial Ecology Report* (Appendix D).

In addition, there are also a number of management measures and procedures currently in place that are used at the existing mine to manage environmental impacts. In particular, such measures include the key threats of introducing weed or pest species such as the Cane Toad to the island. These measures will also apply to the project and will assist to reduce the potential for these indirect impacts to arise from the project. These controls are discussed in Section 8 – Environmental Management.

6.6.4 Impacts on Threatened Vegetation Communities

The TPWC Act contains no listings for TECs. No TECs listed under the EPBC Act were found or are predicted to occur within the project site. As such, no impacts to EPBC Act listed communities are anticipated.

6.6.5 Impacts on Threatened Flora Species

No threatened flora species listed under the TPWC Act or EPBC Act were found or are predicted to occur within the project site. As such, no impacts to threatened flora species are anticipated.

6.6.6 Impacts on Threatened Fauna Species

As described in Section 6.5.4, several threatened fauna species listed under the TPWC Act and EPBC Act have been recorded or have a high potential to occur within the project site. Assessments of significance were conducted on the threatened species listed under the TPWC Act and the EPBC Act that were considered to have a high or moderate potential for occurrence in the project site. The assessments of significance were undertaken in accordance with the Significant Impact Guidelines, or species-specific Significant Impact Guidelines, where relevant (refer to the *Terrestrial Ecology Report* (Appendix D). The assessments of significance concluded that the incremental impacts of the project will not give rise to significant impacts on all assessed species. This was due to the small additional clearing required to be undertaken (14 ha) which amounts to a very small proportion of the available habitat for each species that will remain on the island. In addition, the proponent has undertaken a significant planning process to realign the access corridor and design the haul road to minimise potential environmental impacts. The proponent also has a suite of impact avoidance and mitigation measures in place that will assist to reduce potential impacts on these threatened species. These measures are discussed in Section 6.7.

The Mertens' Water Monitor was the only TPWC Act threatened species likely to occur within the project site (further to those TPWC Act listed species that are also listed under the EPBC Act, and that are discussed above). This species was assessed against the direct and indirect impacts of the project and it was concluded that the project will not give rise to significant impacts on the species. This conclusion was based on the small additional clearing required to be undertaken (14 ha) which amounts to a very small proportion of the habitat that will remain on the island for this wide-ranging species. The bridge design principles adopted during project planning (refer to Section 2 – Project Description) will also enable unobstructed fauna movements along the Emerald River, which will assist in reducing impacts on the species. Impact avoidance and mitigation measures currently in place will also assist to reduce potential impacts on the species and are described in Section 6.7.

6.7 IMPACT MITIGATION

Impact mitigation is typically centred on a hierarchy of impact reduction principles, namely avoidance, mitigation and compensation. These principles, and how they relate to the project, are discussed in this section.

6.7.1 Measures to Avoid Impacts

The avoidance of impacts has been achieved to the extent possible through an iterative planning process which occurred over a 2-3 year period. This planning process was undertaken to ensure that environmental and cultural factors were considered in determining the alignment of the access corridor and the design of the haul road and waterway crossings. This process included investigation of multiple possible alignments for the access corridor. A risk-based approach was adopted to determine the significance of the cultural, environmental, engineering and safety constraints. The preferred access corridor alignment was selected to avoid disturbance of sensitive vegetation types such as monsoon vine thicket and mangroves, as well as reduce disturbance of riparian vegetation, to the extent possible. The haul road was also designed to avoid disturbance of the main channel of the Emerald River and to optimise the waterway crossing locations to minimise impacts on flood flows and areas of inundation, which have the potential to impact vegetation communities. The required clearing has also been kept to the minimum width required for the safe construction and operation of the haul road. The iterative process is described in further detail in Section 2 – Project Description.

6.7.2 Measures to Mitigate Impacts

The proponent has been mining on Groote Eylandt for over 50 years. There are a number of policies and procedures that have been progressively developed to mitigate impacts of mining and associated activities on terrestrial ecology values. These will apply to the project and are discussed in the following sections.

Permit to Clear Process and Pre-clearance Survey

All clearing will be undertaken in accordance with the proponent's Permit to Clear process. This process is undertaken prior to the commencement of any clearing. This process includes a pre-clearance survey which will:

- Delineate the limits of clearing and clearly mark the clearing limits on plans and on the ground; and
- Identify any noxious weeds so that clearing can be undertaken in a manner that avoids the spread of weeds, as far as possible.

The process also includes endorsement from the ALC. Further information on the Permit to Clear process is included in Section 8 – Environmental Management.

Clearing Procedures

The extent of clearing will be restricted to the minimum area required to safely construct and use the haul road. Vegetation removal will be carried out using appropriate earthmoving equipment. Disturbance of the topsoil will also be kept to a minimum to enable reuse in mine rehabilitation works, where possible.

A spotter will work with the dozer operator during the clearing of any vegetation to ensure the dozer operator maintains the correct alignment. The dozer operator and spotter will also utilise a GPS to assist with clearing. Personnel responsible for vegetation clearing will also be subject to training on threatened species and environmental management.

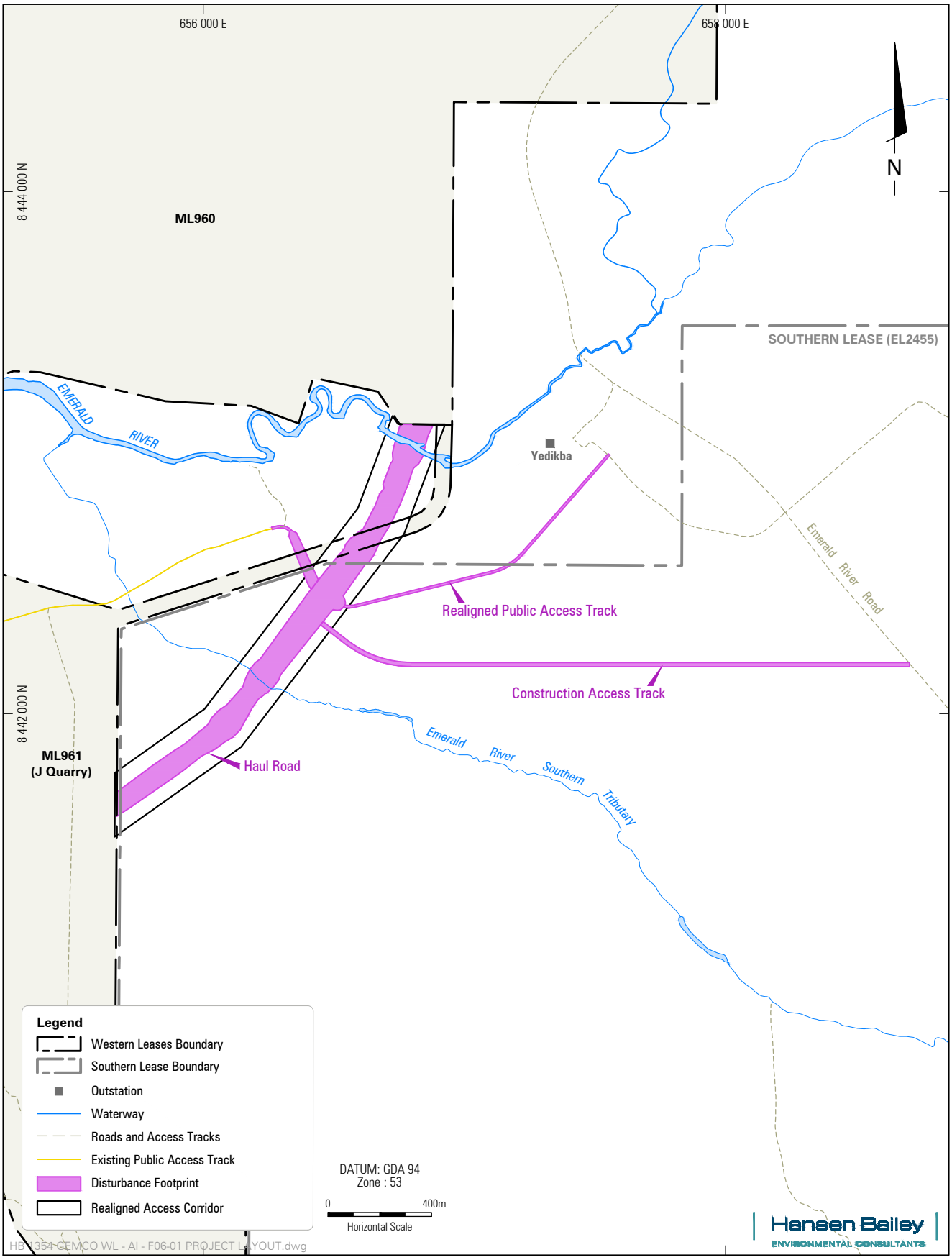
Weed Management

Weed management measures to be adopted for the project will focus on employee awareness, preventing the introduction of weeds, and on the early detection and eradication of weeds before they establish. Weed control and monitoring will be undertaken within cleared areas in accordance with the Weed Management Plan used at the existing mine. The Weed Management Plan is supported by a suite of relevant procedures, including a Weed Field Guide. These procedures include measures that will assist to minimise the risk that project activities will introduce or spread weeds into the project site. Such measures relevant to the project include washdown and inspection procedures for all high risk vehicles and inspections of work clothes and boots for all personnel prior to commencing daily construction work. Further information on weed management is discussed in Section 8 – Environmental Management.

Cane Toad Management

The proponent has a Cane Toad Management Plan and associated quarantine procedures in place. The prevention of the introduction of the Cane Toad is critical to maintaining populations of small mammals on Groote Eylandt, including threatened species such as the Northern Quoll. The management plan includes preventative measures such as quarantine procedures relating to barging of equipment, inspections of barges and vehicles, Cane Toad fencing at the port, and use of a Cane Toad detection dog at the port. There are also monitoring measures and, in the event of a Cane Toad being found, reporting and disposal procedures. These procedures would apply to the project. Further information on Cane Toad management is discussed in Section 8 – Environmental Management.

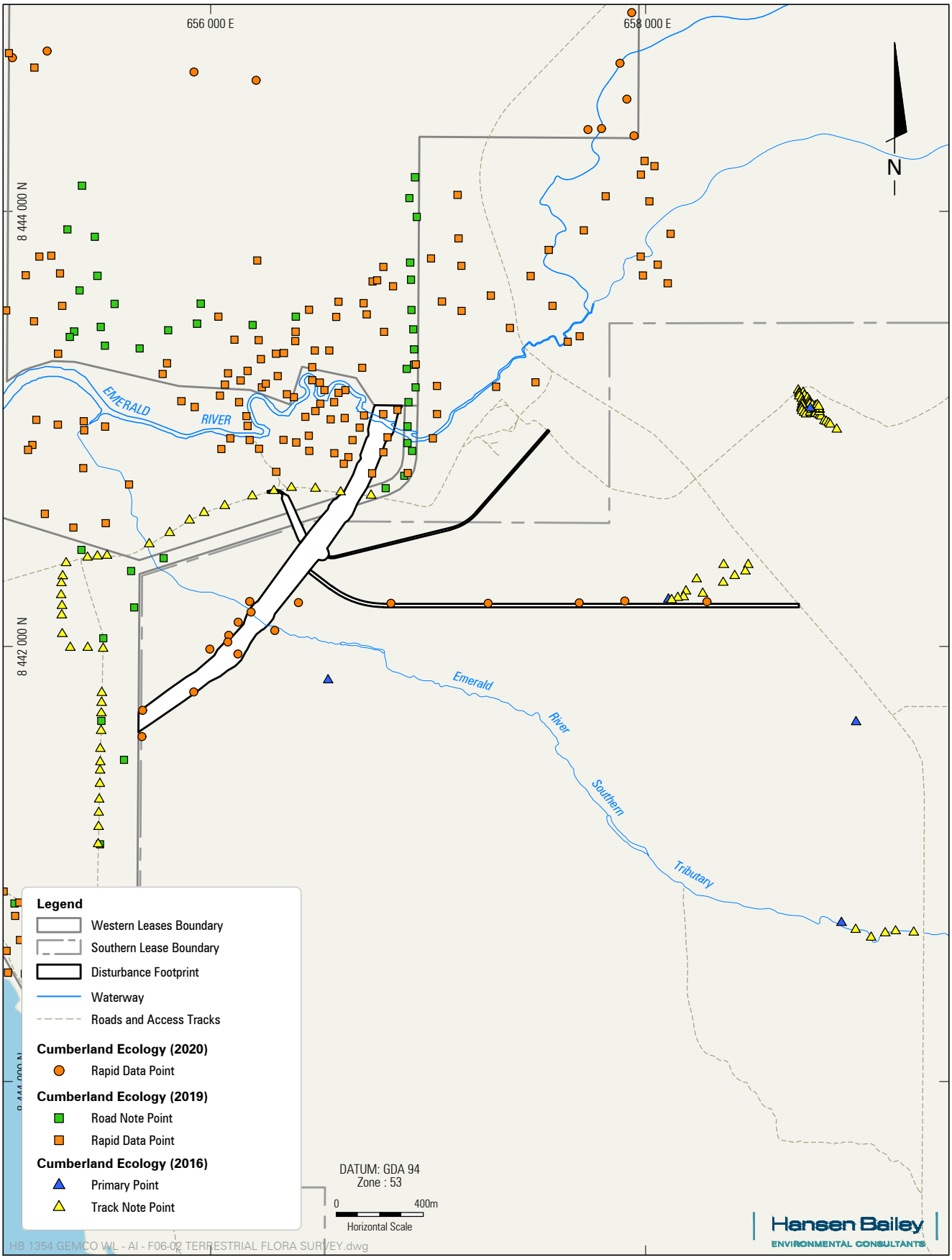
FIGURES



J QUARRY HAUL ROAD REALIGNMENT

Project Disturbance Footprint

FIGURE 6-1

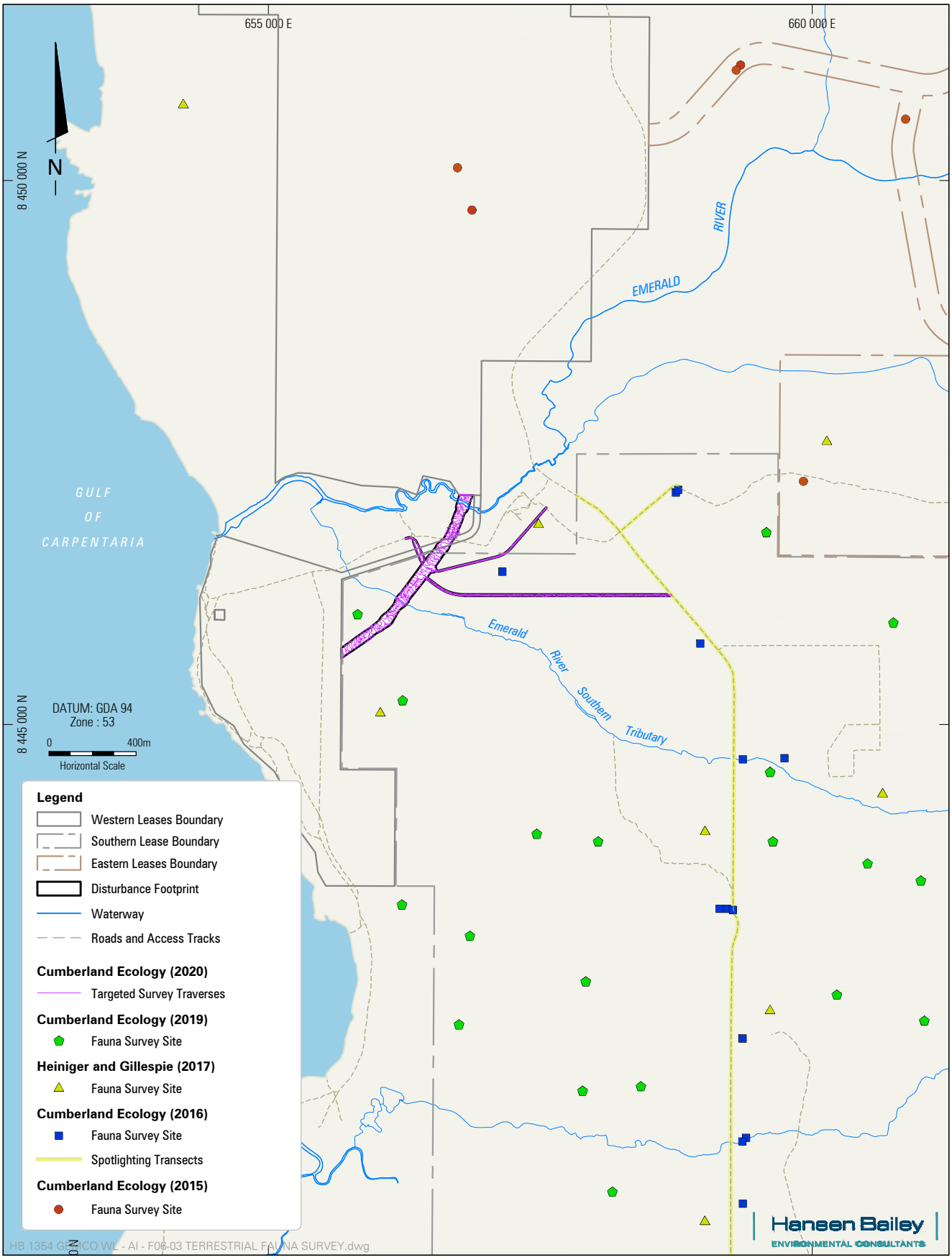


J QUARRY HAUL ROAD REALIGNMENT

Terrestrial Flora Survey Locations

FIGURE 6-2

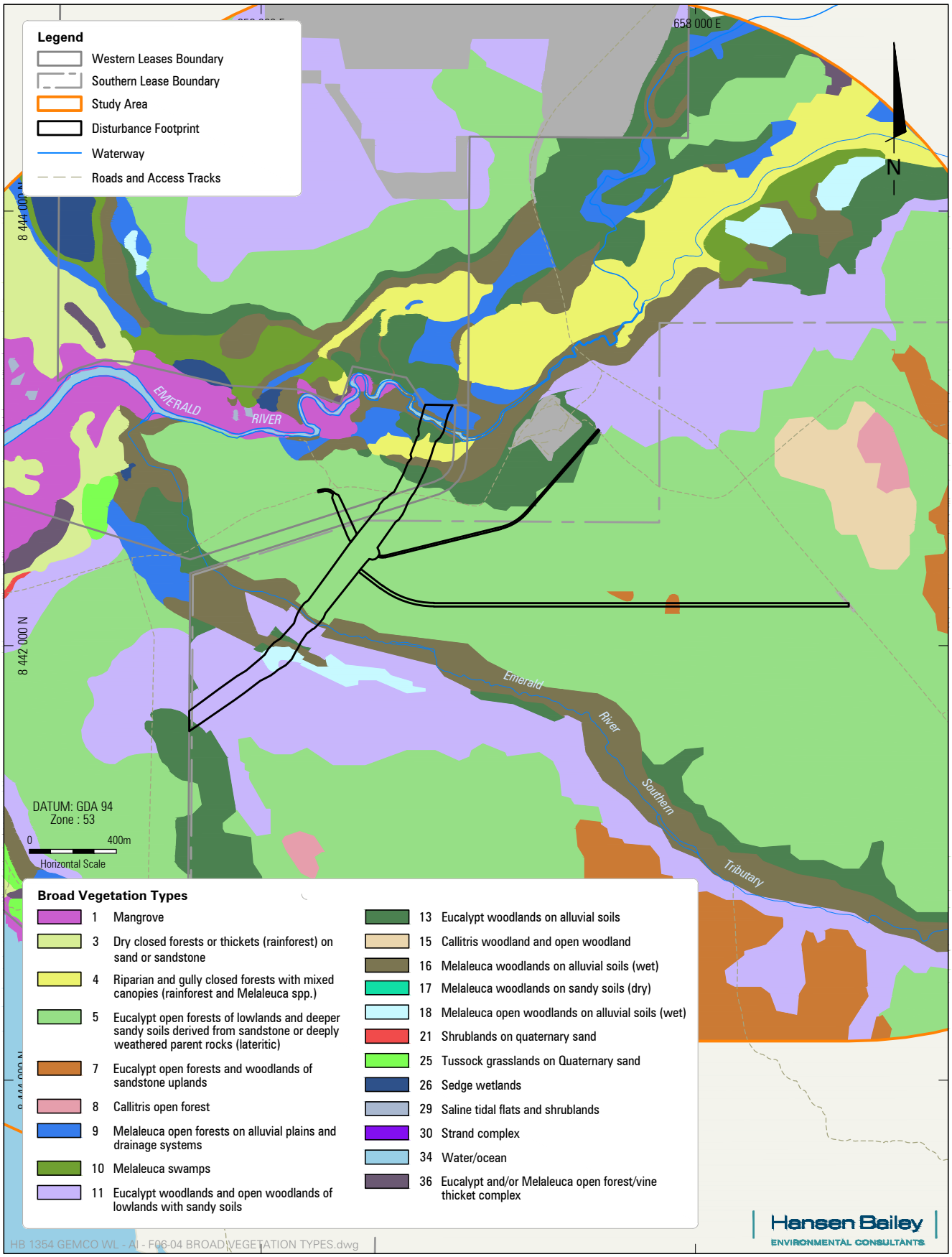
SOUTH32



J QUARRY HAUL ROAD REALIGNMENT

Terrestrial Fauna Survey Locations

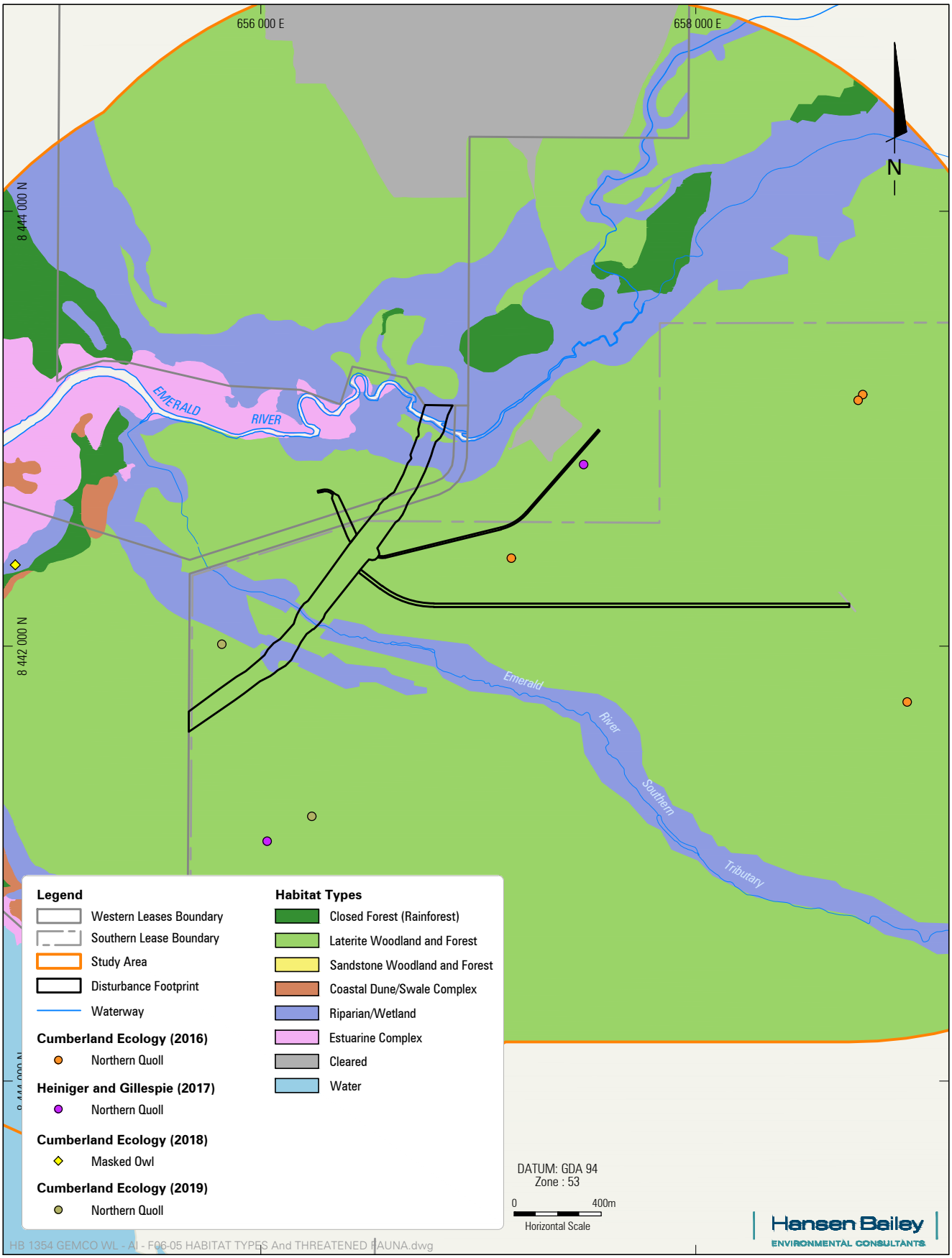
FIGURE 6-3



J QUARRY HAUL ROAD REALIGNMENT

Broad Vegetation Types within the Study Area

FIGURE 6-4



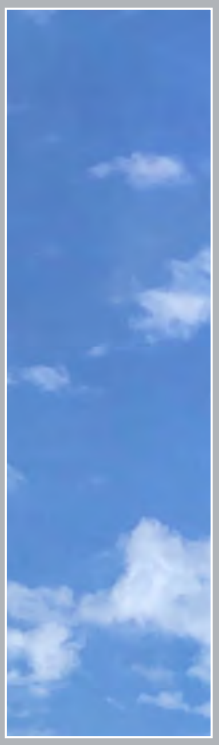
J QUARRY HAUL ROAD REALIGNMENT

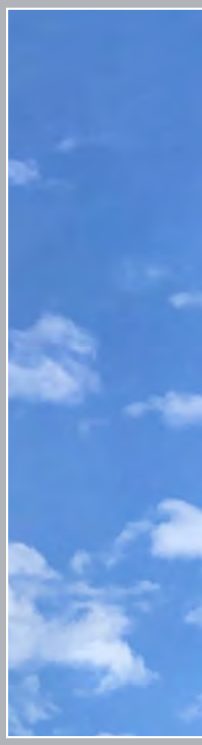
Habitat Types and Threatened Fauna within the Study Area

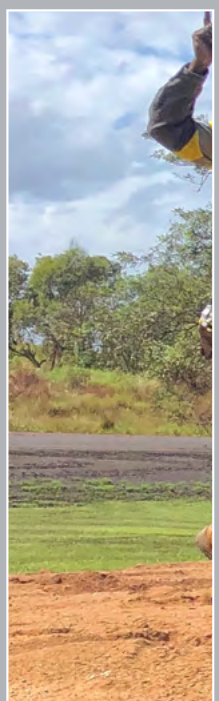
FIGURE 6-5

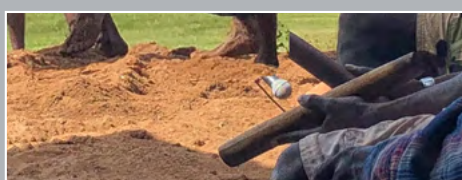
7

Culture and Heritage









CONTENTS

Figures

7 CULTURE AND HERITAGE

7.1 INTRODUCTION

This section describes the culture and heritage values relevant to the J Quarry Haul Road Realignment (the project). This section provides an overview of the potential for impacts on sacred sites and archaeology and draws on information from several specialist sacred sites and archaeological reports prepared by the proponent, where relevant.

7.2 SACRED SITES

The *Northern Territory Aboriginal Sacred Sites Act 1989* (NT) (Sacred Sites Act) is designed to protect sacred Aboriginal sites. Sacred sites are places in the landscape that have a special significance under Aboriginal tradition. They may include features in the landscape such as rivers, trees or rocky outcrops. Sacred sites often have a Dreaming association. The Aboriginal Areas Protection Authority (AAPA) is an independent statutory organisation established under the Sacred Sites Act, which is responsible for overseeing the protection of Aboriginal sacred sites.

As discussed in Section 2- Project Description, the Groote Eylandt Archipelago has been declared an Indigenous Protected Area and is managed by the Anindilyakwa Land Council (ALC). The ALC has an anthropology department and the ALC's anthropologists work with the Traditional Owners to research and record traditional culture, and identify areas where access is restricted for cultural reasons (ALC, 2020). In 2016, the proponent engaged the ALC anthropology department to undertake a sacred sites assessment and prepare a report that provides clear documentation of the sacred sites in the Western Leases (and areas in close proximity), in order to ensure that future activities do not give rise to any impacts on sacred sites. The project is located partially within the study area of the sacred site assessment. This work was completed in 2019. The scope of this research included identifying and locating sacred sites and describing the required protection measures that Traditional Owners believe are suitable for the management of the sacred sites, in perpetuity. This included preparing clear instructions in relation to buffer zones that are required around each individual sacred site. As a result of this assessment, a large number of sacred sites were documented, including sites within proximity to the project site.

In addition, the proponent has commenced a sacred sites assessment of the Southern Lease (EL 2455). The project is also located partially within the study area of this sacred site assessment. This work is ongoing, but similar to the work in the Western Leases described above, aims to identify and locate sacred sites within the Southern Lease and describe the required protection measures that Traditional Owners believe are suitable for the management of the identified sacred sites, in perpetuity.

The sacred sites assessments in both the Western Leases and Southern Lease, along with the proponent's extensive consultation with the ALC and Traditional Owners, has informed the location and design of the project, which avoids all known sacred sites and associated buffer zones.

In the coming months, the proponent intends to lodge an application for an Authority Certificate for the Western Leases, which will include the project site. An Authority Certificate provides conditions for any works undertaken on or near sacred sites. Although it is not a legal requirement to be in possession of an Authority Certificate, having an Authority Certificate and undertaking the work in accordance with the requirements of the certificate indemnifies the holder against prosecution under the Sacred Sites Act for damage to sacred sites in the area of the Authority Certificate. The AAPA is responsible for issuing Authority Certificates under the Sacred Sites Act.

7.3 ARCHAEOLOGY

7.3.1 Overview of Regulatory Requirements

Several pieces of legislation establish lists or registers which offer statutory protection to places and objects that are considered to have cultural values. The Commonwealth government registers are established under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and under the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth) (ATSIHP Act). The *Heritage Act 2011* (NT) (Heritage Act) covers all places and objects of heritage value in the Northern Territory. The relevant Acts are discussed in the following sections.

Environment Protection and Biodiversity Conservation Act

The EPBC Act, which is administered by the Federal Department of Agriculture, Water and the Environment (DAWE), provides for the protection of a hierarchy of heritage places and objects that are listed in three registers. These include the World Heritage Register, the (Australian) National Heritage Register and the Commonwealth Heritage Register. The EPBC Act sets out a framework for the protection of places and objects listed on these registers.

Aboriginal and Torres Strait Islander Heritage Protection Act

The ATSIHP Act is also administered by DAWE and provides protection for Aboriginal cultural heritage. Under this Act, the Environment Minister can make declarations of preservation in relation to Aboriginal cultural heritage. Declarations can be made if the Minister is satisfied that the area is a 'significant Aboriginal area' and is under threat of injury or desecration.

Heritage Act

The Heritage Act is administered by the Heritage Council of the Northern Territory Department of Territory Families, Housing and Communities. It is a requirement of the Heritage Act that a Work Approval be obtained from the Heritage Council prior to any disturbance of a heritage place or object that is declared or protected under this Act.

The Heritage Act provides protection for the following two classes of cultural heritage:

- All places and objects formally assessed and added to the Northern Territory Heritage Register; and
- All Aboriginal and Macassan places and objects (whether previously documented or not), as listed in the Aboriginal and Macassan Sites Database.

7.3.2 Archaeological Assessment

Public registers were searched to determine if there are any objects or places present in the project site that were protected on public registers. In addition, an archaeological report detailing a survey conducted within the south west portion of Groote Eylandt (including the full extent of the project site) was consulted to determine if any archaeological sites have been discovered in proximity to the project site. This study included a series of survey transects in areas deemed prospective to contain archaeological sites (based on Traditional Owner knowledge as well as the expert knowledge of the archaeological team). The archaeological team surveyed for artefact scatters, stone arrangements and quarries, shell middens, rock art, and contact sites (SHIM Consulting, 2014). The intent was to provide a baseline of cultural heritage sites in the south western portion of Groote Eylandt.

Database Searches

The results of database searches were as follows:

- The World Heritage Register, the (Australian) National Heritage Register and the Commonwealth Heritage Register do not list any sites within or in close proximity to the project.
- No declarations under the ATSIHP Act have been made for areas within or in close proximity to the project.
- The following sites are listed on the Northern Territory Heritage Register and shown on Figure 7-1, but have not been declared under the Heritage Act:
  - The site of the Emerald River Mission, which is located to the south of the Emerald River and in proximity to the realigned access corridor; and
  - The Emerald River Cemetery, which is located to the south of the Emerald River, and in proximity to the realigned public access track and construction access track.

Indigenous Archaeological Sites

Figure 7-1 shows the survey boundary for the Indigenous archaeological survey conducted by SHIM Consulting in 2013 (SHIM Consulting, 2014). Figure 7-1 also shows the location of the sites recorded from this survey. No archaeological sites are located within the area proposed to be disturbed for the project. A single archaeological site (a shell and artefact scatter) is known to occur in proximity (880 m) to the disturbance footprint (Figure 7-1). The site will not be impacted by the project. No impacts on any Indigenous archaeological sites are therefore predicted. Nevertheless, a procedure for unexpected finds will be adopted as a precautionary measure and is described in Section 7.3.3.

Non-Indigenous Archaeological Sites

Figure 7-1 shows the location of the site of the former Emerald River Mission (also known as Yedikba Mission), and Emerald River Cemetery. The mission was established by the Anglican Church Missionary Society and was operational between the 1920s-1940s. It is believed to be the first European settlement on Groote Eylandt (Department of Natural Resources, Environment, the Arts and Sport, 2011). The majority of structures relating to the mission no longer remain, however, the remnants of a jetty constructed and utilised by the Mission can still be seen on the Emerald River (Figure 7-1). The Mission is now utilised as an Outstation (Yedikba) by the Traditional Owners. The Emerald River Cemetery has historical importance as it was associated with the Emerald River Mission, and contains a number of gravestones.

The realigned public access track is the component of the project that is closest to the site of the former Emerald River Mission (approximately 150 m away). However, it is located further from the site of the former Emerald River Mission than the existing public access track, which will be decommissioned and rehabilitated once the realigned access track has been developed. No impacts from the realignment of the public access track are therefore predicted. The realigned access corridor is approximately 400 m from the site of the former Emerald River Mission and consequently no direct or indirect impacts on heritage values are predicted.

No impacts are predicted at the Emerald River Cemetery, given that it is located approximately 400 m from the closest portion of the disturbance footprint (the realigned public access track), and approximately 1 km from the realigned access corridor.

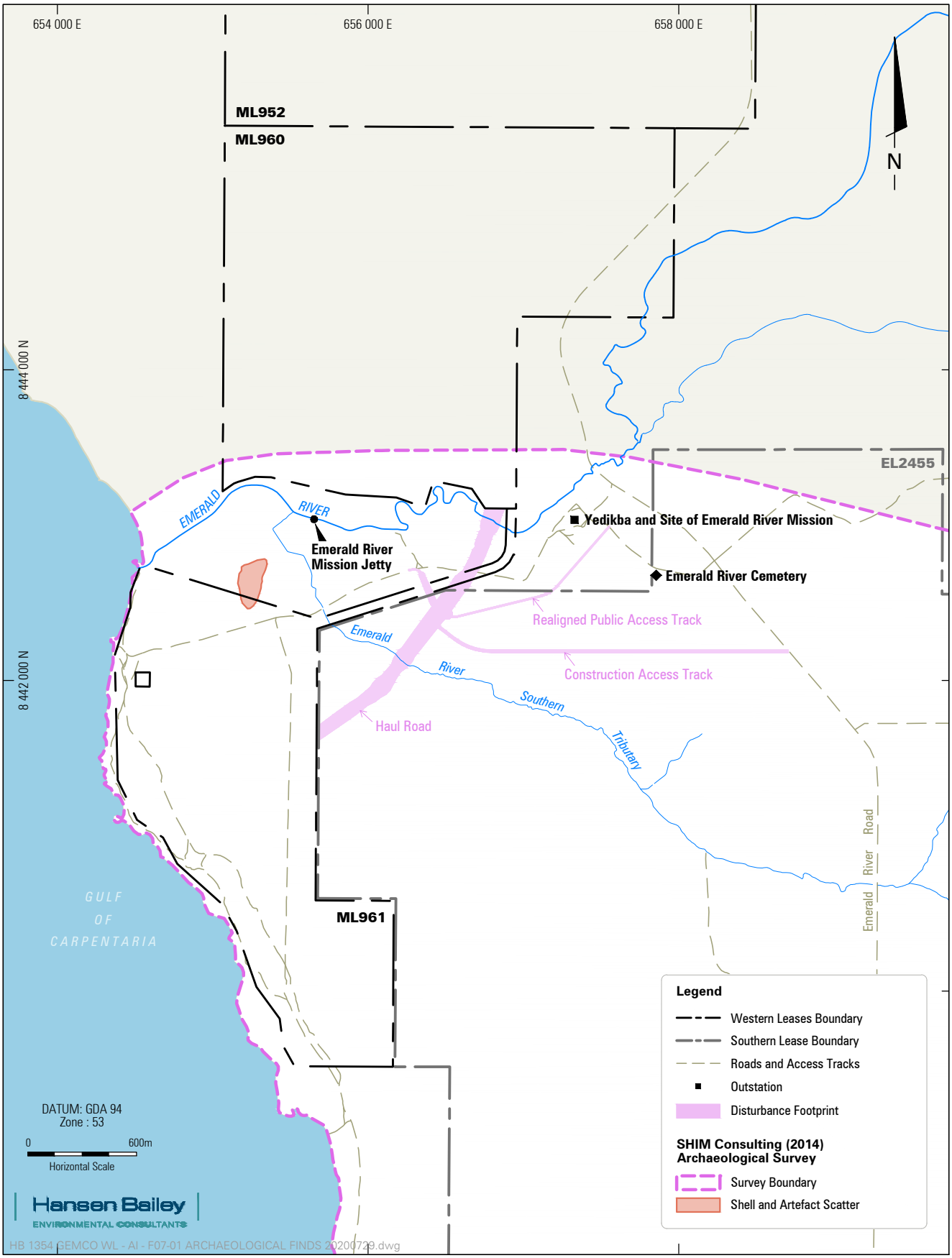
7.3.3 Mitigation Measures

Mitigation measures include the following:

- As part of the workforce induction process, there is a module on cultural heritage and cultural awareness training.
- In the event that the proponent's employees or contractors suspect that they have uncovered an unexpected archaeological find, the following process will apply:
  - Immediately cease disturbance of any areas surrounding the find;
  - If it is considered that the find is at risk of being inadvertently damaged by construction activities, a temporary fence/barricade will be erected around the find with GPS coordinates obtained;
  - The ALC will be notified of the discovery of areas of potential archaeological significance immediately following the discovery, and prior to any disturbance;
  - The ALC, and if necessary, a suitably qualified archaeologist, will be requested to inspect the find and determine its significance; and
  - Should the find be of archaeological significance, the Northern Territory Heritage Council will be notified, and appropriate mitigation strategies will be developed in consultation with the ALC and the Northern Territory Heritage Council.

These measures will help mitigate impacts in the unlikely event that previously unrecorded sites of cultural heritage significance are located during construction of the project.

FIGURES



J QUARRY HAUL ROAD REALIGNMENT

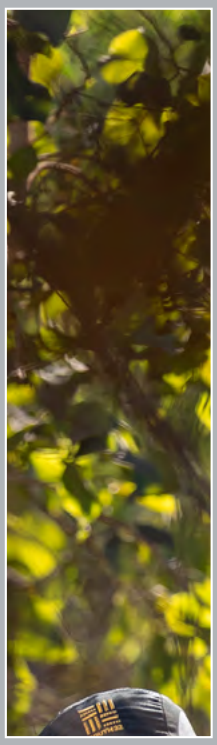
Documented Archaeological Finds

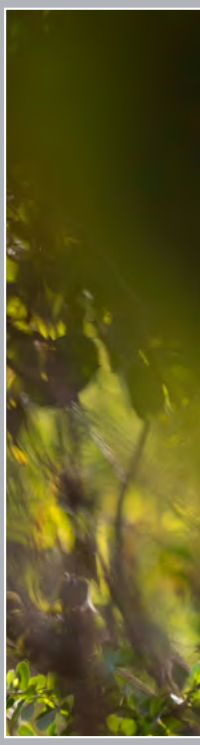
FIGURE 7-1

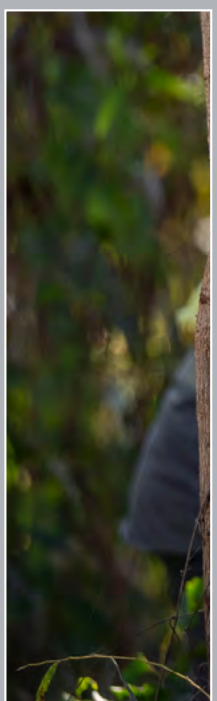
SOUTH32

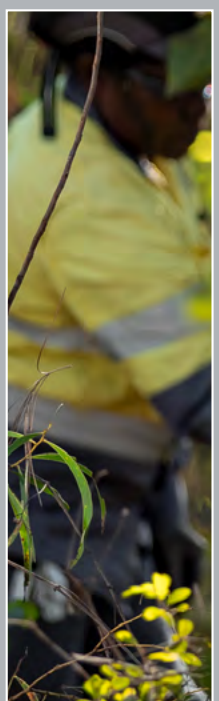
8

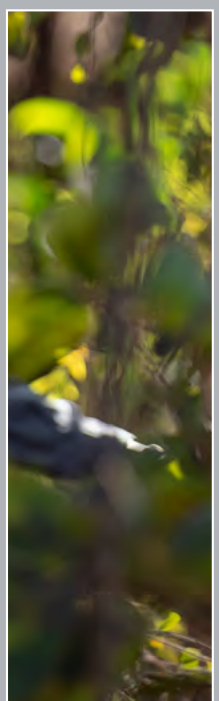
Environmental Management

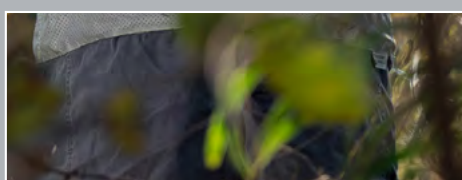












CONTENTS

8 ENVIRONMENTAL MANAGEMENT

8.1 INTRODUCTION

This section describes the proposed environmental management measures that will be developed and implemented to address the potential environmental impacts associated with the J Quarry Haul Road Realignment (the project).

8.2 ENVIRONMENTAL MANAGEMENT FRAMEWORK

8.2.1 Environmental Policy and Standards

The proponent places the highest value on being a responsible operator and is committed to minimising the impact of its business on the environment. The proponent adheres to strict internal environmental management standards, and has an environmental management system in place that is consistent with the requirements of *ISO 14001 Environmental Management Systems – Requirements with Guidance for Use*.

The proponent has internal documentation which specifies the minimum mandatory environmental standards and performance requirements for its operations. These standards and procedures are relevant to the management of land, biodiversity, water, air, greenhouse gas, hydrocarbons and waste. Various internal targets and key performance indicators (KPIs) are routinely set by management for site operations and departments. Monitoring and internal reporting of results relative to these KPIs occurs regularly in order to review the effectiveness of management and mitigation strategies. In the event that a non-compliance or a notifiable incident occurs, the proponent reports these incidents to the Anindilyakwa Land Council (ALC) and to the Northern Territory Department of Primary Industry and Resources (DPIR) consistent with Section 29 of the *Mining Management Act 2001* (NT) (the Mining Management Act).

In addition, South32 has a Sustainability Policy (2019) which guides environmental and social management as well as sustainability planning for the business. The policy is supported by a number of standards which assist to minimise environmental and social impacts, support regulatory compliance and drive continual improvement in regards to environmental performance. These South32 standards include the:

- Environment Standard (and the associated Implementation Guide);
- Health, Safety, Environment, and Community Reporting Standard;
- Community Standard; and
- Closure Standard.

These South32 standards apply to the existing mine and will also apply to the project, as relevant.

8.2.2 Mining Management Plan

Prior to commencing construction of the haul road, it will be necessary for the proponent to submit an amendment to the Western Leases Mining Management Plan (MMP) to DPIR in support of an approval for authorisation under the Mining Management Act. The amended MMP will include a description of the realignment of the access corridor and associated development of the construction access track, as well as the environmental management measures to be adopted to mitigate and manage potential impacts (consistent with those described in this document).

8.2.3 Environmental Incident Reporting

The proponent has well established procedures in place for reporting and investigating environmental non-conformances and hazards. All environmental incidents are recorded on an internal database, risk ranked, and investigated to determine the cause. Corrective actions are then implemented and monitored. Key learnings from the incidents are noted on the internal database, and the learnings are communicated to the workforce via email and during daily pre-start safety meetings, and are incorporated into training and site induction processes. In accordance with the Mining Management Act, significant environmental incidents must be reported to the DPIR as soon as possible.

8.2.4 Community Complaints

The proponent encourages community members to submit any complaints or issues so they may be investigated and resolved as appropriate. Where necessary, this may include monitoring or changes to environmental management plans and procedures.

The proponent also liaises closely with the ALC regarding community issues, and undertakes quarterly forums with the ALC to raise, discuss and communicate any environmental concerns.

8.2.5 Review and Auditing

The environmental management framework encourages continual improvement in environmental performance through the review and, if necessary, revision of environmental management plans or procedures. Internal and external compliance audits of the environmental management framework are conducted to ensure compliance with the proponent's mandatory environmental standards and regulatory requirements.

8.2.6 Environmental Training and Education

The proponent is committed to educating all employees about their individual responsibilities regarding health, safety and environmental management, through specific induction, training and education programs. An important component of the existing site induction program covers targeted environmental issues, including:

- Key environmental legislation and other requirements, and the consequences of non-compliance;
- Potential environmental impacts across the site and at each work area, and how the proponent controls these impacts;
- Groote Eylandt's threatened species and the importance of the island's biosecurity (Cane Toads, weeds etc.);
- Measures to increase energy efficiency and reduce greenhouse gas emissions;
- The importance of water efficiency;
- The importance of managing dust;
- The importance of managing noise;
- Where to dispose of waste appropriately and the proponent's land-based spill response procedure; and
- The importance of, and how to report environmental incidents/hazards.

8.3 ENVIRONMENTAL MANAGEMENT MEASURES

8.3.1 Introduction

Given the proponent has been undertaking mining and exploration activities on Groote Eylandt for over 50 years, the proponent has a suite of management measures and procedures that are used at the existing mine to manage environmental impacts. These management measures and procedures will also apply to the project, where relevant. These measures and procedures are described in the following sections and include clearing procedures, rehabilitation activities, and the management of erosion and sedimentation, acid sulphate soils, invasive species, wastes and hazardous materials.

8.3.2 Clearing Procedures

Clearing will be undertaken in accordance with the proponent's Permit to Clear process. This process includes a pre-clearance survey to determine the precise location of the required clearing. The pre-clearance survey will address the following:

- The limits of clearing will be clearly delineated (via flagging) and will be restricted to the minimum areas required to safely construct the haul road and access tracks.
- The area to be cleared will be inspected for weeds. In the unlikely event a weed is present, the location of these weeds will be GPS recorded and information will be provided to the proponent's Environment Department as well as the Rehabilitation and Mine Services Team. Any weeds that are identified will be sprayed or manually removed prior to any clearing being undertaken.

Clearing will be undertaken in accordance with the proponent's procedures including the Vegetation Clearing Procedure (PRO-4192) and the Permit to Clear and Burn Vegetation (PRO-4149), as relevant. Compliance with the clearing limits delineated in the pre-clearance surveys is assured through a spotter working with the dozer operator during clearing. The spotter's role is to ensure the dozer operator maintains the correct alignment. Both the spotter and the dozer operator have a GPS tablet with georeferenced maps containing the coordinates of the clearing limits.

Consultation will be undertaken with the ALC as part of the Permit to Clear process. As part of this process, a cultural monitor (i.e. a Traditional Owner who speaks for the country) will be invited to visit the clearing area.

8.3.3 Rehabilitation

This assessment assumes that the haul road and construction access track are permanent disturbances, as the long-term future of this infrastructure will depend on the preferences of the Traditional Owners at the time that the infrastructure is no longer required by the proponent. In the event Traditional Owners require the haul road and construction access track to be permanently closed and rehabilitated, the following activities will be undertaken:

- Removing the built infrastructure components, namely the bridge and culvert structures;
- Re-profiling of the haul road to natural ground level; and
- Ripping, applying topsoil and seeding the haul road to encourage regeneration of vegetation.

The unused portion of the existing public access track will be closed and rehabilitated once the realigned public access track is constructed and suitable for use. Rehabilitation will include ripping and seeding the track and applying topsoil to encourage regeneration of vegetation. The track will be inspected following rehabilitation to confirm vegetation is regenerating and to identify any erosion issues or presence of weeds.

8.3.4 Erosion and Sediment Control

Construction will be undertaken predominantly in the dry season, which limits the potential for issues with erosion and sediment control. As the project is located in a tropical setting, erosion has the potential to occur through direct rainfall impact loosening soil particles, as well as overland flow washing soil particles away. An Erosion and Sediment Control Plan will be developed and implemented for construction to address these potential impacts. The plan will include the following control measures that are proposed to manage potential erosion:

- All exposed batters will be vegetated and lined with natural matting products (coconut fibre matt or mulch).
- Riprap will be placed on the upstream and downstream shoulders of the causeway sections of the haul road to reduce erosion of the road surface;
- Silt fencing will be installed, as appropriate, in the vicinity of construction work around waterways; and
- A polymer coating will be regularly applied to causeway surfaces to reduce the breakup of the road surface during overtopping events.

8.3.5 Acid Sulfate Soil Management

Acid sulfate soil testing conducted for the project suggests that there may be materials in the Emerald River and Southern Tributary that are characterised as Potential Acid Sulfate Soils (PASS). Although the project will only require relatively limited excavation, an Acid Sulfate Soils Management Plan will be prepared and implemented for the construction phase. This plan will address the necessary lime dosing of any excavated soils to reduce the potential to oxidise any areas of PASS that are disturbed during construction.

8.3.6 Weed Management

The proponent manages weeds via a Weed Management Plan (WMP). The plan is supported by a number of internal procedures designed to manage and control weeds on the proponent's mining and exploration tenements and in the Alyangula township. These procedures are readily available to the proponent's workforce and contractors. These procedures will be cross-referenced in associated contractual obligations for this project. The procedures include:

- Weed Management Plan (STA-3091) and associated Weed Field Guide (PRO-3094);
- Vegetation Clearing Procedure (PRO-4192);
- Topsoil Management Procedure (PRO-4144);
- Quarantine Inspection Procedure (PRO-3198);
- Vehicle and Equipment Inspection Checklist (GEM-FRM-3872); and
- Rehabilitation Monitoring and Evaluation Procedure (PRO-3191).

These procedures are periodically reviewed and are consistent with the requirements of Northern Territory legislation.

Given that the project site is currently largely unaffected by weeds, weed management activities will focus on preventing the introduction of weeds, the early detection and eradication of weeds before they establish and employee awareness. The activities described below will be undertaken to reduce the potential risk of the project introducing weeds.

Monitoring

The following monitoring will be undertaken in relation to weeds and the project:

- A pre-clearance survey will be undertaken of the area to be cleared. This survey will include identifying any weeds that exist in the area to be cleared. Any weeds that are found will be removed prior to clearing.
- Undertaking routine inspections of haul road verges for weeds.
- Areas of rehabilitation will be monitored for the presence and distribution of weeds. This includes the rehabilitated portion of the existing public access track, and any areas of the haul road disturbed only for construction purposes.

In the event any weeds are identified, the location of the weeds will be GPS recorded and information will be forwarded to the proponent's Rehabilitation and Mine Services Team. Any weeds that are identified during pre-clearance surveys will be sprayed or removed prior to clearing. Recommended actions that are necessary for controlling weeds will be recorded in the proponent's geographic information system (GIS) database and actions will be scheduled as part of the work program for the proponent's Rehabilitation and Mine Services Team. The database will also include a record of weed control actions that are required in response to the sighting, a record of the actions that have been undertaken, and details of follow up monitoring.

Preventing the Spread of Weeds

The following measures will be undertaken to reduce the spread and establishment of weeds:

- Vehicles will be subject to washdown and inspection procedures before commencing construction activities. This will apply to all mine and contractor vehicles that will be working in these areas, including scrub dozers, light vehicles and other support vehicles.
- The existing vehicle wash bay facility is located at the mine industrial area adjacent to the maintenance workshop and at the Ndunga Industrial Facility adjacent to the Rowell Highway. The inspection procedure involves checking the entire piece of equipment for noticeable traces of soil/seeds and plant material. This includes checking the deck area, wheel arches, belly plates, front grill and radiator. Plant or equipment that are observed to contain seeds or plant material will be refused access to the project site until it has been adequately cleaned.
- Construction personnel will undertake a daily check for weed seeds on work clothes or boots prior to commencing work.
- Contractors and suppliers will be required, as part of the proponent's standard supply contract, to ensure that all plant, vehicles and equipment have been adequately washed down prior to arrival on the island. Prior to arrival on the island, the proponent's nominated representative will be required to inspect all plant and equipment on the Australian mainland to ensure compliance with washdown requirements.
- During operations, haul trucks will follow a set, low risk route between the existing mine site and J Quarry, minimising the risk of spreading weeds. As such, haul trucks that follow this low risk route will not be subject to routine washdown. However, any high-risk vehicles (i.e. vehicles operating within the existing GEMCO mine that are subject to existing weed infestations, off road areas etc) will need to be washed down in existing facilities prior to using the new haul road and accessing J Quarry.

Weed Control

The control methods used will depend on the weed species, and the location and extent of the weed infestation. An integrated weed management approach which considers appropriate land management practices and physical and chemical controls is currently in place at the existing mine and will be applied to the project, where deemed appropriate. Control activities undertaken within the active mining areas include, but are not limited to, hand weeding and the use of vehicle mounted spray units for the application of selective herbicides. These measures would be applied, where relevant, to any weed infestations in the project site.

Communication and Reporting

Reporting and consultation in relation to weeds will include the following:

- The proponent will report on weed management activities annually as part of MMP reporting requirements under the Mining Management Act.
- The proponent will continue to facilitate ongoing consultation with the ALC on matters relating to weed management.
- Site-wide Communication Briefs will be used to alert workers and the Groote Eylandt community of any new weed threats, and to provide weed identification information.
- As part of the site inductions and pre-start safety briefings, all construction staff and contractors will be made aware of their responsibilities regarding weed management to ensure there is an ongoing and general awareness of the risks of weed incursions.

Weed Management Responsibilities

The following outlines the current internal responsibilities regarding weed management, which will also apply to the project activities, as relevant:

- The proponent's Rehabilitation Mine Services Team has overall responsibility for weed management within the proponent's mining, exploration, township and special purpose leases. The Environment Department is responsible for updating and reviewing weed management procedures on an annual basis.
- The proponent's Supply Department is responsible for ensuring suppliers are made aware and comply with the proponent's requirements in relation to weed management.

8.3.7 Cane Toad Management

The proponent has a Cane Toad Management Plan (GEM-STA-3082), Cane Toad Response Plan (GEM-STA-3082) and associated quarantine procedures in place, which would apply to the project. The management plan includes monitoring, and, in the event of a Cane Toad being found, reporting and disposal procedures. The management plan and response plan are currently under review by the proponent, in collaboration with the Northern Territory Department of Environment, Parks and Water Security.

Current Cane Toad management activities include:

- Cane Toad awareness programs conducted through:
  - Site inductions;
  - Inductions of airport and barge personnel;
  - Contractor inductions prior to arrival on Groote Eylandt;
  - 'Keep Groote Cane Toad Free' signage at the airport, the main road in Alyangula, throughout the accommodation facilities, mess facilities and at the mine site and port;
  - Community information posters in Alyangula which include the process to be adopted in the event of a Cane Toad being sighted;
  - Community quarantine and biosecurity awareness sessions;
  - Information cards on Cane Toads being provided in airplane seat pockets for all commercial flights to Groote Eylandt, and for the proponent's charter flights;

  - In-flight announcements by flight attendants for all commercial flights to Groote Eylandt, and for the proponent's charter flights; and
  - Site-wide Communication Briefs.
- Inspections of every barge coming to Milner Bay are undertaken by barge operators. The proponent's Environment Team, together with the ALC rangers, also undertake periodic inspections of the barges to ensure compliance with quarantine protocols. A Cane Toad detection dog is used as part of the inspection process.
- Lockers are provided to fly-in fly-out staff to store work boots and other luggage on the island, as a means of reducing the probability of accidentally transporting Cane Toads.
- Cane Toad-proof fencing designed to contain and prevent toad movement surrounds the perimeter of the shipping yards in Milner Bay and Darwin. The fences are inspected on a monthly basis, and repairs are undertaken as required, to ensure the integrity of the fencing. The perimeter fence was upgraded in 2018 and continues to serve as an effective barrier in the island wide defence and management of potential Cane Toad incursions. A Cane Toad-proof fence around the proponent's warehouse is also under construction.

The proponent has developed a Cane Toad Response Plan to enable appropriate responses to be initiated in the event a Cane Toad is detected on the proponent's mineral leases. All Cane Toad incidents which occur within Alyangula or the proponent's leases are recorded by the proponent. Cane Toad incidents include interceptions of Cane Toads during quarantine inspections, reported or suspected toad sightings and eradication of toads. Recording incidents in this way enables quantification of the risk by determining the frequency and type of incident so that future planning can be improved. The proponent also undertakes regular reviews of quarantine procedures to confirm their adequacy and make recommendations for their continuous improvement. These reviews are undertaken by trained and experienced quarantine officers.

8.3.8 Waste Management

The proponent has a waste management system in place for the existing mine. The project is not expected to create a significant volume of waste. All wastes generated will be managed in accordance with the existing waste management system. The waste management system is based on the regulatory requirements, values and principles of the *Waste Management and Pollution Control Act 1988* (NT)*, Waste Management and Pollution Control (Administration) Regulations 1998* (NT)*,* and the *Waste Management Strategy for the Northern Territory 2015-2022* (NT EPA, 2015)*.*

The waste management system adopts the principles of the waste management hierarchy as far as practicable. Key features of the system include segregation and secure containment of all wastes for appropriate reuse, recycling or disposal at licensed facilities; employee awareness of waste management practices; environmental auditing; and regular inspections and ongoing monitoring.

The proponent operates several waste management facilities on Groote Eylandt for the reuse, recycling or disposal of the various waste streams. A proportion of the wastes collected are transported to the mainland for repair, reuse, recycling or disposal by licensed contractors.

8.3.9 Hazardous Materials Management

The only significant hazardous material/substance required for the project is diesel fuel, which will be stored at the fuel storage facilities located at the existing mine. Where possible, vehicles and equipment will be refuelled at the existing mine site or park up areas located within the existing Western Leases. However mobile refuelling may be required for dozers, cranes, and other construction vehicles and equipment that remain at the project site during construction, such as small diesel generators used for night-lighting.

In the event mobile refuelling is required, diesel will be transported and stored in 5000 L tanks on support trucks. The proponent has refuelling procedures in place to prevent and control any spills that may occur during vehicle refuelling (namely the Land Based Spill Response (PRO-3115)). In addition, the proponent will ensure that:

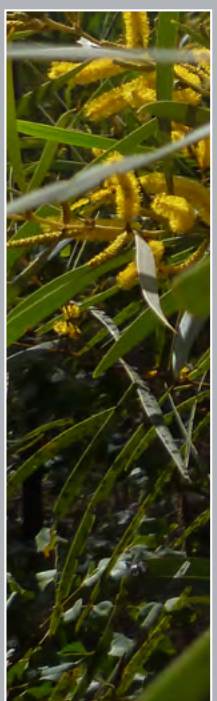
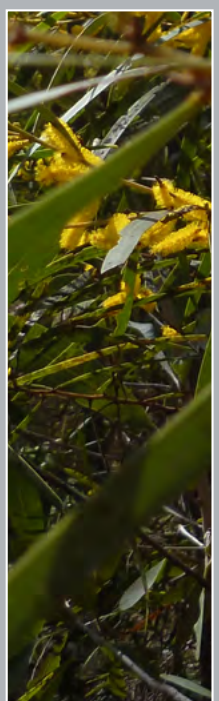
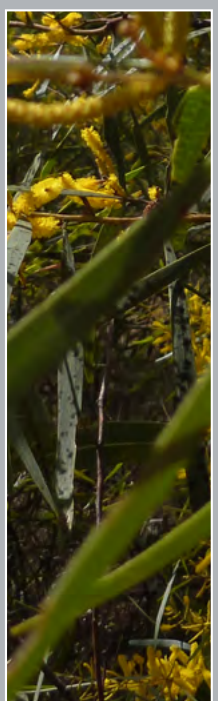
- Spill clean-up kits are available on support trucks;
- Staff receive appropriate training in the use of spill clean-up kits;
- Any spillages which may result during refuelling activities are contained; and
- Contaminated materials are removed and disposed in accordance with the existing mine procedures.

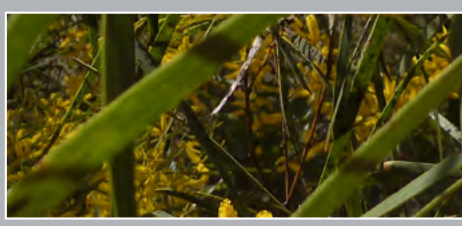
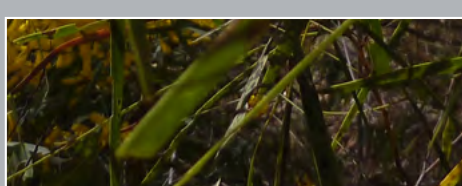
Should other hazardous substances (or dangerous goods) be required during construction, the transport, use and disposal issues will be planned and managed prior to use on site and appropriate measures implemented in accordance with existing mine procedures and relevant guidelines and legislation.

9

Glossary



9 GLOSSARY

The following terms are commonly used throughout this referral. Further explanation or a description may be provided in the main report or appendices.

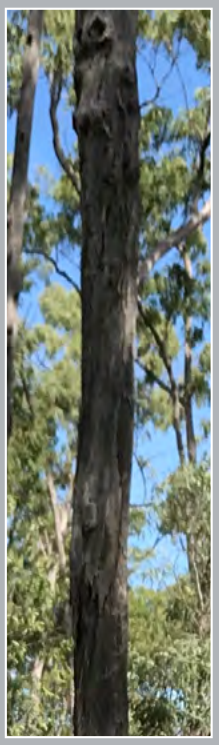
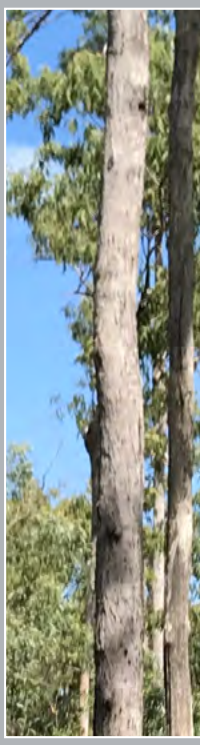
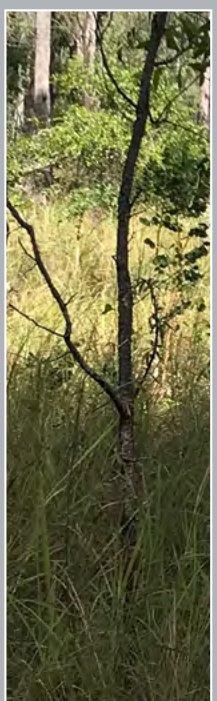
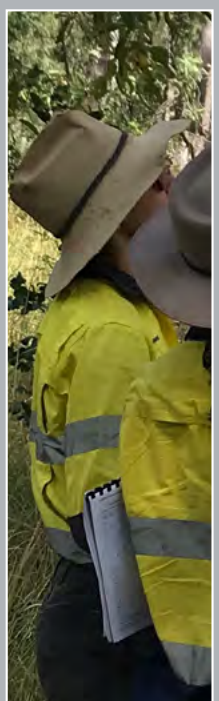
TERM	DEFINITION
Aboriginal Freehold Land	Land declared under *Aboriginal Land Rights (Northern Territory) Act 1976* (Cth) (ALRA) to be Aboriginal Land, held as freehold tenure. On Groote Eylandt, this land is held by a Land Trust as established under ALRA
Abutment	A structure built to support the lateral pressure of an arch or span, e.g. at the ends of a bridge
Acid sulfate soils	Naturally occurring sediments and soils containing iron sulfides or sulfidic materials, which, when disturbed, oxidise to form sulfuric acid
Archipelago	A group of many islands in a large body of water
Bank full	Of a river: swollen to the top of its banks; full to its banks of or with water
Biodiversity	The diversity of different species of plants, animals and micro-organisms
Catchment	The surface drainage area from which a river, stream or reservoir receives its water
Causeway	A raised road or path, across low or wet ground
Clan	A group of people generally related by blood or marriage. It is an important unit in Aboriginal society, having its own name and territory, and is the land-owning unit
Culvert	A hydraulic structure that allows water to flow under a road (or similar infrastructure) from one side to the other
Eastern Leases	Mining Leases 31219 and 31220, as shown on Figure 1-1
Ecosystem	An interacting system of animals, plants, other organisms with non-living parts of the environment
Embankment	A raised structure (of earth or gravel) used to hold back water or carry a roadway
Ephemeral	Relating to a waterway with defined bed and banks, which flows only intermittently after rain
Erosion	The wearing away of land surface by wind or water
Floodplain	Land in proximity to a stream or river that is naturally subject to flooding
GEMCO	Groote Eylandt Mining Company Pty Ltd, the proponent
Geomorphology	The study of landforms and landform evolution
Geochemical	Chemical compositions related to the geology of an area or sample
Geological	Relating to the earth, the rocks of which it is composed, and the changes which it has undergone or is undergoing
Greenhouse gas	A gas that may contribute to the global warming effect. Includes carbon dioxide, methane, nitrous oxide and some fluorine containing compounds
Groundwater	Water found beneath the surface of the ground

TERM	DEFINITION
Habitat	The native environment where a given animal or plant lives or grows, often described in terms of geography, climate and vegetation
Haul road	A road used by large haul trucks and other mining equipment to transport ore
Hydrology	The study of the distribution, movement and management of water, both on and below the Earth's surface
Indigenous	Defined as Aboriginal and Torres Strait Islander
J Quarry	An area within ML 961, as shown on Figure 1-2
Laterite	A soil type rich in iron and aluminium, formed in hot and wet tropical areas
LiDAR	Light Detection and Ranging, is a remote sensing survey method
Macroinvertebrate	An animal lacking a backbone that is large enough to see without the aid of a microscope
Mitigation	The act of lessening in intensity, to prevent or make less severe
MNES	'Matters of National Environmental Significance' that are listed under the EPBC Act
Open cut mining	Process used to remove minerals found over a large area, close to the surface. The mine is dug downward in benches or steps
Outstation	Small remote Aboriginal settlement with varying levels of occupation
Perennial	Relating to a waterway with defined bed and banks, which flows all year
the project	The J Quarry Haul Road Realignment, consisting of the realignment of an access corridor and associated development of a new haul road in the approved access corridor, as well as the development of a construction access track and realignment of an existing public access track, shown on Figure 1-3
Rehabilitation	The process whereby the ground surface in a disturbed area is made safe and stable, enabling natural regeneration to then occur
Riparian	Pertaining to, or situated on, the bank of a body of water, such as a river
Riprap	Rocky material used to armor, stabilize, and protect the soil surface against erosion and scour in areas of concentrated flow or wave energy
Runoff	The portion of rainfall that is not infiltrated or evaporated, and flows along the ground surface
Sacred sites	Places in the landscape that have a special significance under Aboriginal tradition
Scour	The removal of sediment such as sand and rocks usually around bridge abutments, piers or areas which are subject to constant wave or tidal action
Sediment	Solid particles which tend to settle in a liquid
Sediment ponds	Engineering structures constructed to capture and detain rainfall runoff, allowing any entrained sediment to settle out of suspension before the runoff is released into the environment
Significant Vegetation	From the Land Clearing Guidelines (DENR, 2020): Spatially restricted habitat types that are important to a relatively large number of wildlife species including rainforest, monsoon vine forest or vine thicket; sandsheet heath; riparian vegetation; mangroves; and vegetation containing large trees with hollows suitable for fauna
Socio-economic	Of, or relating to, both social and economic considerations

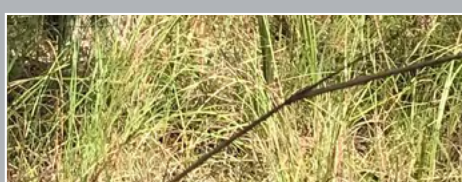
TERM	DEFINITION
Southern Lease	Area within the Exploration Licence 2455 shown on Figure 1-1
Taxa	Categories in the biological classification system for all living organisms
Topography	The surface features of an area of land
Topsoil	The upper most layer of soil where the highest concentration of organic matter and micro-organisms are found. Often referred to as the “A” horizon
Traditional Owners	People recognised as the Traditional Aboriginal Owners of the land based on their traditional and cultural associations with the land
TUFLOW	Relating to surface water modelling, TUFLOW is 1D and 2D flood simulation software that simulates the complex movement of floodwaters across a particular area of interest using mathematical approximations to derive information on floodwater depths, velocities and levels
Waste	An unwanted by-product or surplus product, including a gas, liquid, solid or energy, from an industrial, commercial, domestic or other activity
Wearing course	The surface layer of a pavement that takes the wear of traffic
Western Leases	Multiple Mineral Leases that form GEMCO’s existing mine on Groote Eylandt, and shown on Figure 1-1
White rock	Areas of sandstone outcropping that may be considered to be culturally sensitive in places

10

Abbreviations





10 ABBREVIATIONS

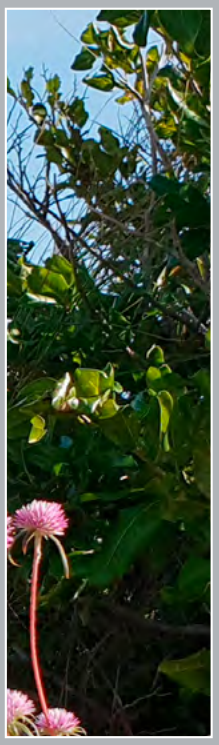
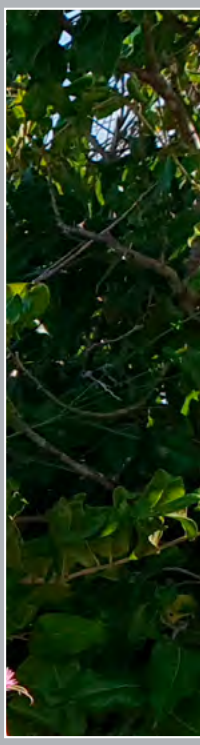
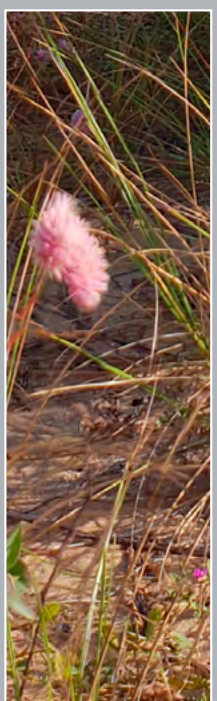
The following abbreviations are commonly used throughout this referral.

ABBREVIATION / ACRONYM	DEFINITION
%	percentage
AAPA	Aboriginal Areas Protection Authority
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ALC	Anindilyakwa Land Council
ALRA	*Aboriginal Land Rights (Northern Territory) Act 1976* (Cth)
ASS	Acid Sulfate Soils
ATSIHP Act	*Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth)
AusRivAS Manual	Northern Territory AusRivAS Sampling Manual
DAF	Department of Agriculture and Fisheries
DAWE	Department of Agriculture, Water and the Environment
DBH	Diameter at Breast Height
DEPWS	Department of Environment, Parks and Water Security
DPIR	Department of Primary Industry and Resources
EIS	Environmental Impact Statement
EL	Exploration License
EP Act	*Environment Protection Act 2019* (NT)
EP Regulations	*Environment Protection Regulations 2020* (NT)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
ESD	Ecologically Sustainable Development
FIFO	Fly-In Fly-Out
Fisheries Act	*Fisheries Act 1988* (NT)
GEMCO	Groote Eylandt Mining Company Pty Ltd
GIS	Geographic Information System
GPS	Global Positioning System
ha	hectare
Heritage Act	*Heritage Act 2011* (NT)
In-situ	In the original place
IPA	Indigenous Protected Area

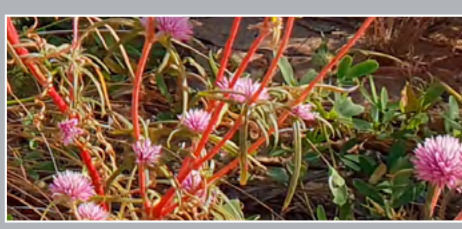
ABBREVIATION / ACRONYM	DEFINITION
km^2	Square kilometres
KPIs	Key Performance Indicators
L	Litres
LiDAR	Light Detection and Ranging
ML	Mining Lease
MMP	Mining Management Plan
MNES	Matters of National Environmental Significance
NGER Act	*National Greenhouse and Energy Reporting Act 2007* (Cth)
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority
OHS	Occupational Health and Safety
PASS	Potential Acid Sulfate Soils
Planning Act	*Planning Act 1999* (NT)
PMST	EPBC Act Protected Matters Search Tool
Sacred Sites Act	*Northern Territory Aboriginal Sacred Sites Act 1989* (NT)
SER	Supplementary Environment Report
TEC	Threatened Ecological Community
TPWC Act	*Territory Parks and Wildlife Conservation Act 2006* (NT)
VMU	Vegetation Management Unit
WM Act	*Weeds Management Act 2001* (NT)
WMP	Weed Management Plan

11

References






11 REFERENCES

Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth)

Aboriginal Land Rights (Northern Territory) Act 1976 (Cth)

Anindilyakwa Land Council (2020), Anthropology, viewed 29 April 2020 at <https://www.anindilyakwa.com.au/culture/anthropology>

ANZECC & ARMCANZ (2000), *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand: Canberra.

Australian Bureau of Statistics (2017), 2016 Census of Population and Housing, Anindilyakwa (Groote) IARE70600, Community Profile Spreadsheet, viewed 1 May 2020 at <https://www.abs.gov.au/websitedbs/D3310114.nsf/Home/2016%20Census%20Community%20Profiles>

Cumberland Ecology (2015*), Eastern Leases Project: Terrestrial Ecology Assessment Report*, Cumberland Ecology Pty Ltd: Carlingford Court

Cumberland Ecology (2016), *Southern Lease Project. Baseline Terrestrial Ecology Report*, Cumberland Ecology Pty Ltd: Carlingford Court

Cumberland Ecology (2019), *Southern Lease Small Mammal Research Project - Report*, Cumberland Ecology Pty Ltd: Carlingford Court

Cumberland Ecology (2020), *GEMCO Western Leases and Surrounds. Vegetation Mapping Report*, Unpublished Report to GEMCO, Cumberland Ecology Pty Ltd: Carlingford Court

Department of Agriculture and Fisheries (2018), *Accepted development requirements for operational work that is constructing or raising waterway barrier works*, DAF: Brisbane

Department of Agriculture, Water and the Environment (n.d), Indigenous Protected Areas, viewed 29 April 2020 at <http://www.environment.gov.au/land/indigenous-protected-areas>

Department of Environment and Natural Resources (2020), *Land Clearing Guidelines, Northern Territory Planning Scheme*, viewed 17 September at < https://nt.gov.au/__data/assets/pdf_file/0007/236815/land-clearing-guidelines.pdf>

Department of Natural Resources, Environment, the Arts, and Sport (2011), Emerald River Mission Sites – Background Historical Information, Heritage Branch: Darwin, viewed July 16 at <http://www.ntlis.nt.gov.au/heritageregister/f?p=103:302:::NO::P302_SITE_ID:390>

Department of Sustainability, Environment, Water, Population and Communities (2011), *Survey guidelines for Australia's threatened fish*, DSWEPC: Canberra.

Department of the Environment (2013), *Matters of National Environmental Significance. Significant impact guidelines 1.1*, DotE: Canberra.

Environment Protection Act 2019 (NT)

Environment Protection and Biodiversity Conservation Act 1999 (Cth)

Environment Protection Regulations 2020 (NT)

Heiniger, J., Davies, H.F., & Gillespie, G.R (2020), *Status of Mammals on Groote Eylandt: Safe Haven or Slow Burn?* Austral Ecology, doi: 10.1111/aec.12892

Heritage Act 2011 (NT)

Lloyd, J., & Cook,S (2002), *Northern Territory AusRivAS Sampling and Processing Manual*, Natural Resources Division, Department of Lands, Planning and Environment.

Mineral Titles Act 2010 (NT)

Mining Management Act 2001 (NT)

National Greenhouse and Energy Reporting Act 2007 (Cth)

Northern Territory Aboriginal Sacred Sites Act 1989 (NT)

Northern Territory Environment Protection Authority (2015), *Waste Management Strategy for the Northern Territory 2015-2022*, NT EPA: Darwin

Northern Territory Environment Protection Authority (2020a) *NT EPA Environmental Factors and Objectives, Environmental impact assessment guidance,* NT EPA: Darwin

Northern Territory Environment Protection Authority (2020b), *Referring a Proposed Action to the NT EPA, Environmental impact assessment guidance for proponents, draft for consultation*, NT EPA: Darwin

SHIM Consulting (2014), *A Report on an Archaeological Survey of the South West of Groote Eylandt including the Southern Leases Conducted in 2013*. Unpublished Report to the Anindilyakwa Land Council, Alyangula

Simpson, S.L., Batley, G.E., Charlton, A.A., Stauber, J.L., King, C.K., Chapman, J.C., Hyne, R.V., Gale, S.A., Roach, A.C. & Maher, W.A. (2005), *Handbook for Sediment Quality Assessment,* CSIRO: Bangor, NSW.

Standards Australia/New Zealand (1999), *Water quality—Sampling Part 12: Guidance on sampling of bottom sediments* (AS/NZS 5667.12).

Territory Parks and Wildlife Conservation Act 2006 (NT)

Waste Management and Pollution Control (Administration) Regulations 1998 (NT)

Waste Management and Pollution Control Act 1988 (NT)

Weeds Management Act 2001 (NT)