Cyclone Mineral Sands Project
Public Environmental Review

June 2015

Lost Sands Pty Ltd
Wholly Owned Subsidiary of
Diatreme Resources Limited

DIATREME
RESOURCES LIMITED

Report	Version	Prepared by:	Authorised for release by	Issued to:	Date:
Cyclone Mineral Sands Project - Draft Public Environmental Review	1	MWH Global	 P. McMurtrie Lost Sands Pty Ltd	OEPA for preliminary review	14/10/2014
Cyclone Mineral Sands Project - Draft Public Environmental Review	2	MWH Global	 P. McMurtrie Lost Sands Pty Ltd	OEPA for distribution to other State Government agencies	18/11/2014
Cyclone Mineral Sands Project – Draft Public Environmental Review	3	MWH Global	 P. McMurtrie Lost Sands Pty Ltd	OEPA for approval to release for public comment	29/05/2015
Cyclone Mineral Sands Project – Public Environmental Review	4	MWH Global	 P. McMurtrie Lost Sands Pty Ltd	Stakeholders for public comment	29/06/2015

INVITATION TO MAKE A SUBMISSION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. The environmental impact assessment process is designed to be transparent and accountable, and includes specific points for public involvement, including opportunities for public review of environmental review documents. In releasing this document for public comment, the EPA advises that no decisions have been made to allow this proposal to be implemented.

Lost Sands Pty Ltd (Lost Sands) proposes to develop the Cyclone Mineral Sands Project. The Project will include a mine with an estimated 10 year operational life, and associated infrastructure including a transport corridor that passes through the Great Victoria Desert Nature Reserve. In accordance with the *Environmental Protection Act 1986* (EP Act), a Public Environmental Review (PER) document has been prepared which describes this proposal and its likely effects on the environment. The PER document is available for a public review period of 5 weeks from **29 June, 2015**, closing on **03 August, 2015**.

Comments from government agencies and the public will assist the EPA to prepare an assessment report in which it will make recommendations to government.

Where to get copies of this document

Printed and CD copies of this document may be obtained from:

Peter de San Miguel
MWH Australia
41 Bishop Street, Jolimont, WA 6014
(08) 9388 8799

Hard copies of the document cost $10 (including postage); CDs will be provided free of charge.

The PER may also be accessed through the proponent's website at www.diatreme.com.au.

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action – including any alternative approaches. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged with electronic submissions being acknowledged electronically. The proponent will be required to provide adequate responses to points raised in submissions. In preparing its assessment report for the Minister for Environment, the EPA will consider the information in submissions, the proponent's responses and other relevant information. Submissions will be treated as public documents unless provided and received in

confidence, subject to the requirements of the *Freedom of Information Act 1992*, and may be quoted in full or in part in the report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the PER document or on specific elements. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific elements in the PER document:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable; and
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER document;
- if you discuss different sections of the PER document, keep them distinct and separate, so there is no confusion as to which section you are considering; and
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: **03 August, 2015**

The EPA prefers submissions to be made at: https://consultation.epa.wa.gov.au.

Alternatively submissions can be:

- posted to: Chairman, Environmental Protection Authority, Locked Bag 10, EAST PERTH WA 6892; or
- delivered to the Environmental Protection Authority, Level 8, The Atrium, 168 St Georges Terrace, Perth.

If you have any questions on how to make a submission, please ring the Office of the Environmental Protection Authority on 6145 0800.

Executive Summary

Introduction

Lost Sands Pty Ltd (Lost Sands) is the proponent of a proposal to develop the Cyclone Mineral Sands Project (the Project). This Project is located on the northern margin of the Eucla Basin; approximately 25 kilometres (km) west of the Western Australian (WA) / South Australian (SA) border. This proposal was referred to the Environmental Protection Agency (EPA) on 22 February 2013 under Section 38 of the *Environmental Protection Act 1986* (EP Act). A Public Environmental Review (PER) level of assessment was set by the EPA on 25 March 2013, with a five week public review period (Assessment No. 1970). The Environmental Scoping Document (ESD) for this assessment was released by the EPA on 19 August 2013. This PER document has been prepared to meet the requirements of the ESD and the assessment process.

Proposal Overview and Location

The Project is located in WA on the northern margin of the Eucla Basin, approximately 317 km north of Eucla and 220 km north of the Trans-Australia Railway. The mining area and northern section of the transport corridor lie within the Pila Nguru Lands Determination Area (WC95/51); of which the Pila Nguru (Spinifex People) represented by the Paupiyala Tjarutja Aboriginal Corporation are the traditional custodians. The proposed transport corridor traverses the Great Victoria Desert Nature Reserve (GVDNR). The remainder of the Project is located on unallocated Crown land (UCL) (**Figure ES1**).

Lost Sands is planning to develop the deposit into a ten year mining operation to produce zircon and two high titanium mineral products. The Project includes mine pits, processing infrastructure, tailings storage facilities (TSFs), an accommodation camp, airstrip, water supply infrastructure, a water storage facility (WSF), access roads and a transport road (**Figure ES2**). It is proposed that the ore concentrate will be trucked south on a constructed haul road to the Forrest rail siding on the Trans-Australian Railway (**Figure ES3**).

The mine pit, processing infrastructure and some production bores will be located within Tenement M69/141. Mine water usage will be minimised by recycling within the wet concentrator plant and by recovering water from the TSF, primarily by direct pumping from a sump within the TSF walls, with a secondary option to establish shallow spears / spearfields and recover water by vacuum pumping. Shallow bores for recovery of water from tailings will also be investigated. Tailings will be covered with an appropriate thickness of overburden to ensure rehabilitation is not adversely affected by salt in the tailings.

Supporting infrastructure such as the accommodation camp, airstrip, access roads, remaining bores and pipeline infrastructure will be located within Miscellaneous Licences that will be applied for in parallel with this PER.

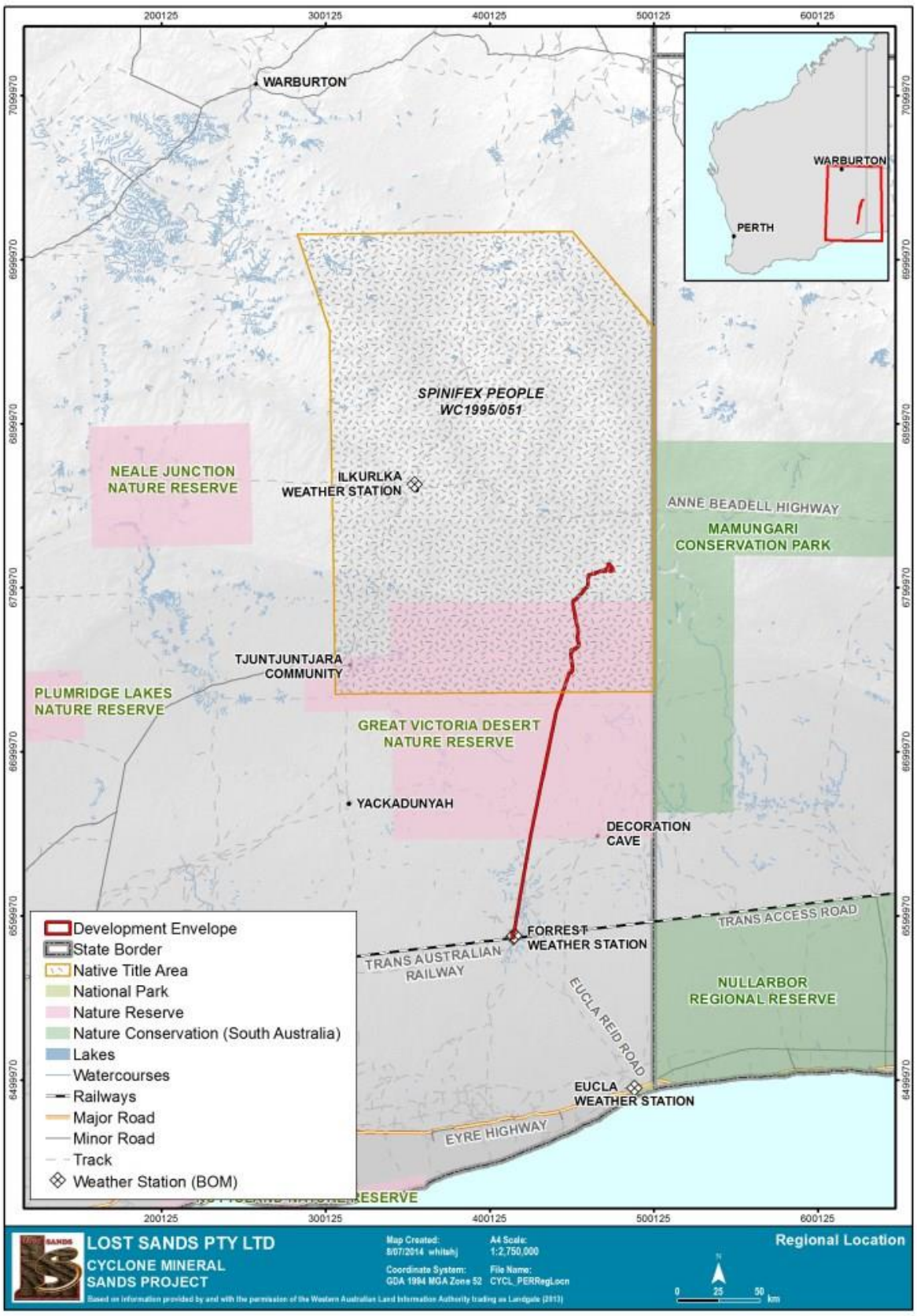

Figure ES1: Cyclone Mineral Sands Project Location

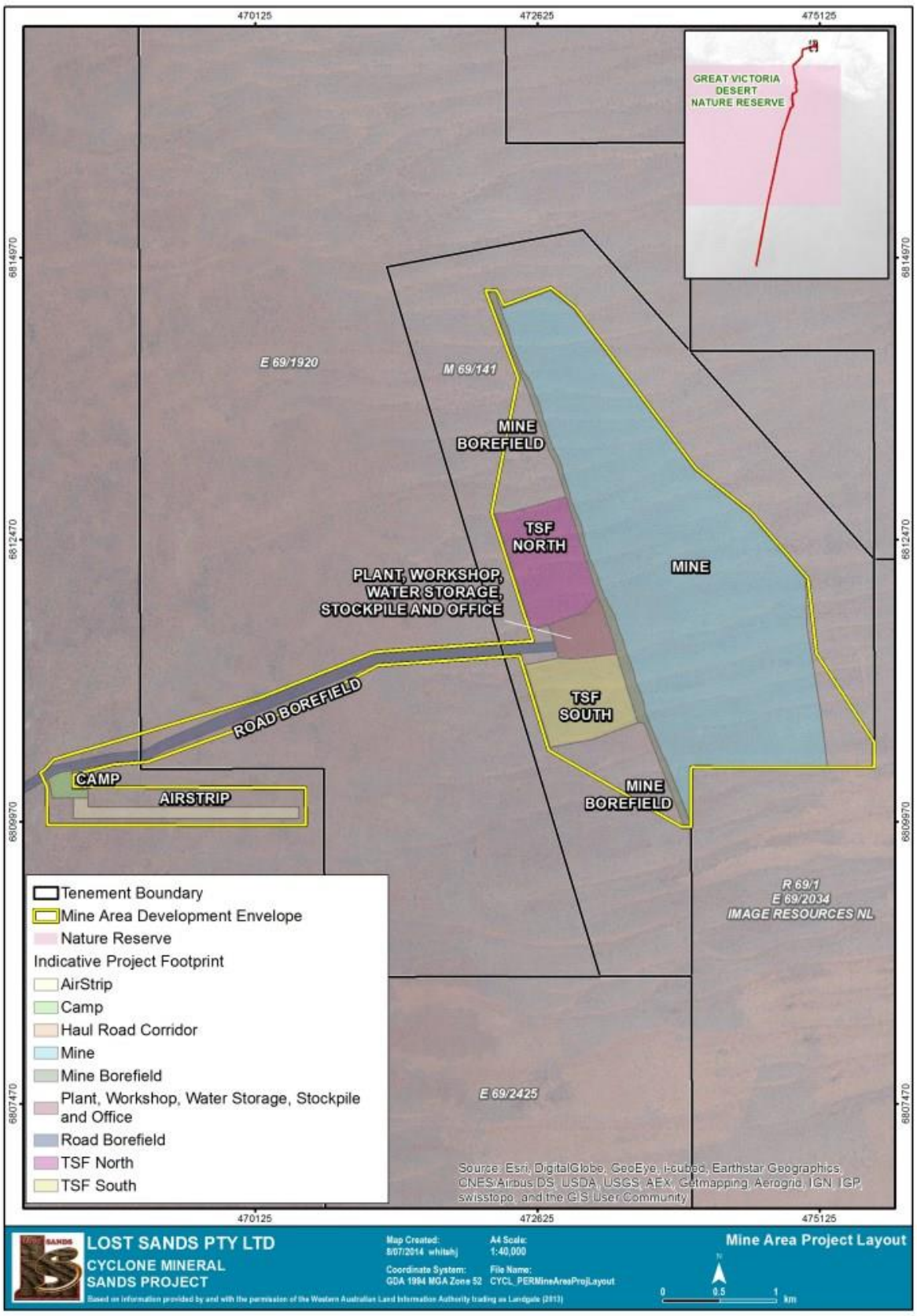

Figure ES2: Cyclone Mineral Sands Project Layout

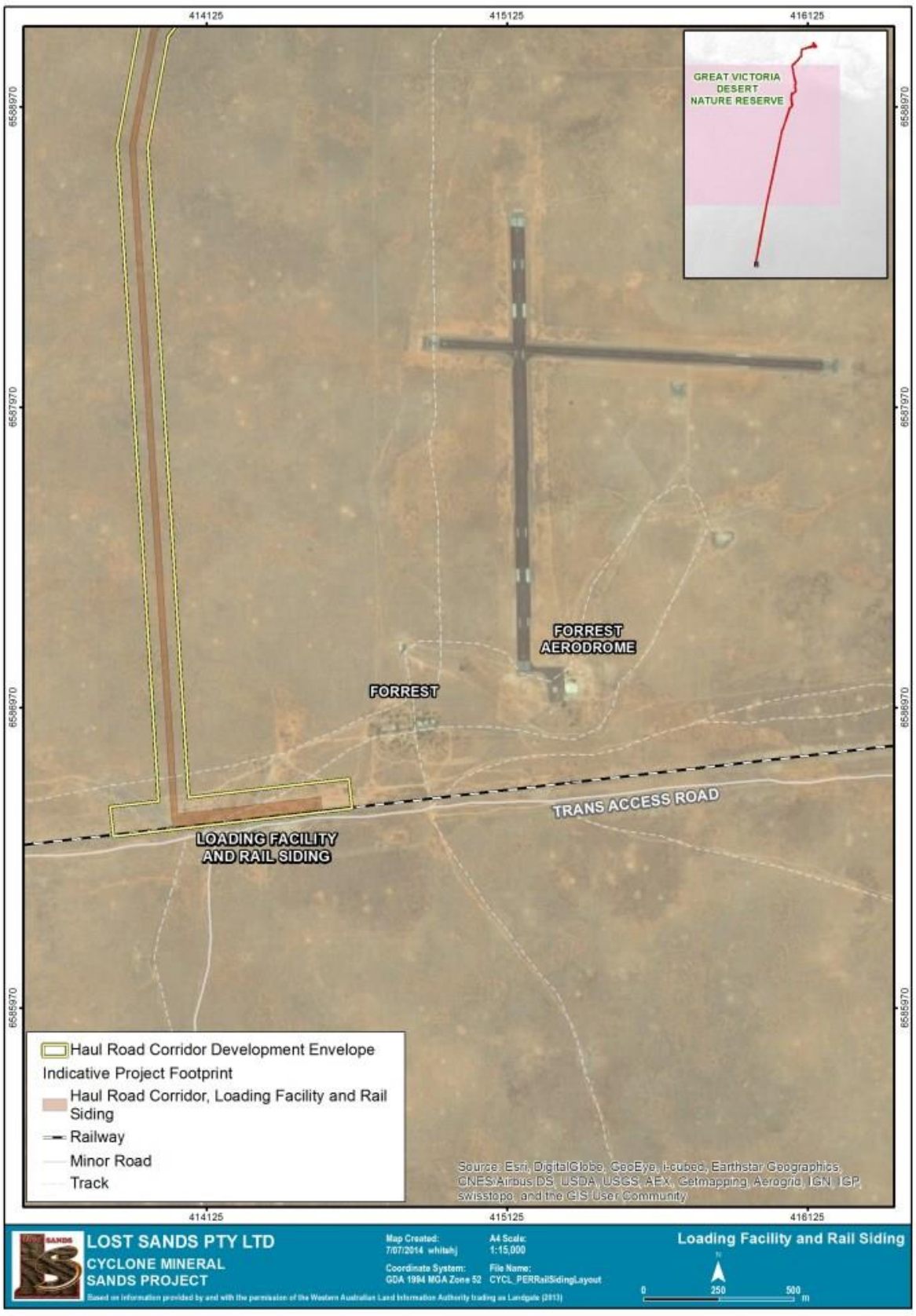

Figure ES3: Cyclone Mineral Sands Project Rail Siding Layout

The rail line is an important transport infrastructure component for linking the mine to a port in WA (or SA). The transport corridor extends south-southwest to Forrest; a gravel access and haul road will be constructed from the mine to the Forrest Siding. The preferred option is the route through the Great Victoria Desert Nature Reserve (GVDNR). The road is 240 kilometres (km) long with approximately 150 km in the GVDNR.

An expected 306 hectares (ha) of clearing will be required within the GVDNR (0.012% of the reserve) to build the haul road, out of the 467 ha of clearing required within the haul road development footprint for the Project. Samples of a range of possible road materials have been tested by a roads engineer to develop a road design concept using these materials. The recommended construction technique involves the use of binding and dust suppressant additives to reduce maintenance costs and water usage on the compacted dry sand and gravel surface. The road design will be based on triple road trains carrying 110 tonnes (t) per truck.

The haul road will be unsealed; haulage trucks and light vehicles utilising the haul road will generate dust. Anticipated truck movements equate to two (2) truck movements in any four hour period, or 12 truck movements in any 24 hour period. The annual mineral concentrate transport averages 150,000 t. The majority of the transport will occur during daylight hours but some night transport will be required. Routine road maintenance including grading and addition of binders and dust suppressants is planned.

The mining area is located in the Shire of Laverton, approximately 600 km east of the town of Laverton. The transport corridor passes through this and two other WA Local Government Areas: the Shire of Menzies; and the City of Kalgoorlie/Boulder.

The nearest communities are the Tjuntjuntjara Aboriginal community, 130 km west of the Project area within the GVDNR; and Forrest at the southern most extreme of the Project area. Tjuntjuntjara was established in 1988 and members are part of a larger group known as Pila Nguru, or Spinifex People.

Forrest consists of a rail siding on the Trans-Australian Railway, an airstrip and six dwellings (which are all affiliated with the airport business). An Australian Rail Track Corporation (ARTC) worker's rest house is located south of the railway line, opposite the proposed container storage area; this is temporary accommodation that is only used once a week. There is no permanent resident at Forrest; the airport manager normally stays for one year on contract.

The key characteristics of the Project are given in **Table ES1**.

Table ES1: Key Characteristics of the Proposal

Proposal Title	Cyclone Mineral Sands Project	
Proponent Name	Lost Sands Pty Ltd	
Short description	The proposal is to develop a minerals sands mine approximately 317 km north of Eucla and includes: • open cut mine pits; • processing infrastructure including TSFs; • processing facilities; • backfill of mined pits; • WSF; • an approximately 240 km long haul road through GVDNR, from the mine to Forrest railway siding; • supporting infrastructure including access and haul roads, an accommodation camp, power station and airstrip; and • groundwater abstraction from a borefield with supporting infrastructure.	
Element	**Location**	**Proposed Extent**
Physical Elements		
Open cut mine pits	Figure ES2	Clearing of up to 558 ha of native vegetation within a 1,028 ha development envelope
Mining and processing infrastructure, internal roads, office and workshop	Figure ES2	Clearing of up to 146 ha of native vegetation within a 1,028 ha development envelope
Airstrip and Camp	Figure ES2	Clearing of up to 27 ha within a 1,028 ha development envelope
Water borefield and supporting infrastructure	Figure ES2	Clearing of up to 70 ha within a 1,028 ha development envelope
Haul Road and loading facility	Figure ES3	Clearing of 161 ha outside of the GVDNR, within a 2,561 ha development envelope. Clearing of up to 306 ha inside the GVDNR, within a 2,561 ha development envelope
Operational Elements		
Water abstraction	Figure ES2	4 L/s or 0.1 GL total for the construction phase 250 L/s or 7.9 GL per year total for the mining operation
Power	Figure ES2	8 Megawatts to be supplied by a small remote power station for the mining operation A dedicated generator may supply electricity for the operation of bore pumps and transfer pumps
Backfill	Mine pits	Tailings and overburden will be used to backfill previously mined-out pit areas

Stakeholder Consultation

Lost Sands has proactively consulted with the local community, the Pila Nguru on a regular basis since the establishment of the Project. Lost Sands engaged stakeholders early in the planning for this proposal, primarily in the interests of achieving a collaborative approach and to ensure that local knowledge is considered in the design and management of the proposal.

Stakeholder consultation for the proposal commenced in November and December 2005 when the proposal was introduced to the Pila Nguru. The Pila Nguru continued to be consulted through the exploration phase of the project until the project development stage in 2013/2014. In 2012 Lost Sands extended its stakeholder consultation process to include regulatory bodies such as:

- Department of Water (DoW)
- Department of Mines and Petroleum (DMP)
- Department of Environment and Conversation (DEC) now known as the Department of Parks and Wildlife (DPaW) and the Department of Environmental Regulation (DER);
- Environmental Protection Authority (EPA); and
- Office of Environmental Protection Authority (OEPA).

Additional stakeholders also consulted during the project development stage included the Forrest airport and ARTC. The broad outcomes of the stakeholder consultation activities associated with the proposal to date have included:

- increased government and community awareness and understanding of the project;
- involvement of regulatory authorities in shaping project activities;
- identification of areas of concern to local residents, the wider community and other stakeholders;
- provision of information by local stakeholders for use by Lost Sands in planning and investigations;
- identification of potential business/employment opportunities for local stakeholders; and
- opportunities for members of the traditional custodian and local community to voice opinions and concerns.

Preliminary Key Environmental Factors – Existing Environment, Impact Assessment, Management and Offsets

The EPA identified preliminary key environmental factors for this proposal which included:

- Flora and Vegetation;
- Terrestrial Fauna;
- Subterranean Fauna;
- Heritage;
- Hydrological processes;
- Amenity;
- Rehabilitation and closure (Integrating factor); and
- Offsets (Integrating factor).

Table ES2 summarises the relevant information on the existing environment, potential impacts and required management in relation to the preliminary environmental factors identified by the EPA, as published in the ESD which it prepared for the PER (**Section 3** and **Appendix B**).

Section 3 of this PER also described the Lost Sands Environmental Management Strategy, the Principles of Environmental Protection and the legislative framework for the Project. **Section 4** describes the studies undertaken to information the PER and the existing environment of Study Area. **Section 5** addressed the potential environmental impacts, the EPA Guidance Statements relevant to this proposal and the mitigation and management these preliminary key environmental factors in relation to achieving the EPA's Environmental Objectives. In addition to the environmental factors outlined within the ESD, this section also discussed the specific potential impacts and mitigation and managements to avoid or minimise impacts upon the Great Victoria Desert Nature Reserve.

A number of other environmental matters were identified as not requiring assessment and evaluation in the PER document, as they were not deemed to be significant or can be regulated and managed to meets the EPA's objectives. These other factors include:

- Landforms;
- Terrestrial environmental quality;
- Inland waters environmental quality;
- Air quality; and
- Human health.

A number of supporting studies and investigations have been undertaken to inform this PER. The key elements of these studies and investigations are included within **Section 4** and **Section 5** of this PER document. These supporting studies and investigations included:

- Preliminary Flora and Vegetation Survey;
- Level 2 Vegetation and Flora Survey and Impact Assessment Desktop Fauna Assessment of the Cyclone Deposit Project;
- Fauna Assessment of Transport Corridor Options for the Lost Sands Project (Cyclone Deposit);
- Level 2 Terrestrial Fauna Impact Assessment;
- Subterranean Fauna Desktop Assessment;
- Heritage Assessment;
- Cyclone Mineral Sands Project Hydrology Assessment;
- Groundwater Feasibility Study;
- Desktop Review of Groundwater Supply Targets;
- Cyclone #1 Investigation Production Bore – Bore Completion Report;
- Hydrogeological Report;
- Environmental Noise Assessment; and
- Dust Management Plan for The Cyclone Zircon Project Rail Siding (Forrest WA).

The individual reports for these studies and investigations are provided within the Appendices.

Numerous management plans have been developed with the objective of avoiding and minimising impacts to the environment from construction and operation of the Project. These management plans are included in **Appendix C** and include:

- Overarching EMP;
- Vegetation and Flora Management Plan;
- Fauna Management Plan;
- Weed Management Plan;
- Fire Minimisation Plan;
- Dust Management Plan;
- Water Management Plan;
- Aboriginal Cultural Heritage Management Plan; and
- Haul Road Management Plan.

Table ES2: Summary of Potential Environmental Impacts, Management and Assessment Outcomes in Relation of EPA Objectives

Preliminary Key Environmental Factor	EPA Objective(s)	Existing environment	Potential impact and Assessment of Significance	Environmental Management and Mitigation	Summary of How Proposal Meets EPA Objectives
Flora and Vegetation	*To maintain representation, diversity, viability and ecological function at the species, population and community level*.	A Level 2 Vegetation and Flora Survey and Impact Assessment was undertaken in 2014 at the Project following a preliminary desktop and reconnaissance survey that were undertaken in 2012. Ten major vegetation groups were identified and divided into 40 vegetation associations across the Study Area. The ten broad vegetation types include: • Mulga Woodlands; • Casuarina woodlands; • Depressions In Casuarina Woodlands; • *Eucalyptus gongylocarpa* Woodlands; • Mixed Eucalyptus Mallee Woodlands; • Lake Bed and Margins; • Degraded Dune At Nullarbor Boundary; • Myall (*Acacia papyrocarpa*) Woodlands; • Extensive Open Plains On Nullarbor Plain; • Shrublands Within Nullarbor Plain; • Cleared Areas; and • Mosaics. Vegetation condition recorded across the majority of the Study Area was generally considered to be 'Excellent' within the GVD regions and 'Very Good' to 'Good' within the Nullarbor Plain.Some areas could be considered 'Degraded'; however, it is also possible that poor conditions encountered on the Nullarbor Plain are the result of normal climatic conditions. Completely degraded areas were limited to clearing around rail and airstrip infrastructure around Forrest at the southern end of the haul road development envelope and some isolated access tracks. Grazing from camels and rabbits was evident, particularly in the Nullarbor Plain where vegetation structures had been altered at a number of sites. No Threatened Flora listed under the *Wildlife Conservation Act Wildlife Conservation Act 1950* (WA) (WC Act), or Threatened Flora species listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth)(EPBC Act) have been recorded in the Study Area. Ten flora taxa recorded within the Study Area were identified as conservation significant, with one taxa recorded in Phase 2 being flagged as a potential new species. • *Eremophila decussata* (Priority 1); • *Dampiera ? eriantha* (Priority 1); • *Eremophila undulata* (Priority 2); • *Acacia eremophila* numerous-nerved variant (A.S. George 11924) (Priority 3); • *Eucalyptus pimpiniana* (Priority 3); • *Eucalyptus canescens subsp. beadellii* (Priority 3); • *Eucalyptus canescens subsp. canescens* (Priority 3); • *Lepidium fasciculatum* (Priority 3); • *Eucalyptus vokesensis* (Unknown status - New record to WA); and • *Microcorys* sp. 1 (Unknown Status - Potential new species). The proposed haul road passes through the Great Victoria Desert Nature Reserve (GVDNR), a class A nature reserve.	Potential impacts to flora and vegetation from the Project include: *Clearing* Of the 40 vegetation associations described within the Study Area; 27 (including mosaics) lie under the Project Envelope; four within the Mining Area development envelope and 24 within the haul road development envelope. Only vegetation associations 9 (*Eucalyptus steppe* on Northern red sand dune) and 14 (Eucalyptus and Acacia on Northern dune swale) have more than 5% of their total mapped area within the mining area development footprint (31.22% and 12.49% respectively). The principal reason for this is that only a small proportion (1.4%) of the Study Area is within the B42 land system which is characterised by dune fields such as those exemplified by vegetation association 9 and 14. Land system B42 extends for a considerable distance to the north, east and west, and is a major land system within the GVD. As sand dunes are a principal feature of the GVD it can be inferred that Project development does not pose a threat to this landform as a whole. No vegetation association within the Haul Road footprint stands to have more than 5% of its extent within the Study area impacted. This is primarily a result of lateral banding of vegetation associations across the landscape and relatively large size of the study area in comparison to the comparatively thin footprint. Individuals of the following three species lie within the haul road footprint; distributions of these priority species are known to be widespread both within and outside the Study Area on sand plain areas: • *Acacia eremophila* numerous-nerved variant (A.S. George 11924) (Priority 3); • *Eucalyptus pimpiniana* (Priority 3); and • *Eucalyptus canescens subsp. canescens* (Priority 3) Without conventional mitigation such as avoiding clearing and maintenance of surface water flows, potential impact to these species as a whole from proposed activities is considered low to moderate. With conventional mitigation the potential impact is considered low. *Eucalyptus vokesensis* and *Microcorys* sp. 1 were recorded within sand dune areas in close proximity to the Haul Road envelope (150 m and 141 m respectively), and there exists the possibility that unrecorded populations may incur some impacts from development of the Project. Both taxa populations were also recorded some distance away from the Haul Road (450 m and 1 km). Potential impacts cannot be accurately predicted, but with conventional mitigation the potential impacts are likely to be low to negligible. *Modification To Surface And Groundwater Flows* Some vegetation associations may be impacted through interruption of surface water flows through construction of the haul road. These impacts would be considered low or moderate on a local scale, and low or negligible on a regional scale. Conventional surface water control measures that maintain surface flows will ameliorate potential risks to the vegetation and flora from changes in flows. No ground water dependent ecosystems or species were recorded within the Study Area. *Introduction And Spread Of Weeds* The majority of weeds were in low numbers and frequency and are unlikely to diminish the biological diversity of the Study Area as the majority are spread by fauna and water vectors. Development and use of the haul road may result in the transport and spread of weed species, predominantly in a south to north direction.	A Vegetation and Flora Management Plan has been prepared and includes (but is not limited to), the following management measures: • minimising clearing at all times; • demarcating and avoiding conservation significant flora where possible; • development of a conservation significant flora and weed identification guide, to be made available to all personnel that are managing clearing activities; • stockpiling vegetation and topsoil appropriately; • progressive rehabilitation techniques, and trials to determine the best means to restore vegetation as close as possible to pre-mining state; and • monitoring of vegetation, flora and priority flora in appropriate locations along haul road and surrounding the mine site; • maintaining surface water flow where possible; • mapping of weeds prior to Project construction and ongoing monitoring; • development of a weed management plan that focuses on the prevention of weeds being introduced into the GVDNR and includes ongoing weed monitoring and management, weed hygiene measures and eradication techniques; • incorporating a binding agent into the construction of the haul road in order to minimise dust; • implementing regular dust suppression along the haul road and internal mine roads; • design and implementation of a vehicle washdown station at the southern end of the haul road at the rail siding. This could ensure that all vehicles travelling into the Project do not carry in any new introduced weeds species. This would be especially relevant for earth moving equipment during construction. This action would need to be implemented in conjunction with separate actions to limit the spread of weeds already within the Project area, such as weed mapping; • avoiding transport of material from road building activities into shallow depressions and other low lying areas; • personnel education and awareness training; and • development of a fire minimisation plan.	Through assessment of potential impacts to vegetation and flora arising from clearing, modification to surface and groundwater flows, spread of weeds, generation of dust and initiation of fire, it has been determined that with application of suitable management measures and rehabilitation techniques there is not likely to be a significant impact to vegetation and flora from construction and implementation of the Project. However, given the status of the GVDNR, clearing of 306 ha within the GVDNR may be considered a significant residual impact until such time as rehabilitation is complete, and therefore may require offsets. Therefore, it is expected that the EPA's objective to '*maintain representation, diversity, viability and ecological function at the species, population and community level'* will be satisfied, subject to the implementation of suitable offsets.

Preliminary Key Environmental Factor	EPA Objective(s)	Existing environment	Potential impact and Assessment of Significance	Environmental Management and Mitigation	Summary of How Proposal Meets EPA Objectives
		No groundwater dependent ecosystems were recorded in the Study Area. No permanent standing, flowing or major ephemeral water flow lines were observed within the Study Area. Some vegetation associations appeared to be reliant on surface water including several small lakes and shrublands associated with small depressions on the Nullarbor Plain. 12 introduced species were found in the Flora Study Area, two of which are Declared Pests within Western Australia: *Heliotropium europaeum* and *Echium plantagineum.* A further weed species *Carrichtera annua* (Ward's Weed) is not a Declared Pest; however, it is considered invasive and was widespread across the Nullarbor Plain bioregion. (Refer PER Section 4.6 and Appendix D)	*Generation Of Dust* The Haul Road will be unsealed, and haulage trucks and light vehicles utilising the Haul Road will generate dust. Impacts to vegetation from dust are likely to be limited to within 50 to 100 m of the roads. Dust is unlikely to result in the loss or significant impact to any particular vegetation association; however, the population of Priority 2 Flora *Eremophila undulata* may be affected by excessive dust under certain conditions. *Use Of Saline Water And Binding Agent On Haul Road* A binding agent will be used in construction of the road in order to minimise dust generation. Depending on the nature of the binding agent, it is possible that contaminants could be released to the surrounding soils and vegetation. In addition, saline water will be used to suppress dust along the haul road. Incidental spraying of saline water on the vegetation alongside the Haul Road and runoff from the road may potentially result in a decline in vegetative health Potential impacts to vegetation and flora from saline water and binding agent are considered to be lower than those from the generation of dust; hence dust mitigation is considered to be a necessary management action. *Alteration to the Fire Regime* Construction and operation of the Project may potentially result in the initiation of fire that may spread to the surrounding vegetation if not controlled. *Potential Impacts to the GVDNR* Construction and operation of the haul road will result in indirect impacts to vegetation, flora and fauna within the GVDNR as detailed above. The direct impact will be clearing of 306 ha within the GVDNR until such time as rehabilitation is successful. Given the status of the GVDNR, this may be considered a significant residual impact and is likely to require offsets.		
Terrestrial Fauna	*To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.*	A Terrestrial Fauna Impact Assessment was undertaken by Outback Ecology/MWH to assess the impact of the Project on fauna habitats and assemblages. This assessment included both desktop and field components. Eight broad fauna habitat types identified in the Study Area. These are widespread and typical of the GVD and Nullarbor bioregions, with the exception of the Claypan and Mallee over Spinifex types, which may be more limited. The Project footprint does not require any clearing in the Claypan habitat type. 325 species of native vertebrate fauna could potentially occur within the Study Area. Of the 29 conservation significant species likely to occur in the study area, two mammal species and 11 bird species (13 species in total) were recorded during the terrestrial fauna assessment including: • Central Marsupial Mole (*Notoryctes typhlops*); • Malleefowl (*Leipoa ocellata*); • Princess Parrot (*Polytelis alexandrae*); • Peregrine Falcon (*Falco peregrinus*); • Major Mitchell's Cockatoo (*Lophochroa leadbeateri*); • Blue Bonnet (*N. haematogaster narethae*); • Brush-tailed Mulgara (*Dasycercus blythei*); • Striated Grasswren (*Amytornis striatus striatus*);	Potential impacts to fauna from the Project include: *Impacts to Fauna Habitats* Seven of the eight broad fauna habitats identified in the Study Area may be affected by land clearing during the construction and operation of the Project, as they intersect either one or both of the development envelopes. The Dune Field, Sheoak Woodland and Mulga-Mallee Woodland habitats would be subject to the greatest direct impact, however, only represent a potential disturbance of 3.1%, 0.6% and 0.6% respectively of each of these habitats mapped within the Study Area. Within broad habitat types there are also significant habitat features comprising sand dune crests and drainage depressions that will be impacted. *Impacts on Vertebrate Fauna* There are several threatening processes that may impact fauna and fauna assemblages as a result of development of the Project: • Habitat removal and modification • Altered fire regime • Collision with vehicles. • Noise and vibration • Artificial light • Increased dust generation • Introduced flora • Introduced fauna *Impacts on Vertebrate Fauna of Conservation Significance*	A Fauna Management Plan has been prepared with the objective of minimising impacts to local fauna populations from the implementation of the Project and is included in **Appendix C.** The fauna management plan includes specific measures to minimise impacts to conservation significant species and includes, but is not limited to the following management measures: • plan and complete clearing activities to limit clearing of vegetation in general, and clearing of significant habitats such as Dune Fields and dune crests in particular. Where possible, schedule clearing outside of breeding times of species of conservation significance and complete clearing progressively to allow fauna time to disperse; • create a fauna awareness programme for staff and contractors detailing how impacts to fauna of conservation significance can be minimised during site operations; • if evidence of a resident population of conservation significant species is detected, develop a Significant Species Management Plan for the species to supplement the Project's fauna management plan; • implement an Introduced Fauna Management Plan that includes reporting sightings, minimising ingress of introduced fauna to the Project, and controlling numbers of existing introduced fauna in the Project areas;	Given the widespread representation of all habitat types both within and outside the Project, and the identification of all conservation significant species in other regional assessments, the impacts of the Project on terrestrial fauna are considered not significant on a local or regional scale. However, given the status of the GVDNR, potential impacts to the GVDNR may be considered significant and require offsets. Therefore, it is expected that the EPA's objective to *'maintain representation, diversity, viability and ecological function at the species, population and assemblage level'* will be satisfied, subject to the implementation of suitable offsets.

Preliminary Key Environmental Factor	EPA Objective(s)	Existing environment	Potential impact and Assessment of Significance	Environmental Management and Mitigation	Summary of How Proposal Meets EPA Objectives
		• Bush Stone-curlew (*Burhinus grallarius*); • Nullarbor Quail-thrush (*C. cinnamomeum alisteri*); • Australian Bustard (*Ardeotis australis*); • Southern Crested Bellbird (*Oreoica gutturalis gutturalis*); and • Rainbow Bee-eater (*Merops ornatus*). 14 species of introduced fauna potentially occur in the Study Area, with seven (50%) of these species recorded during the field survey component of this Assessment. 22 invertebrate specimens collected were considered to be SREs based on current scientific knowledge. None of the potential SRE species collected during this Assessment were obtained from within a restricted habitat. All the SRE species were collected either from multiple habitats in the Study Area or from habitats that were not considered to be restricted to the Study Area. Consequently, the potential SRE status of these species does not necessarily represent a restricted distribution, but may instead represent a lack of taxonomic resolution or lack of regional records. (Refer PER **Section 4.7** and Appendix E)	The impact of the Project on each fauna species of conservation significance likely to occur in the study area was assessed using the ranking criteria. The highest risk ranking for the Project was 'moderate' for two species: Central Marsupial Mole (*Notoryctes typhlops*) and Princess Parrot (*Polytelis alexandrae*).The impact for the remaining 17 species is considered low, minimal or negligible. The Central Marsupial Mole was found in the sand dune crests of the Dune Field habitat type during the Terrestrial Fauna Impact Assessment, and is unlikely to be found in other habitat types in the Project area. Dune Field habitat in the development envelopes represents only 4.4% of the total amount of this habitat type mapped in the Study Area, and sand dune crests in the development envelopes represent only 4.8% of the total amount of this significant habitat feature mapped in the Study Area. It is likely that individual Central Marsupial Moles will be lost during construction and operations of the Project, however suitable habitat for the Marsupial Mole is widespread in the GVD, and populations are likely to be widespread outside of the Project, such that there is not likely to be a significant impact on local and regional populations from construction and operation of the Project. The greatest impact to the Princess Parrot from the development of the Project would be the loss of Dune Field habitat, and specifically mature Marble Gums and nesting hollows within it. Broadly, individual Princess Parrots within the Project disturbance footprint are unlikely to be lost during Project construction and operation, as this species has a high dispersal capability (except during nesting, when eggs and chicks may be at risk). Hence, the Project is unlikely to have a significant impact on local and regional populations of the Princess Parrot. *Invertebrate Fauna* Given that no SRE species have collection records within the Project Development Envelope and considering that no SRE species were found to occur within restricted habitats that will be impacted by the Project, it appears unlikely that the Project will have a significant impact to SRE species. *Potential Impacts to the GVDNR* Clearing for construction and operation of the haul road will result in direct impacts to the GVDNR until such time as rehabilitation is successful. Given the status of the GVDNR, this may be considered a significant residual impact and is likely to require offsets.	• implement a Traffic Management Plan that enforces speed limits in areas that are known to contain fauna that may be susceptible to vehicle strikes; • implement a Fire Minimisation Plan (in conjunction with DPaW and the Pila Nguru) to ensure that altered fire regimes do not compromise the quality of foraging and breeding habitats in the vicinity of the Project area; • consider noise, artificial light and dust impacts to fauna during design, construction and operation and implement engineering controls to mitigation impacts where ever possible;. • plan for closure within the Project design phase, and in each subsequent phase, by identifying final land uses, rehabilitation challenges, locations of rehabilitation resources such as topsoil and planning for progressive rehabilitation throughout the life of the operation; • if Princess Parrots are observed breeding in the vicinity of the Project, the area will be demarcated and reported to DPaW, and a buffer zone to protect against disturbance will be applied; • in areas where the clearing of mature Marble Gums is unavoidable, conduct pre-clearance surveys to ensure any tree hollows present are clear of nesting or roosting Princess Parrots and other vertebrate fauna; • if Malleefowl mounds are observed in the vicinity of the Project, the mounds will be demarcated and reported to DPaW, and buffer zones to protect against disturbance will be established; and • in areas where the clearing of potential breeding habitat is unavoidable, conduct pre-clearance surveys to ensure these areas are free of Malleefowl mounds	
Subterranean Fauna	*To maintain representation, diversity, viability and ecological function at the species, population and assemblage level*.	Subterranean Fauna Assessment was completed at the Project consisting of a desktop component and a field reconnaissance survey, completed between 4 and 6 October, 2013. The Project area is considered to contain limited prospective habitat for either stygofauna or troglofauna for several key reasons: • the proposed mining will extend to depths of approximately 40 metres below ground level (mbgl), which will remain above the water table; • the fine grained nature of the geological facies below the ore means the voids and spaces commonly associated with stygofauna habitat will not be available; • the fine grained nature and absence of voids also means resources (such as oxygen and nutrients) would be restricted from flowing into the aquifers; • the red sand and interdune loam in the upper metres of the overburden are likely to represent a desiccated	Potential direct impacts on subterranean fauna associated with the development of the Project are: • removal of habitat through excavation of the ore reserve within the proposed mining area; and • changes in infiltration and aquifer recharge related to compaction and increase in sediment load in run-off that could reduce surface-subsurface water exchange during flow periods (e.g., lessen input of resources) and alter groundwater quality, which may exceed species tolerance limits (Marmonier 1991; Outback Ecology/MWH 2014); and • reduced nutrient input as a result of vegetation clearing. The subterranean habitats present within the proposed mining area and preliminary borefield were not considered to be prospective for supporting stygofauna and troglofauna (Appendix F). Therefore, it is considered unlikely that any subterranean fauna species will be impacted by the activities proposed by the Project. The subterranean habitats present within the proposed southern sector of the haul road are considered to be prospective for	No further investigation of stygofauna or troglofauna values are considered necessary for the Project. If the degree of development activities were increased in the southern sector of the haul road to include relatively extensive excavation or groundwater abstraction then further investigation of subterranean fauna values may be required.	The overall findings of this subterranean fauna assessment indicate that the proposed development of the mining area, preliminary borefield and haul road will meet the EPA objectives in that the proposal does not pose a threat to maintaining subterranean fauna representation, diversity, viability and ecological function at the species, population and assemblage level.

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		environment with humidity levels too low for troglofauna populations to persist; • the uppermost stratum lacks the vugs and voids typically associated with prospective troglofauna habitat; and • the calcrete that is present within the project is pedogenic (formed with soil) as compared to valley calcrete (formed with water). Valley calcrete contains the voids that provide suitable subterranean habitat in other calcrete deposits in Western Australia; The strata underlying the southern part of the haul road development envelope (extending for approximately 100 km north of Forrest) associated with the Eucla Basin Tertiary limestone and sandstone sediments are more prospective for subterranean fauna, particularly nearing the karst systems of the Nullarbor Plains that begin to be evident from the southern sector of the GVD Nature Reserve approximately 100 km north of Forrest. A limestone cave system, named Decoration Cave, is present approximately 38 km to the west of the proposed transport corridor and 80 km northeast of Forrest. Stygofauna and troglofauna species have been recorded from the Nullarbor Plains Karst system so are highly likely to be present in the area of the southern part of the transport corridor. (Refer PER Section 4.6 and Appendix F)	supporting stygofauna and troglofauna. However, the level of impact of the proposed development is considered low. In addition, the geology present appears to be relatively uniform and widespread indicating continuity of potential habitat beyond the proposed haul road. Therefore, it is unlikely that there is a risk to the long term conservation of any subterranean fauna species that may be present in the area.		
Hydrological processes	*To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance are protected.*	***Groundwater*** Several desktop groundwater studies have been undertaken for the pre-feasibility stages of the Project to determine potential groundwater sources. The Project lies within the Officer Basin; one deep investigation bore (Cyclone #1) has been drilled in the mining area, and a Bore Completion Report and associated Hydrogeological Report has been prepared. *Regional groundwater* The Project is within the southern central area of the Waigen area and linked Birksgate sub-basin of the Officer Basin. These two areas cover approximately 80,000 km^2. The regional groundwater movement in the deep aquifers is from recharge areas around 200 km north of the Project to the south. Shallow, saline to very saline low yielding aquifers occur in paleochannels within the Gunbarrel Basin which overlies the Officer Basin and are associated with distant salt lakes and playas within the GVD bioregion. Major regional paleochannels occur below major surface water drainage lines. Occasional localised shallow aquifers with fair to poor quality groundwater occur in the region the closest known being at the Tjuntjuntjara Community and the Ilkurlka Roadhouse (130 km northwest of the mine site on the Anne Beadell Highway). Salinity within the region varies greatly but is largely considered as highly saline to hyper saline (>30,000 mg/L). *Local groundwater* Three shallow low yielding drilling water supply production bores were constructed approximately 20 km west of the Project to provide water for the construction of the deep investigation production bore. These bores intersected fractures in hard fine grained sandstone at less than 36 mbgl and have a standing water level around 27 mbgl. Conductivity	*Deep Aquifers* Abstraction of groundwater from the deep aquifer identified within the Project area may potentially impact local and regional deep aquifer groundwater resources. The deep aquifers intersected in Cyclone #1 are considered to be part of an extensive major saline aquifer system. Due to the predicted extensive aquifer system available as a groundwater source for abstraction, the amount of water required for the operation of the mine is not likely to have a significant impact on local or regional deep groundwater resources. Due to the confined nature and depth of the proposed groundwater source, contamination of the deep aquifer from mining operations will not occur. There are no other current users of this large saline water resource within the Waigen area or Birksgate Sub basin, consequently there will be no adverse impact on other users from extracting groundwater from this saline aquifer. *Shallow Aquifers* Potential impacts to local and regional shallow aquifers include: • drawdown through abstraction of groundwater from the deep aquifer; • seepage from water storage facilities; • development of recharge mounds; and • hydrocarbon and chemical contamination from mining activities Due to the confined nature of the deep aquifer, it is highly unlikely that there is any connectivity to shallow aquifers, and therefore unlikely that abstraction from the deep aquifer will impact the shallow aquifers. There are also not any groundwater dependent	A water management plan has been prepared to manage and monitor the bore field, shallow aquifers within the mine area and possible recharge mounds (**Appendix C**). This plan will be further developed through the Mining Proposal and Works Approval processes to define parameters, timing and triggers for monitoring. The plan includes but is not limited to the following management actions: • Installation of a minimum of 20 shallow monitoring bores, half to the weathered rock interface and the other half to 40 m depth. These will be located within tenement M69/141 around the mine development area including a line of bores near the western boundary of the development area.. • Regular monitoring and annual assessment of bore and bore field abstraction, chemical and trace metal water quality monitoring and groundwater level monitoring including monitoring variations in potentiometric surfaces (sub artesian aquifer pressure surfaces).	Potential impacts to the shallow aquifers from mining operations will be managed through implementation of a groundwater management plan and monitoring program such that they are not likely to be significant. The confined nature of the proposed groundwater source means that it is highly unlikely that there is any connectivity to the shallow aquifers; hence it is unlikely that abstraction from the deep aquifer will impact the shallow aquifers. In addition, in the remote instance that drawdown of the shallow aquifers does occur, all surrounding users of the regional shallow aquifers are situated at a suitable distance from the Project such that impacts will not occur. There are also not any groundwater dependent ecosystems or habitat prospective for subterranean fauna within or surrounding the proposed borefield. Given the above, it is predicted that the EPA objective for groundwater will be met and that potential impacts to groundwater will not be significant.

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		varied between 33,700 and 37,900 microsiemens per centimetre (µS/cm) when drilled. These bores are not capable of supplying the continuous yield required for the operation. The Cyclone #1 bore was drilled into the high yielding saline Officer Basin aquifer adjacent to the proposed mine, and was airlifted on completion to assess aquifer yield and groundwater quality. The deep aquifers are part of an extensive regional aquifer system and are confined by overlying clay beds. The water level in the deep bore in the mining area was approximately 87 mbgl. Major aquifers were intersected between 527 m and the bottom of the hole at 812 m. Aquifer thickness was at least 250m (the aquifer had not bottomed out at the end of drilling). Post borehole construction, the salinity was measured as 33,000µS/cm. (Refer PER **Section 4.9** and Appendix G)	ecosystems or habitat that is prospective for subterranean fauna within or surrounding the area of the proposed borefield. Extraction of groundwater from the deep aquifer for the Project mine supply will not have any impacts on the aquifers used for the water supply for Tjuntjuntjara Aboriginal community and Ilkurlka Roadhouse or other distant communities within the GVD bioregion in SA. Extraction of groundwater from the deep aquifer for the Project mine supply will not have impacts on known Aboriginal soaks which are local, shallow up-gradient groundwater resources. The known soaks are distant from the proposed mine and bore-field. Groundwater abstracted from the deep aquifer will be stored in water storage facilities within the Project area. Potential seepage and development of recharge mounds may occur from these water storage facilities as well as the tailings storage facilities. This can be managed through installation of monitoring bores and implementation of a monitoring program. Hydrocarbon and chemical contamination of shallow aquifers may occur through construction and operation of the mine however this can be mitigated through standard mine site environmental management techniques that will be detailed within the Project EMP.		
		Surface water A surface water assessment of the Project area was undertaken by MWH in March 2014 and described three scales of surface water catchments; regional, local and inter-dunal. *Regional catchments* The low relief and lack of sufficient rainfall to generate significant drainage patterns gives rise to an absence of regionally significant creeks or water courses. Surface water expressions are restricted to salt plains, pools, non-perennial lakes and short-reach water courses. The Project area is located near the catchment divide between regional catchment areas. From the proposed camp area, the ground falls to the northwest and a salt lake system, which in turn drains southwards towards the Nullarbor Plains. *Great Victoria Desert Nature Reserve* There are no permanent creeks or rivers within the GVDNR and most watercourses are short and ephemeral. Surface water expressions are restricted to salt plains, pools and non-perennial lake systems. Due to the combination of flat topography and arid climate, watercourses will flow infrequently and only following heavy rain. Depending on intensity of the rainfall event, flow may occur for only a short period. The dunefields are the key topographical features of the GVDNR and will impact potential flow paths during high rainfall events. Surface water flows in flood events will likely flow along the line of the sand dunes and eventually attenuate due to a combination of flat topography, poorly defined drainage, infiltration and evaporative losses. *Local Catchments* The local surface water catchments are small, locally limited and not well defined. Surface water expressions when present are typically trapped pools or gullied ruts from local slopes.There are no permanent creeks/rivers due to the combination of topography and arid climate. Notable lake systems are: the Serpentine Lakes 30 km to the east, the Wanna Lakes 30 to 40 km northwest of the campsite area, and the Forrest lakes 55 km south of the Project area. The Project area is just within the extreme edge of a dunefield and just west of a nearby catchment dividing ridgeline (to the east).	Potential impacts of the Project on surface water regimes relate to the placement of the proposed mine, infrastructure and roads and include: • interruption of natural drainage channels; • drainage shadows down gradient of the mine site, airstrip and roads; • ponding up gradient of the mine site and roads; • increased sediment runoff and scour; and • possible hydrocarbon and chemical contamination. The percentage disturbance within the regional catchment is small which implies any alteration to the surface water regime may be noticed at a local level, but will be insignificant within the regional catchments. *Interruption of natural drainage channels* The pit areas will interrupt the flow of the natural drainage line across the inter-dunal catchments. The pit catchment is representative of approximately 3% of the total regional catchment area and is located near to the catchment divide within the local catchments, therefore the impact of the pit on the drainage lines is localised to within the pit footprint. Given the low rainfall, high evaporation, small catchment area associated with the inter-dunal catchments and the pit's proximity high in the catchment, the potential for significant volumes of runoff are low and the pit is not likely to have a significant impact on surface water flows. Infrastructure platforms and TSFs interrupt the flow of eight natural inter-dunal drainage lines. The upstream reach of these drainage lines will be very short and runoff volumes very low due to the presence of the pit void upstream of the infrastructure areas. Runoff will likely infiltrate or flow as sheet flow around the raised platforms and tailings facilities. The existence of the mine camp in its current position west of the airstrip will provide minimal disruption to the overflow path. Natural drainage lines will suffer minimal disruption from the airstrip as it is orientated parallel with the flow pathways and a proposed swale and bund will serve to divert flows around the airstrip. The haul road will interrupt surface water flows however these will be diverted through culverts and over floodways. This will have the effect of altering surface water flows at a local catchment level. This effect will dissipate as the flows move downstream and join the sheet flows and channel flows that are contributing to the river system from the larger catchment area. The impact of the haul road	A Water Management Plan has been prepared (**Appendix C**), with the objective of protecting surface water. The management and monitoring proposed in the Water Management Plan is based on the desktop Hydrology Assessment, and will be refined based on site specific survey data and ground conditions. The Hydrology assessment identified major and minor drainage crossings along the haul road development envelope that are likely to require installation of floodways and culverts. Management and monitoring of surface water that will be undertaken in accordance with the Water Management Plan will include, but not be limited to: • minimising the clearing footprint within the development envelopes to minimise potential erosion; • minimise vegetation clearance associated with watercourses; • implementing soil erosion control techniques to prevent erosion and an increase in surface water turbidity. • monitoring of the drainage shadow from the pit on an annual basis; • opportunistic monitoring of surface water during rainfall events; • monitoring of diversion channels, outfalls, swales, bunds and floodway channels; A Project conceptual surface water management plan for the purposes of managing stormwater and protecting Project infrastructure has also been developed. For the purposes of construction, this will be further refined based on site specific survey data and ground conditions.	The Project will have insignificant impacts on regional hydrology. Some local impacts may occur but will also not be significant. Any potential impacts can be minimised through the application of the surface water management plan. Therefore the EPA objective will be met for surface water.

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		Interdunal catchments From east to west across the Project area there is a fall of approximately 80 m. The local topographic high is approximately 2.5 km east of the centre of the proposed minesite footprint and is at a height of approximately 370 m Australian Height Datum (mAHD). The accommodation camp is located approximately 7 km west-southwest of the centre of the minesite and is at approximately 290 mAHD. The airstrip lies on relatively flat ground approximately 1.5 km east from the camp and 5.5 km from the centre of the minesite footprint. Any runoff generated off this local topographic high will flow across the minesite and towards the camp. There is a slight depression at around 280 mAHD approximately 6 km northwest of the camp. Over the Project site, the runoff is expected to run along the base of the sand dunes towards the Project area and across to the open ground that is west of the Project. (Refer PER **Section 4.10** and Appendix H)	is likely to be insignificant, given that watercourses generally flow infrequently and for short periods as a result of the ephemeral nature of creeks in the area, combined with low, irregular rainfall and high evaporative and infiltration losses. *Drainage shadows and ponding* There will be a drainage shadow created downstream of the pit. Given the low rainfall and high evaporation, this will not be significant within the local and regional catchment. Ponding is not likely to be a significant problem in the Mine area. Potential hydrological risks to vegetation, flora and fauna resulting from drainage shadows and ponding during the operational phase of the haul road include: • ecohydrological impacts of altering surface water flow to vegetation health, in particular sensitive and significant habitats; • surface water flow impacts on soil water retention – saturation levels; • inundation – flooding/ponding impacts on vegetation; • water shadow effects of culverts, for example, ponding upstream increasing periods of inundation in select areas; and downstream effects i.e. scouring and shadow; • deterioration or destruction of habitat suitable for fauna species. Maintaining sheet flow while reducing ponding and shadow effects are essential practices to minimise the impact on vegetation, flora and fauna. Where surface water dependent vegetation associations are located, environmental culverts will be used to re-distribute flows downstream of the road alignment and re-instate sheet flows. Given the irregular rainfall, high losses and ephemeral surface water system, flow may occur for only a short period. Any potential impacts to surface water flows from drainage shadows are therefore expected to be insignificant or short-lived. *Increased sediment runoff and scour* Increased sediment runoff and scour may occur during clearing and through the installation of culverts and floodways, if not correctly constructed. Concentrating flow and energy through culverts or over floodways can lead to erosion and scouring of both the upstream side of the culvert/floodway and of the downstream environment. Culverts and floodways will be installed in accordance with the approved engineered design. Given the low flow volumes, low rainfall and high evaporation, any sediment runoff and scour is likely to be localised and managed through standard environmental management practices. *Potential hydrocarbon and chemical contamination* The following may potentially result in contaminants being washed into local surface water flows: • hydrocarbon or chemical spillage during transport; • use of chemicals including paints, solvents and pesticides for service maintenance; and/or • wash-off of hydrocarbons from road surfaces during rainfall events. This impact will only be significant in the unlikely event of a large accidental hydrocarbon or chemical spillage along the haul road alignment. This risk is low given the general lack of flowing water or permanent pools along the proposed haul road alignment.		

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Heritage	*To ensure that historical and cultural associations are not adversely affected.*	A report detailing Aboriginal Heritage over the Project area was prepared for the Project area. The report described previous heritage investigations of the area and gave a summary of the Aboriginal Heritage values of the proposed mine area and haul road. No places of significance have been recorded within the mine development envelope although the possibility exists that occasional archaeological finds (manuports, or manually transported objects left on the plains in the past) may be located in the development envelope. The haul road development envelope does not directly impact any areas of cultural significance. Three clay pans are located to the west and east of the haul road that are thought to be part of a religious narrative and have cultural significance. (Refer PER **Section 4.11** and Appendix I)	No sites of significance have been recorded within the mine area development envelope, although the possibility exists that occasional archaeological finds (manuports, or manually transported objects left on the plains in the past) may be located within the development envelope The existing haul road alignment does not impact the cultural heritage significance of the surrounding area and has been cleared for use.	An Aboriginal Cultural Heritage Management Plan has been prepared with the purpose being to preserve the cultural heritage of Lost Sands' Cyclone Project mining leases and the haul road from any impacts relating to construction or mining activities, and to continue to foster a working relationship between Lost Sands and the Pila Nguru community. The Plan includes but is not limited to the following management measures: • an archaeological survey will be undertaken over the mine area development envelope prior to disturbance; • should any items of significance be located during the archaeological surveys, Pila Nguru and DAA will be advised and if required the traditional owners will re-locate them prior to disturbance; • should any archaeological items be located during Project construction or operation, the traditional owners and DAA will be advised and consulted as to the appropriate way to re-locate them in accordance with the requirements of the *Aboriginal Heritage Act 1972*; • documentation of geographic and cultural associations of people born near and descended from people born near the Project will be undertaken; • documentation of significant living areas and related religious narratives and key locations adjacent to the Project will be undertaken ; and • cultural awareness training will be provided for all personnel involved in construction and operation of the Project. In addition, Lost Sands will contribute to the community and broader education for the Spinifex people, and will describe the social benefit and capacity building and how that can be continued/enhanced, including but not limited to: • traineeships and on the job training in a range of mine site skills; • financial contribution to the Pila Nguru education; and • a long term site employee target for members of the Pila Nguru community will be established; and • Traineeships for Pila Nguru will be maintained for the life of the operation.	The development impacts on Aboriginal culture and heritage arising from the Project are likely to be low, therefore the EPA's objective *to ensure that historical and cultural associations are not adversely affected* will be met.
Amenity	*To ensure that impacts to amenity are reduced as low as reasonably practicable*	*Dust* Due to the remote and vegetated nature of the site, dust levels are essentially natural background levels. Windblown dust can be an existing source of dust in the dry arid environment. (Refer PER **Section 5.6.1** and Appendix J)	The potential impacts of dust generation during the transport of ore were assessed for the Project due to the location of sensitive receptors at the Forrest Railway Siding. The Forrest Railway Siding contains six residential dwellings. An ARTC worker's rest house is located south of the railway line, opposite the proposed container storage area; this is temporary accommodation that is only used once a week. Activities at the rail siding will consist of: • anticipated truck movements (using triple road trains (18 axles)) equate to two (2) truck movements in any four hour period, or 12 truck movements in any 24 hour period, with the concentrate in enclosed containers; • stacking of up to 130 enclosed containers at the container handling area on a compacted gravel hardstand; and • loading of a train approximately every ten days, which is estimated to take up to ten hours to complete and may occur during the day or night. The dust assessment considered the sensitive receptors at the rail siding and was completed by Metreo Consulting in January, 2014. It	A Dust Management Plan has been prepared to assist in managing potential impacts from dust. Management actions include, but are not limited to: *Dust Control - Road Construction* • minimise clearing and land disturbance to the absolute minimum required to construct the haul road; • any topsoil/surface/vegetative material will be pushed back from the proposed road formation to form parallel windrows on either side of the proposed road formation no more than 2 m high; • control vehicle speeds at the construction site; • use existing roads and avoid construction of any unnecessary new tracks; • water road surfaces prior to working and ensure ongoing road watering to minimise visible dust; and • on completion of construction re-spread windrows onto road batter as quickly as possible.	The limited degree of the impacts and the proposed management actions will ensure that the EPA's objectives of reducing impacts to amenity as low as reasonably practicable will be met.

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			should be noted that there has been only minor activity at the rail siding for many years and hence there have not been any previous dust issues. The following activities will occur to facilitate the development and decommissioning of the Project, and may potentially generate dust: • road construction - for road from site to rail siding. The construction activities have potential to generate dust, although only for a singular and relatively short period of time; • road haulage - The road is located some 700 m west of the cluster of residences and at least 350 m away from the ARTC rest house. Settleable and suspended dust generated through vehicle movements down the roads is a potential impact. The most likely impact is one of visual disturbance caused by visible dust plumes along the haul road; and • container handling - container handling will be undertaken on four occasions each day and this is not expected to represent a significant source of dust since the container handler will be operating at relatively low speeds (Metreo, 2014). Due to the location of roads from the residences, settleable dust is unlikely to be a nuisance problem, whilst suspended dust will have dispersed before reaching these locations. Therefore the most likely impact is one of visual disturbance caused by visible dust plumes along the haul road, which will be controlled by management actions. The relatively slow speed attained by a mobile container handler indicates that dust generation will be minor and that when dust is generated it will not be lifted very high by the vehicle.	*Dust Control - Road Haulage* • limit haul road speed to 40 km/h for the last 2 km into Forrest; and • ensure that any grading of the road only occurs following rainfall or with sufficient watering to avoid dust lift-off. *Dust Control – Container Handling* • the compacted gravel hardstand will be sprayed with a binder as required to limit dust generation during loader operations. *Dust Monitoring* • excessive (to be defined in the EMP) visible dust will be the trigger for an initial response as outlined in the EMP; and • additional dust monitoring including settled dust and automated dust sampling may be implemented if valid complaints are received or observations indicate that it is warranted. *Public Consultation and Complaints* • information of the proposed works will be circulated to properties within Forrest; • signage will be posted around the boundary of the work site to provide contact details for queries and complaints; and • complaints will be responded to by first confirming that meteorological conditions indicate that Lost Sands' activities might have been a source of dust and then addressing the specific activity leading to the dust generation.	
		Noise Noise and vibration levels are essentially background levels due to the remoteness of the location. (Refer PER **Section 5.6.2** and Appendix K)	Noise is expected to be generated at the Project through the operation of earth moving equipment, processing, ore transport and power generation. This may potentially impact the amenity of personnel at the camp and potential sensitive receptors located in the vicinity of the rail siding and proposed loading facility. The noise assessment took into account meteorological information, topographical data, ground absorption and sound source power levels. The assessment found that due to the absence of noise sensitive premises, the mine will be compliant with the regulations. The mine camp is located at least 2 km from the mining operations and the haul road is at least 150 m from any noise sensitive receptor. Noise from the rail siding is predicted to comply with the regulations at all times at the permanent residences, however, it is predicted to exceed the regulations by 5 decibels (dB) at the ARTC Workers Rest Home. The use of this accommodation is sporadic, and the noise inside the dwelling with windows shut is not expected to be significant, but this will still require ongoing consultation and management. The assessment also found that any haul roads should be 150 m from any noise sensitive receptors to ensure compliance with the regulations, although this is only applicable to private roads.	The following key management actions have been proposed to address any potential impacts that may come about as a result of noise: • mine site - place camp at least 2 km from mining operations; • mine site - power generation plant should be placed behind an earth bund to reduce noise to the camp; • Forrest Railway Siding - use of the ARTC Workers Rest Home is once a week. Noise impacts should be managed in consultation with person staying there; and • truck noise - any haul road should be at least 150 m from any noise sensitive receptor.	The results of the noise assessment show that noise associated with the Project is predicted to comply with the assigned levels under the Regulations at all times at the mine and during road haulage operations. The location of the mine, infrastructure and roads and the results of the noise assessment as described above mean that the EPA's objectives of reducing impacts to amenity as low as reasonably practical will be met.
Rehabilitation and mine closure	*To ensure that premises are closed, decommissioned and rehabilitated in an ecologically sustainable*	Construction and implementation of the Project will require rehabilitation and mine closure planning throughout the life of the Project.	Poor rehabilitation and closure procedures, planning and management practices may result in a number of undesirable impacts to the receiving environment, such as: • loss of flora and fauna habitat; • unauthorised vegetation disturbance; • depletion of topsoil resources;	Management measures required for rehabilitation and closure of each of the domains and features are given within the Preliminary Mine Closure Plan (Appendix L). This Preliminary MCP augments this PER, and is not a standalone MCP, as some information that is normally presented within an MCP is presented within the PER, and is not repeated within the MCP.	The preliminary mine closure plan indicates that the EPA's objective for rehabilitation and closure will be met.

Preliminary Key Environmental Factor	EPA Objective(s)	Existing environment	Potential impact and Assessment of Significance	Environmental Management and Mitigation	Summary of How Proposal Meets EPA Objectives
	manner, consistent with agreed outcomes and land-uses, and without unacceptable liability to the State.		• compacted soil layers with poor infiltration rates and forming barriers to plant roots; and • The introduction of weeds to rehabilitated areas.	The proposed management measures will be further developed through preparation of a detailed Mine Closure Plan (MCP) following EPA approval, to augment a Mining Proposal for DMP approval. The MCP will be developed in accordance with the revised joint DMP and EPA *Guidelines for Preparing Mine Closure Plans (2015)*.	
Offsets	*To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.*	The GVDNR is a Class A nature with IUCN Class 1a classifcation. The reserve is of great importance for conservation of biological and landscape values and maintenance of Aboriginal culture and traditional usage. An expected 306 ha of clearing will be required within the GVDNR (0.012% of the reserve) to build the haul road. (Refer to PER **Section 5.8**)	The Project includes construction and operation of a haul road through the Class A GVDNR which will result in clearing of 306 hectares (0.012% of the GVDNR) and may result in the following potential indirect impacts: • modification of surface and groundwater flows; • introduction and spread of weeds; • generation of dust from mining activities and haul road; • use of saline water and binding agent along the haul road; • alteration of fire regime; and • increased access to the GVDNR including additional tracks being created	The mitigation hierarchy has been applied to the potential impacts to the GVDNR as follows: *Avoid* Potential impacts to the haul road during construction and operation will be avoided through: • modification of the haul road route to avoid conservation significant flora, claypans, sand dune crests and significant fauna habitats; and • maintaining clearing and land disturbance to the absolute minimum required to construct the haul road. *Minimise* Potential indirect impacts to the haul road during construction and operation as described above will be minimised through implementation of the following management plans (**Appendix C**): • Overarching Environmental Management Plan • Vegetation and Flora Management Plan • Fauna Management Plan • Haul Road Management Plan • Weed Management Plan • Dust Management Plan • Fire Minimisation Plan • Water Management Plan • Cultural Heritage Management Plan *Rehabilitate* Rehabilitation of the haul road will be undertaken through implementation of the Mine Closure Plan which aims to return the environmental values of the haul road within five years of rehabilitating the road. *Offset* Through application of the mitigation hierarchy above it is determined that the residual impact to the GVDNR is the short-term loss of 306 ha of vegetation within the GVDNR for 12 years of operation plus 5 years of rehabilitation. Lost Sands has therefore proposed an offset for this short-term loss of vegetation within GVDNR, as detailed in the offsets reporting form within Section 5.8, which has been prepared in accordance with the WA Environmental Offsets Guidelines (Government of WA, 2014). The offset plan and associated funding will be finalised within one year of commencement of operations.	The draft offsets package proposed, ongoing stakeholder consultation and commitments to finalise the offsets plan within 1 year of commencement of operations will ensure that the EPA's objective for offsets will be met.

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List of Abbreviations

AH Act	*Aboriginal Heritage Act 1972*
ARI	average recurrence interval
ARTC	Australian Rail Track Corporation Ltd
ASX	Australian Securities Exchange
BCM	Bank cubic meters
BoM	Bureau of Meteorology
DAA	Department of Aboriginal Affairs
DEC	Department of Environment and Conversation
DER	Department of Environmental Regulation
DFS	Definitive Feasibility Study
Diatreme	Diatreme Resources Limited
DMP	Department of Water
DoE	Commonwealth Department of the Environment
DoH	Department of Health
DoW	Department of Water
DPaW	Department of Parks and Wildlife
DRF	Declared Rare Flora
EMP	Environmental Management Plan
EMS	Environmental Management System
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
ESD	Environmental Scoping Document
FOI Act	*Freedom of Information Act 1992*
GVD	Great Victoria Desert
GVDNR	Great Victoria Desert Nature Reserve
HMC	Heavy Mineral Concentrate
IBRA	Interim Biogeographic Regionalisation of Australia
IVI	Importance value index
LoM	Life of mine
Lost Sands	Lost Sands Pty Ltd
MB	Monitoring bores
MCP	Mine Closure Plan
MRWA	Main Roads Western Australia
NMD	Neutral mine drainage
NSW	New South Wales
OEPA	Office of Environmental Protection Agency
PEC	Priority Ecological Community
PER	Public Environmental Review
PFS	Pre-Feasibility Study
SA	South Australian
SG	Specifc gravity
Spinifex People	Pila Nguru
SRE	Short-Range Endemics
Study Area	proposed mine development and haul road development envelopes
TDS	total dissolved solids
TN	total nitrogen
TEC	Threatened Species or Communities

the Flora Assessment	Level 2 Vegetation and Flora Survey and Impact Assessment
The Project area	
TSF	tailings storage facility
UCL	Unallocated Crown Land
WA	Western Australia
WC Act	*Wildlife Conservation Act 1950*
WCP	wet concentrator plant
WSF	water storage facility

List of Units

AHD	Australian Height Datum
dB	decibels
GL	gigalitres
ha	hectares
km	kilometres
L/s	litres per second
m	metres
m^3	cubic metres
M	million
Mbgl	Metres Below Ground Level
mRL	Metres relative to Australian Height Datum
mm	millimetres
t	tonnes
tpa	tonnes per annum
tph	t per hour
uS/cm	microsiemens per centimetre

1 Introduction

1.1 Proponent Details

The Cyclone Mineral Sands Project (the Project) will be developed by Lost Sands Pty Ltd (Lost Sands, or the Proponent). Lost Sands is a wholly owned subsidiary of Diatreme Resources Limited (Diatreme). Diatreme is an Australian company with headquarters in Brisbane; it is listed on the Australian Securities Exchange (ASX).

The Proponent can be contacted at:
Lost Sands Pty Ltd
Level 2
87 Wickham Terrace
Spring Hill QLD 4000

The key contact for the Project is:
Mr Phil McMurtrie
Consultant Project Manager
Ph: (07) 3832 5666
Mobile: 0417 715 228
Email: phil.mcmurtrie@bigpond.com

1.2 Project Location

The Project is located in Western Australia (WA) on the northern margin of the Eucla Basin. It is 25 kilometres (km) west of the WA/South Australian (SA) border, 170 km east-northeast of the Aboriginal settlement of Tjuntjuntjarra, around 317 km north of Eucla and 220 km north of the Trans-Australia Railway (**Figure 1-1**). The proposed transport corridor traverses the Great Victoria Desert Nature Reserve (GVDNR). The mining area and northern section of the transport corridor lie within the Pila Nguru Lands Determination Area (WC95/51). The Pila Nguru (Spinifex People) represented by the Paupiyala Tjarutja Aboriginal Corporation are the traditional custodians.

The Project area (3,588 ha) comprises the mine area development envelope (1,028 ha) and the haul road development envelope (2,560 ha).

1.3 Project Overview

Lost Sands is planning to develop the deposit into a ten year mining operation to produce zircon and two high titanium mineral products. The Project includes mine pits, processing infrastructure, tailings storage facilities (TSFs), an accommodation camp, airstrip, water supply infrastructure, WSF access roads and a transport road (**Figure 1-2**). It is proposed that the ore concentrate will be trucked south on a constructed haul road (**Figure 1-3**) to the Forrest rail siding on the Trans-Australian Railway (**Figure 1-4**).

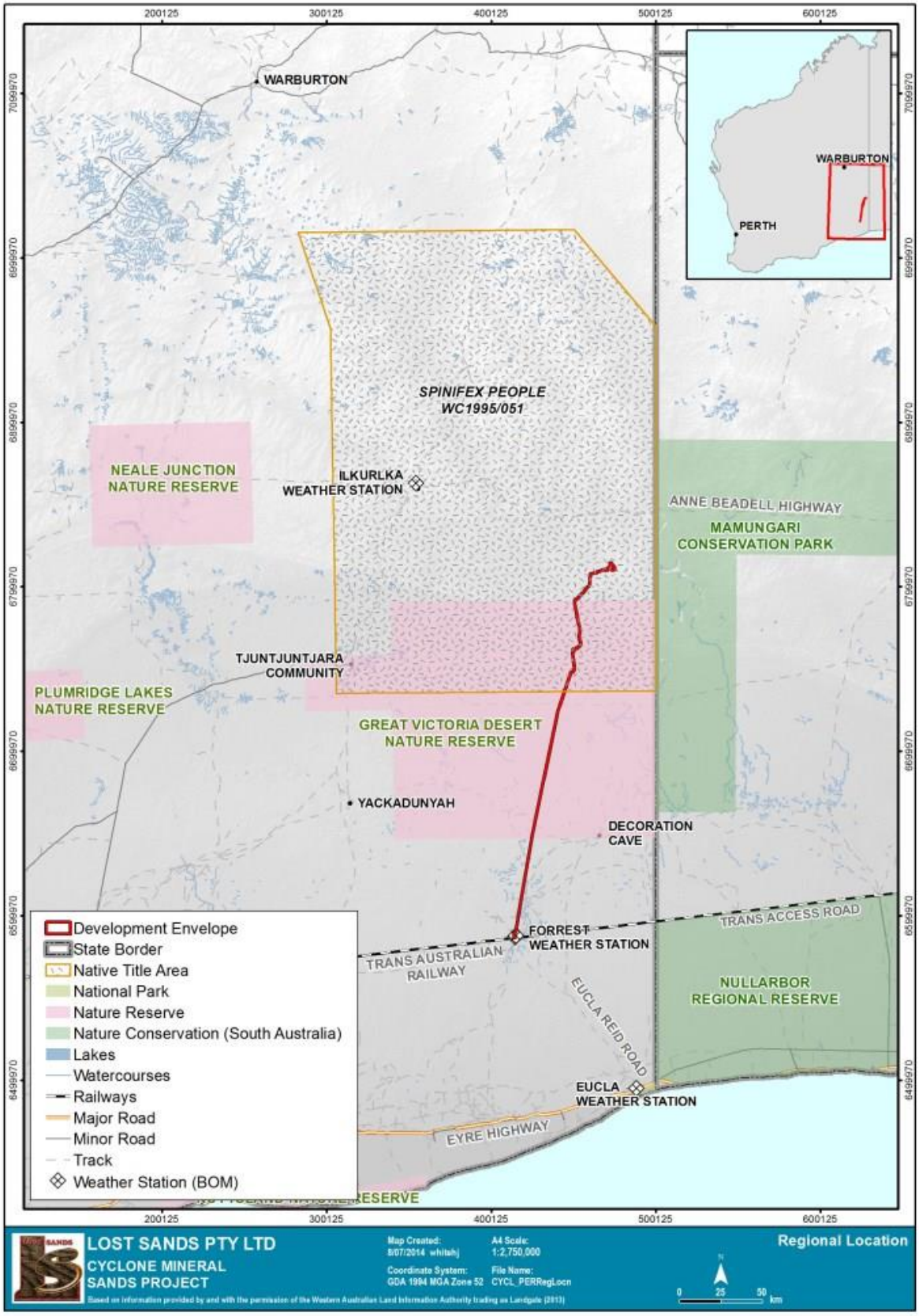

Figure 1-1: Cyclone Mineral Sands Project Location

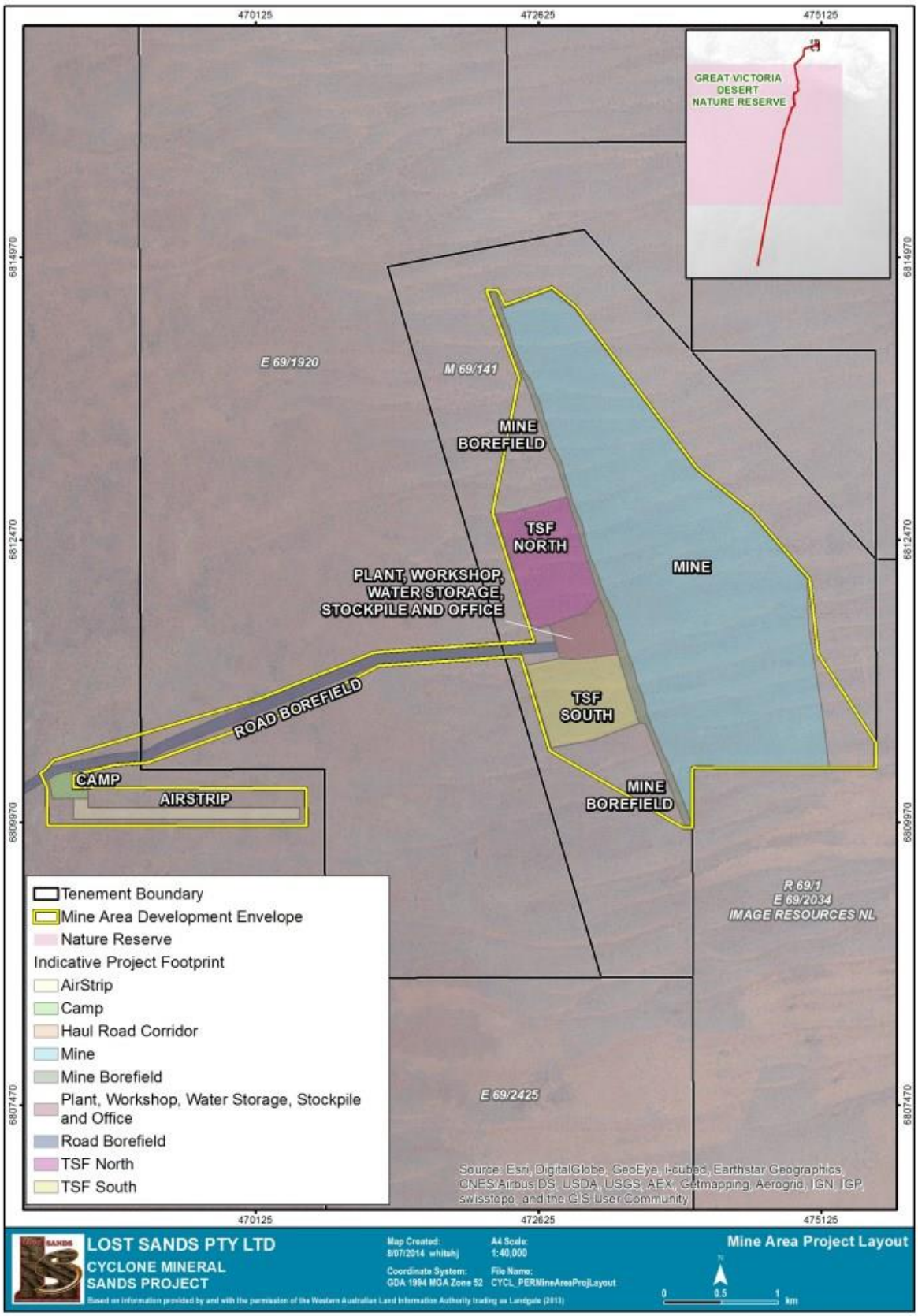

Figure 1-2: Cyclone Mineral Sands Project Layout

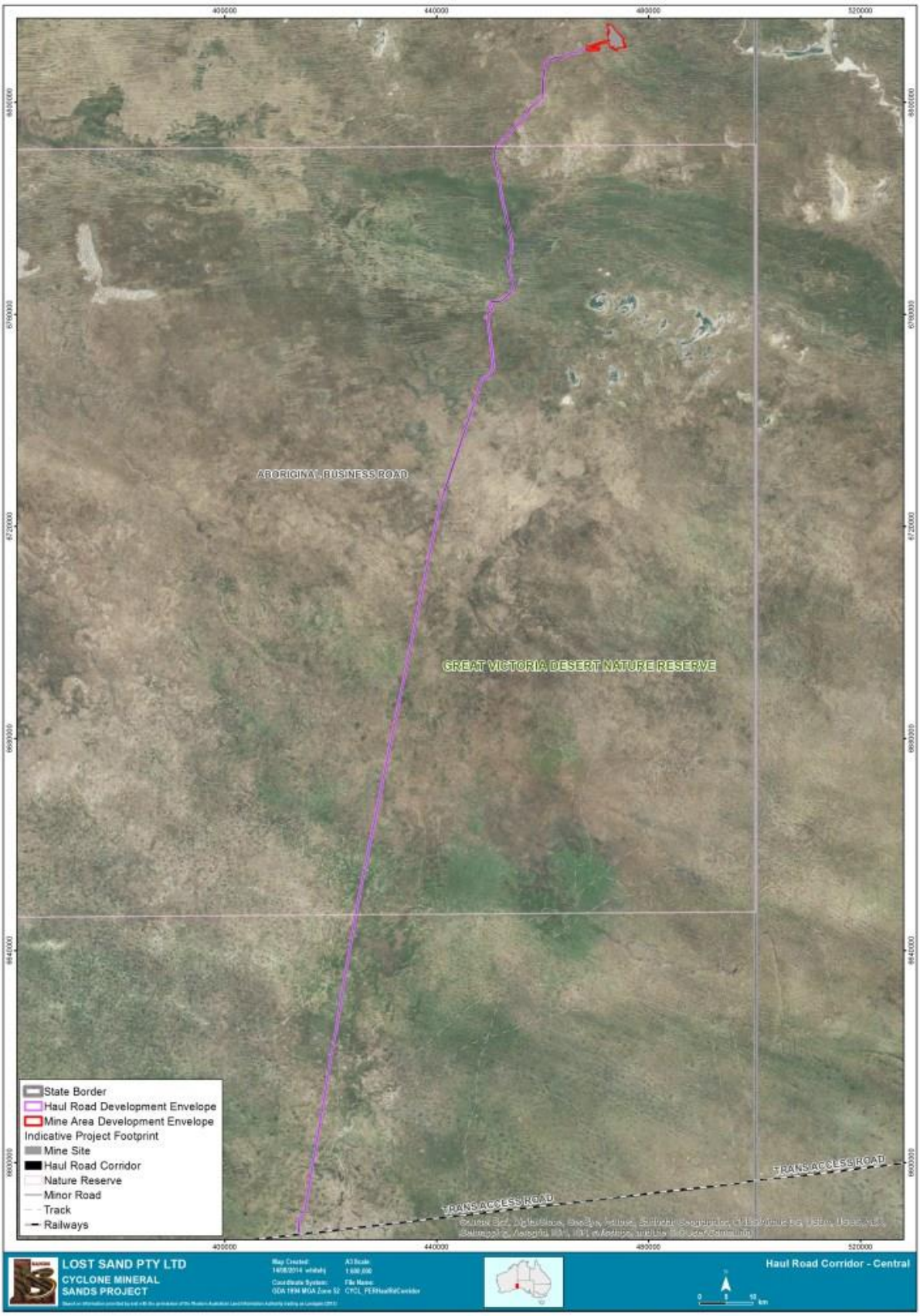

Figure 1-3: Cyclone Mineral Sands Project Haul Road Route

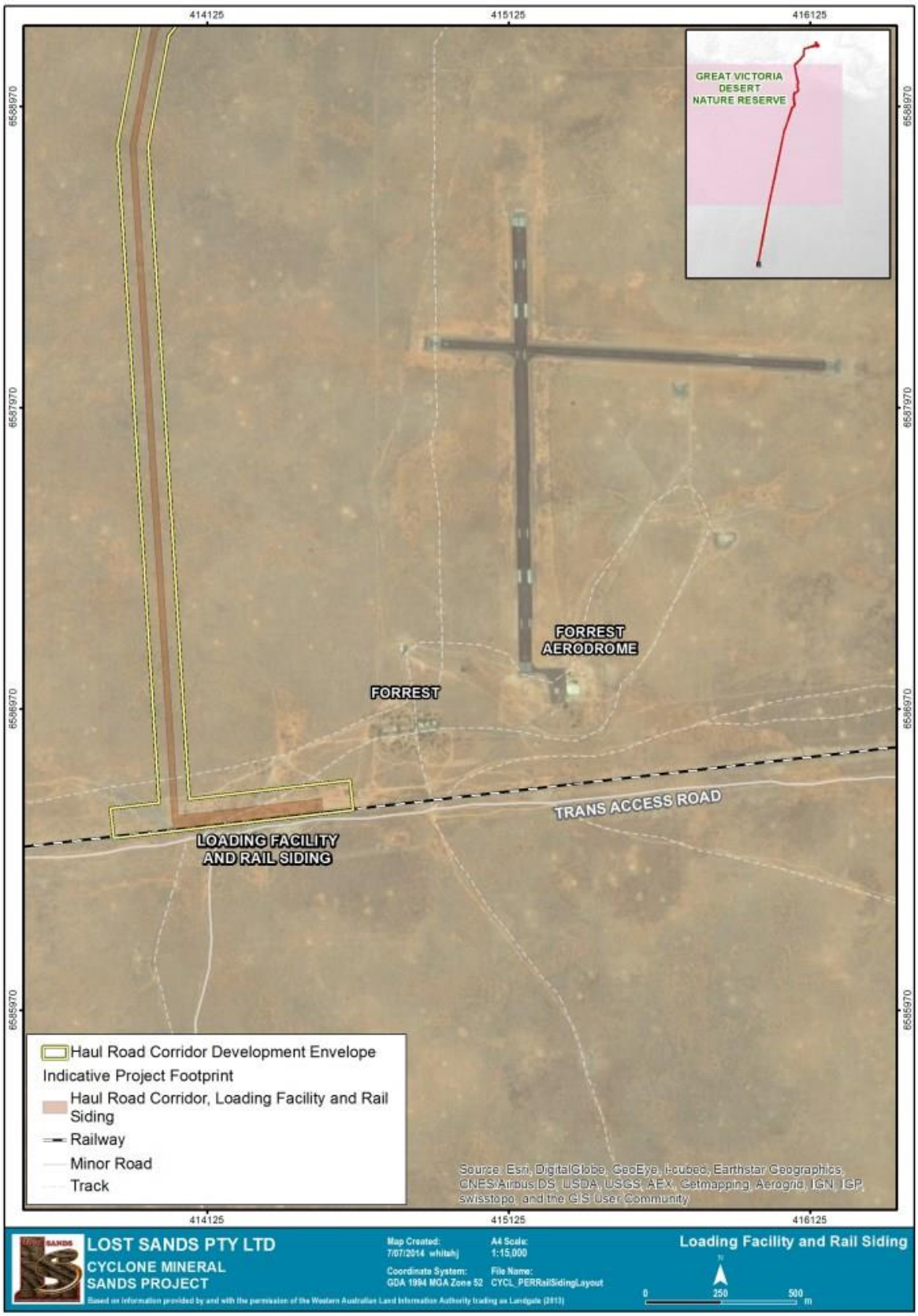

Figure 1-4: Cyclone Mineral Sands Project Rail Siding Layout

The mine pit, processing infrastructure, TSFs and some production bores will be located within Tenement M69/141. Supporting infrastructure such as the accommodation camp, airstrip, access roads, remaining bores and pipeline infrastructure will be located within Miscellaneous Licences that will be applied for in parallel with this Public Environmental Review (PER) process.

1.4 Project Justification

Lost Sands is a mineral exploration company, which has extensive tenure throughout Australia, including the Eucla Basin; with the development of this Project it will transition into production/mining. Lost Sands discovered the Cyclone deposit in July 2007 and through drilling and analysis defined a Mineral Resource and Ore Reserve which was used as part of the Pre-Feasibility Study (PFS), completed in March 2012. The objective of the Project is to establish a mineral sand mine with supporting infrastructure and services for production and export of a heavy mineral concentrate (HMC), containing zircon and titanium minerals. This is driven by worldwide need for ceramics, paint and other commonly used materials which contain zircon and titanium.

Exporting a mineral sands concentrate has been assessed as the best method for achieving the Project objectives at this time. Changes in future conditions including a sudden unexpected increase in the world's need for zircon and titanium could result in a review of this strategy, including the consideration of production of final products within Australia as the best means to achieve the Project objectives.

1.5 Alternatives Considered

1.5.1 Infrastructure

The location of all infrastructure components have been, and will continue to be, subject to review such that the environment, safety and health, the landholders, other stakeholders, and the efficiency of the operation are all given the highest consideration. Areas for services and infrastructure outside the mine pit will be kept to a minimum and will be located either close to the mine or close to the haul road.

Mine water usage will be minimised by recycling within the wet concentrator plant (WCP), and by recovering water from the TSF, primarily by direct pumping from a sump within the TSF walls, with a secondary option to establish shallow spears / spearfields and recover water by vacuum pumping. Shallow bores for recovery of water from the tailings will also be investigated.

A dust suppressant and binding agent will be used on the road surfaces to reduce water usage. Triple road trains will be used for road transport for efficiency and minimising the truck cycle frequency.

Minor future changes are possible with respect to all the infrastructure components; any proposed change will be within the planned envelope for development. Some issues that have arisen and resulted in changes include:

- TSFs: several changes to balance the requirements of being close to the initial mine pit for efficiency, smallest practical size, proximity to the WCP, and in a lower topographic area;
- WCP: close to the centre of mass of the mine, close to the TSFs, close to power supply;
- Offices, workshops and amenities: close to the WCP, low noise, low dust (if required dust suppression spays may be installed to reduce dust from the TSFs during operations);
- Power supply: close to mine and WCP, there will be further evaluation of a single power station and transmission lines as opposed to separate smaller power stations and major power demand components. The evaluation of solar and wind systems could not provide a suitable reliable supply to meet the Project objectives;
- Water Supply: borefield and pipeline layout initially based on broad assumptions for the deep aquifer properties. More detailed information is being progressively obtained resulting in potential changes to the layout within the development envelope;
- Accommodation camp: close to airstrip, low noise, low dust, not too far from mine for connection of services, visual amenity; and
- Airstrip: level ground, close to camp, not too far from mine, approach/departure terrain, prevailing wind direction and strength.

1.5.2 Haul Road

The Pre-Feasibility Study (PFS) for the Project considered eight transport corridor options, and of these, three were subsequently selected for further assessment. The options were:

- a 240 km route through the GVDNR to Forrest (central option);
- a 230 km route on the eastern boundary of the GVDNR and the western boundary of the Mamungari Conservation Park (World Biosphere Reserve) to Deakin (eastern option); and
- a 430 km route around the western side of the GVDNR to Loongana (western option) (**Figure 1-5**).

A transport corridor options assessment was undertaken by Sustainability (**Appendix A**); in order to determine which of the three possible transport corridors was the most favourable considering environmental, social and cultural factors. All three haul road options were found to have similar vegetation types. The primary consideration for potential impacts to vegetation, flora and fauna was the overall disturbance footprint, of which the central option had the smallest. Extensive consultation and collaboration was undertaken with the Pila Nguru people and through this process it was identified that the Western option should be ruled out due to the unacceptable impacts to Aboriginal heritage.

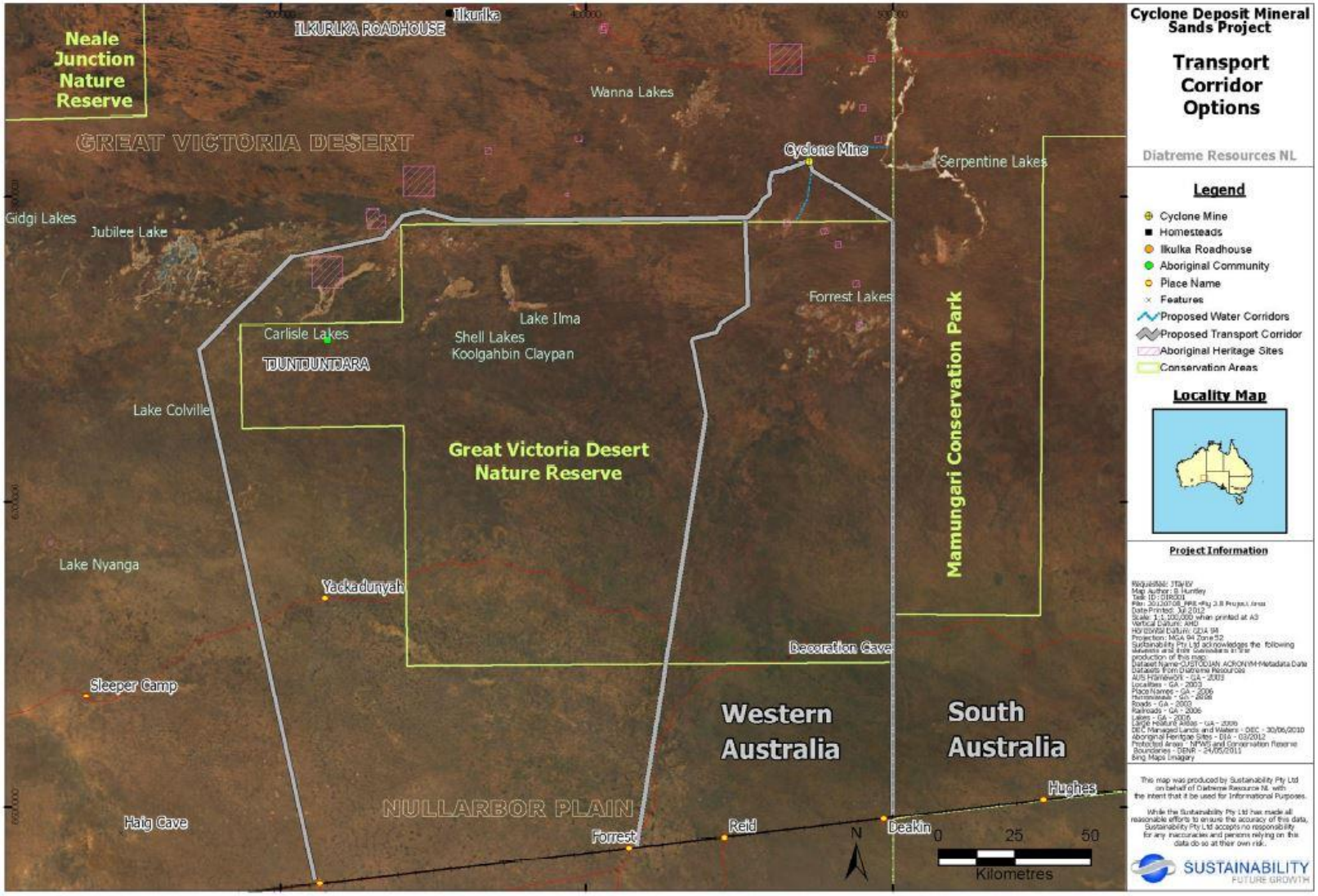

Figure 1-5: Project Location and Transport Options in Relation to Population Centres, Lake Systems and Conservation Parks (Sustainability, 2012)

If administrative boundaries are not taken into account, both the central haul road option and eastern haul road option would result in fragmentation of an extensive continuous conservation reserve. The eastern haul road option will partially impact both the GVDNR and the Mamungari Conservation Park, as well as pass through the Forrest Lakes system and a large area of sand dune habitat, suggesting there will not be any conservation benefit of using this option and potentially an impact to a greater diversity of habitats.

For these reasons and the overall disturbance footprint, which uses 30 km of existing road, it was determined that the central option (see Figure **1**-**5**) would have the least potential impact to vegetation, flora, fauna and cultural heritage values of the region. Based on this conclusion, all further environmental investigations were then focused on the central option.

1.6 Purpose and Scope of the PER

This Project was referred to the Environmental Protection Authority (EPA) by the Proponent on the 22nd February 2013. The level of assessment was set as Public Environmental Review (PER) with a five week public review period on 25 March 2013. The Environmental Scoping Document (ESD) was prepared by the EPA and released as a final on 19 August 2013 (**Appendix B**), and outlines the preliminary key factors and work requirements for inclusion in the PER.

This PER has been prepared in order to fulfil the requirements for assessment of the Project pursuant to Part IV of the Western Australian *Environmental Protection Act 1986* (EP Act). The PER has been prepared in accordance with the EP Act *Environmental Impact Assessment – Administrative Procedures 2012*, the ESD and the Checklist for documents submitted for EIA on marine and terrestrial biodiversity (**Appendix B**).

2 Project Description

2.1 Key Characteristics

The key characteristics of the Project are given in **Table 2-1**.

Table 2-1: Key Characteristics of the Project

Summary of the Proposal		
Proposal title	Cyclone Mineral Sands Project	
Proponent name	Lost Sands Pty Ltd	
Short description	The proposal is to develop a minerals sands mine approximately 317 km north of Eucla and includes: open cut mine pits; processing infrastructure including TSFs; processing facilities; backfill of mined pits; water storage facility; an approximately 240 km long haul road through GVDNR, from the mine to Forrest railway station and siding; supporting infrastructure including access and haul roads, an accommodation camp, power station and airstrip; and groundwater abstraction from a borefield with supporting infrastructure.	
Element	**Location**	**Proposed Extent Authorised**
Physical Elements		
Open cut mine pits	**Figure 1-2**	Clearing of up to 558 hectares (ha) of native vegetation within a 1,028 ha development envelope
Mining and processing infrastructure, TSF, internal roads, office and workshop	**Figure 1-2**	Clearing of up to 146 ha of native vegetation within a 1,028 ha development envelope
Airstrip and Camp	**Figure 1-2**	Clearing of up to 27 ha within a 1,028 ha development envelope
Water borefield and supporting infrastructure	**Figure 1-2**	Clearing of up to 70 ha within a 1,028 ha development envelope
Haul Road and loading facility	**Figure 1-4**	Clearing of 161 ha outside of the GVDNR, within a 2,561 ha development envelope. Clearing of up to 306 ha inside the GVDNR, within a 2,561 ha development envelope.
Operational Elements		
Water abstraction	**Figure 1-2**	4 litres per second (L/s) or 0.1 gigalitre (GL) total for the construction phase 250 L/s or 7.9 GL per year total for the mining operation
Power	**Figure 1-2**	8 Megawatts to be supplied by a small remote power station for the mining operation, mineral processing, accommodation camp and services. Dedicated generators may be used to supply electricity for the operation of bore pumps and transfer pumps.
Backfill	Mine pits	Tailings and overburden will be used to backfill previously mined-out pit areas

2.2 Mining

The area planned to be mined is vegetated with spinifex, shrubs, and scattered Acacia and Eucalypt trees. The larger vegetation will be cleared using a bulldozer and stockpiled outside the mining area for future rehabilitation use. Initial Project clearing will be approximately 150 hectares (ha), with an average of 50 ha per year cleared for ongoing operations including mining activities and support facilities.

Smaller vegetation that remains after initial clearing will be removed along with the topsoil. Topsoil will be collected and transported from the newly cleared mining areas to mining areas ready for rehabilitation, except for the initial pit clearing and at times when suitable rehabilitation areas are not available where topsoil will be stored for future rehabilitation purposes. Topsoil for the borefield and TSFs will be stockpiled for longer periods. Topsoil from the haul road will be stored within the road reserve. The average annual topsoil removal rate within the mining area is 50,000 cubic metres (m^3) per year.

The top of the mineralisation is on average 15 metres (m) below the surface; the mineralised zone extends to approximately 60 m; it will be mined to a maximum depth of 50 m. The overburden is weakly mineralised and includes a laterally extensive zone of induration relating to a lateritic weathering profile. The overburden must be removed to expose the high grade ore zone for mining. Overburden which is removed for development of the initial pit will be used in the construction of the TSF embankment walls. As the capacity within the TSFs is approaching completion, the volume of subsoil required to cover the TSFs will be stockpiled in readiness for progressive rehabilitation of these features. Subsequent subsoil and overburden will be used as backfill within the previously mined out areas. The average annual overburden removal rate is 6.6 million (M) m^3 per year.

All mining will occur above the water table. A bulldozer and dozer trap method will be used to mine the ore at a rate of 10 M tonnes (t) per annum (tpa). There will be two separate 650 t per hour (tph) traps at different sections of the pit face to ensure blending of higher and lower grade ore to produce a controlled feed grade to the WCP. Bulldozers will push ore for a distance up to 100 m into the traps, which will convey the ore at a consistent feed rate to a trommel and slurry bin. The trommel will screen out coarse particles (larger than 3 millimetres (mm)) as a coarse reject; water will be mixed with the finer ore particles to form an ore slurry (**Figure 2-1**).

Slurry pumps will push the ore from the slurry bin to a surge bin at the WCP. Oversize material rejected by the trommel will be stockpiled on the pit floor and relocated as necessary using a bulldozer or front end loader.

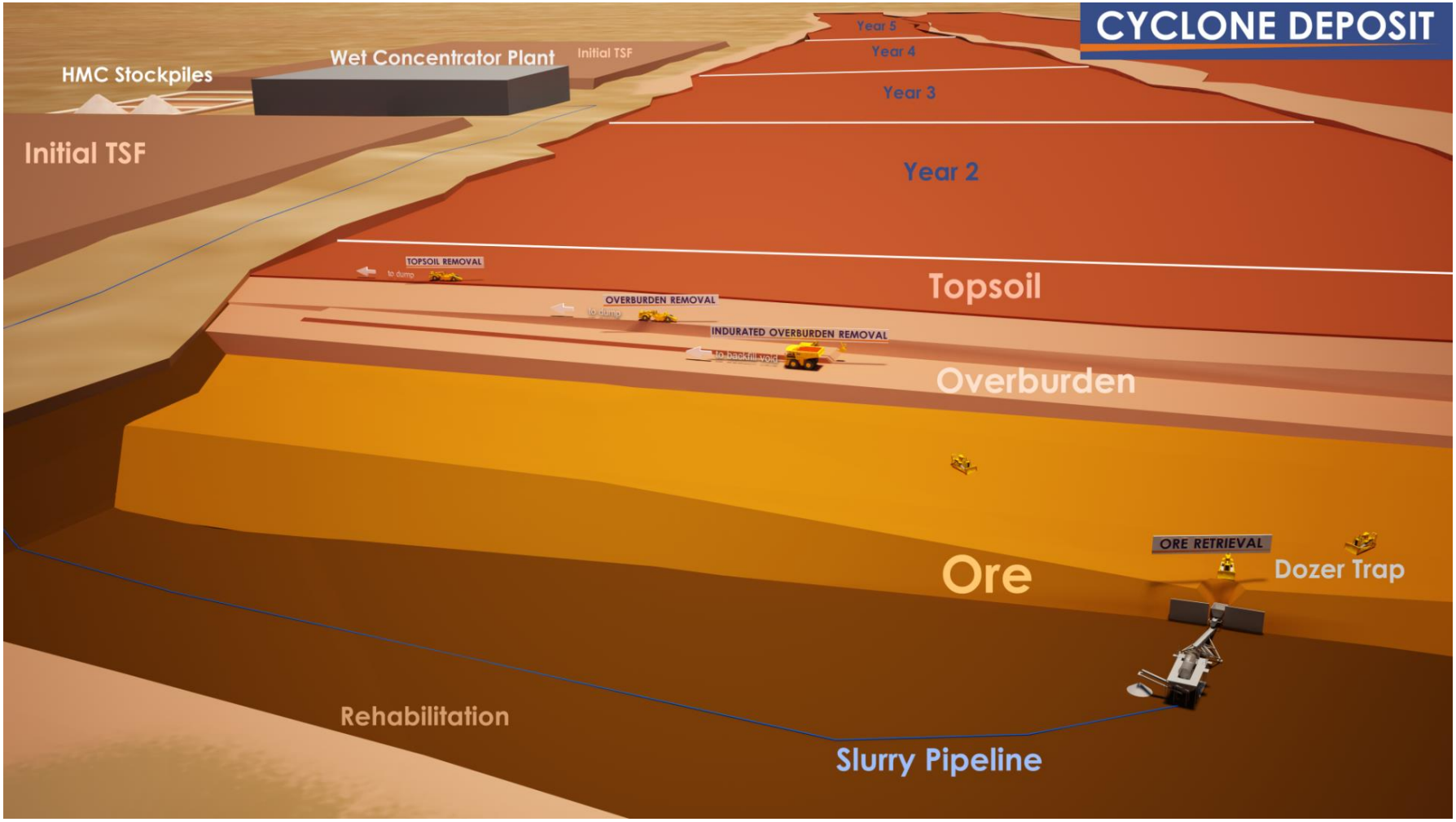

Figure 2-1: Cyclone Project Mining Method

2.3 Processing

The WCP will be located on the western side of the mine and 1 km north of the initial mining area. This WCP location will be fixed for the life of the mine and has been selected to ensure the pumping distances for both ore feed and tailings are not excessive. The TSFs will be located north and south of the WCP to ensure short tailings pumping distances during the first two years of the mine.

Slurried ore will be received by the WCP surge bin; the surge bin will absorb variations in feed rate from the dozer traps to produce a controlled feed rate to the concentrating equipment. The WCP slurry process will include screening and several stages of gravity concentration using spirals, a classifier, and shaking tables to concentrate the valuable heavy minerals. Flocculant will be used in the slimes thickening section of the process, as required for efficiency in tailings and water management.

Performance simulation of the WCP has been conducted using data generated from bulk sample processing. The simulation indicates that a HMC would be produced at a rate of 25 tph from a mining rate of 1,300 tph. The majority of silica minerals, trash minerals and low specific gravity (SG) titanium minerals will be rejected to tailings from the WCP. A high grade mineral concentrate product will be produced containing the zircon and valuable titanium minerals. Metallurgical test work has demonstrated good recovery of zircon and valuable titanium minerals in conventional spiral separators.

2.4 Tailings Management

A process flow chart for tailings management is given in **Figure 2-2**. The ore contains a relatively low proportion of slimes (approximately 4%), which enables the use of normal mineral sands tailings management procedures. During the first year all of the tailings generated will be pumped as a high density slurry into the TSFs. Subsequent to the TSFs being filled to capacity the mine voids will be used for storage of tailings. The schedule of tailings deposition is shown in **Figure 2-3**. The tailings component of backfill in the mine void will comprise:

- oversize from mining unit accounts for 7% of process flow;
- Coarse Tails;
  - Rougher Tails account for 66% of process flow;
  - Scavenger Tails account for 24% of process flow;
  - Screen Tails account for 1% of process flow;
- Fine Tails from HMC circuit account for <1% of process flow; and
- Fines from Thickener accounts for 3% of process flow.

The chemical composition of the rougher and mid-scavenger tails is given in **Table 2-2**.

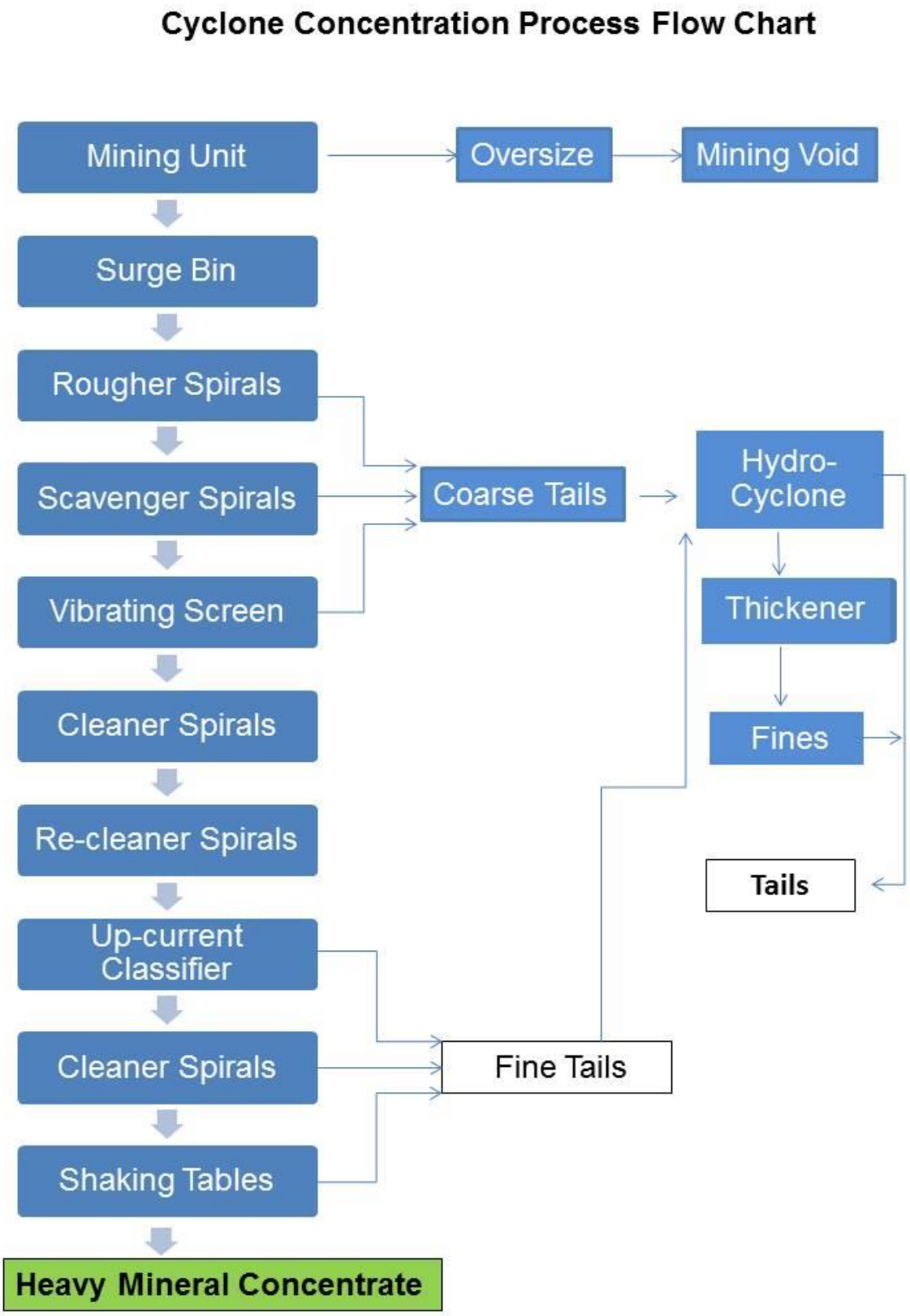

Figure 2-2: Simplified Process Flow Diagram

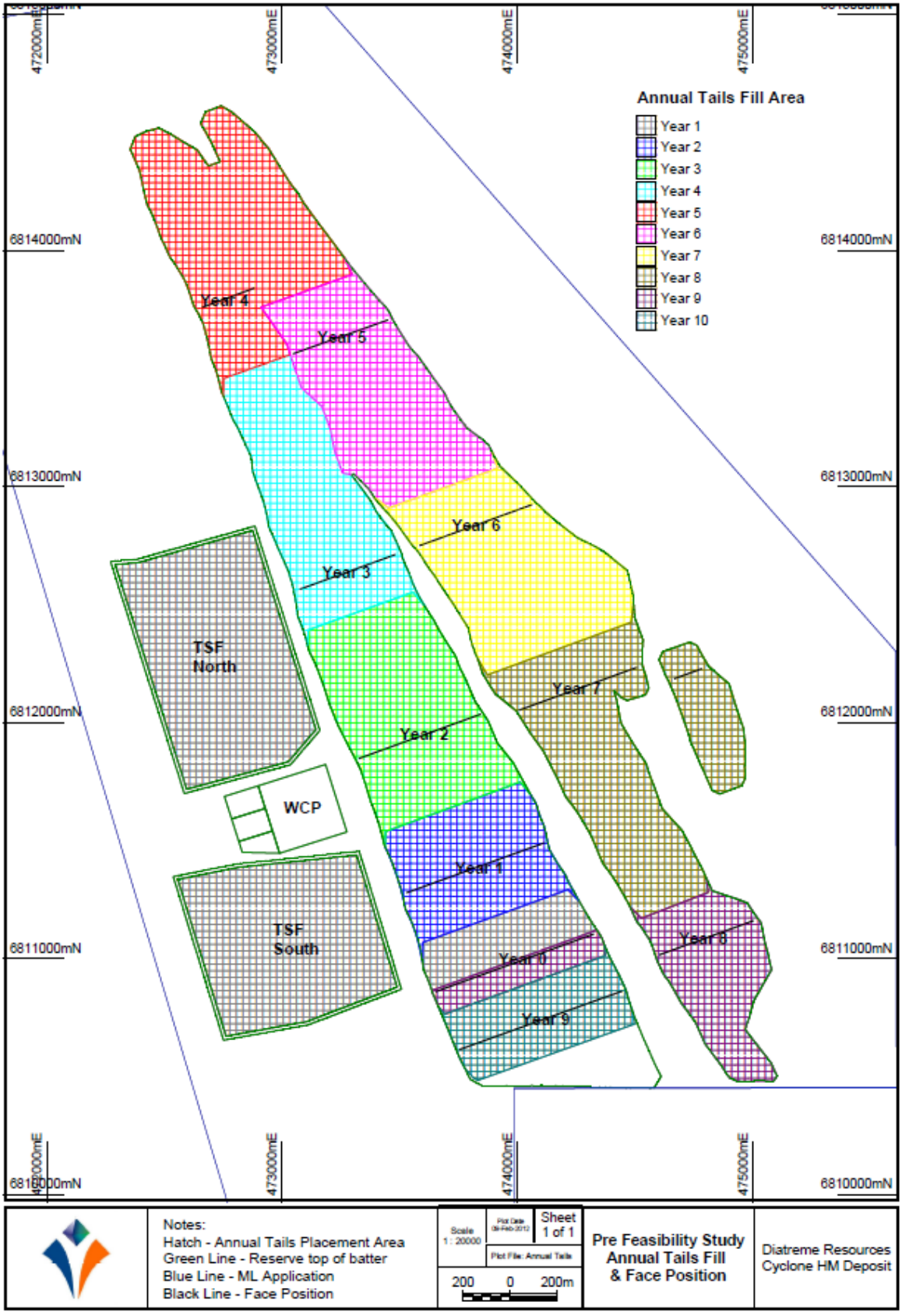

Figure 2-3: Tailings Deposition Schedule

Table 2-2: Tailing Test work Assay Rougher Tails and Mid Scavenger Tails (Mineral Technologies 2013)

Rougher and Mid Scavenger Tests																		
Stream	TiO_2	Fe_2O_3	SiO_2	Al_2O_3	Cr_2O_3	MgO	MnO	ZrO_2	P_2O_5	U	Th	V_2O_5	Nb_2O_5	SO_3	CaO	K_2O	CeO_2	LOI_{1000}
	%	%	%	%	%	%	%	%	%	ppm	ppm	%	%	%	%	%	%	%
T100 Tail (Rougher)	0.73	0.54	96.3	1.48	0.001	0.07	<0.01	0.1	0.003	27	11	<0.01	0.005	0.02	0.1	0.06	0.002	0.77
T200 Tail (Mid Scavenger)	1.23	0.62	95.5	1.31	0.002	0.05	<0.01	0.1	0.006	<10	11	<0.01	0.003	0.02	0.07	0.005	0.002	0.68

A thickener is included in the process for efficiency in water conservation and tailings management, as it will guarantee that the high density slurry tailings are suitable for co-disposal of sand and slimes. All of the slimes streams produced during the WCP process are directed to the thickener, which receives a large flow of water containing slimes removed from the ore. The thickener produces a large flow of clean water suitable for reuse in the process and a low flow of high density slimes tailings that will be mixed with the high density sand tailing for co-disposal.

The TSFs will contain the high density slurry tailings. Water collected from the tailings impoundments will be used as part of the make-up water supply for the operation and will reduce demand for make-up water from the borefield. The recycled water will have a low slimes content and will be used as part of the water supply required to pump ore from the pit to the WCP.

Two TSF areas were designed, immediately north and south of the WCP site to minimise the pumping requirements. Both TSFs utilise dune ridges to form their north and south end walls, with overburden from the open pit likely to form the other walls. The final shape of the TSFs will be a 15 degree side batter angle with a planar upper surface that parallels the general east–west slope of the TSF floor (i.e. natural ground surface). The average fill depth is around 10 m, but reaches 13 m in the deepest part of the interdunal swale. TSF North comprises 5,413,000 m^3 and is scheduled to be 80% filled in Year 1, while TSF South comprises 6,391,000 m^3 and is scheduled to be 75% filled in Year 1. The use of both TSFs in Year 1, together with limited in-pit overburden fill will allow practical options for efficient tailings operation in the first year, and from that point forward there is sufficient capacity remaining in the TSF and space in the mining void to accommodate all overburden and tailings fill (see **Figure 2-3**).

2.5 Transport and Loading Facilities

The mine and WCP will be located 220 km north of the Trans Australia Rail Line. The rail line is an important transport infrastructure component that links the mine to a port in WA or SA. A gravel access and haul road will be constructed from the mine to an existing siding on the rail line. The preferred option is the route through the GVDNR to the Forrest siding.

A conceptual design for the haul road has been developed (**Figure 2-4**). The road design will be based on triple road trains carrying 110 t per truck with a maximum speed limit of 80 km/h. The annual mineral concentrate transport averages 150,000 t which requires four road train trips per day for 340 days of the year. The majority of the transport will occur during daylight hours but some night transport will be required.

The average width of clearing and disturbance for the road is 20 m. The normal width for 97.5% of the road length is 19.5 m allowing for a 6 m wide trafficable surface and clearing both sides for borrow material, drainage, topsoil stockpiles and vegetation windrows. The other 2.5% of the road

length which is a maximum length of 50 m every 2 km involves doubling the clearing width to 40 m for construction of safe passing, overtaking and turning bays which would be used by the triple road trains and any other traffic. A triple road train water truck will regularly use the widenings for turning. There will normally be two mineral road trains on the road and they will know each other's location for coordination of safe passing at the widenings. The widenings are planned to be located at approximate two kilometre intervals and effectively result in an increase to the typical road width from 19.5 m to an overall average road width of 20 metres. Using the 6 m traffic width and specific widenings for passing provides a more efficient road design than widening the entire road to allow safe passing at random locations. This is possible due to the low traffic loading on the road. The entire road corridor would have to be approximately 3 metres wider to allow random passing. The time lost for a truck stopping at a passing bay is estimated to be less than five minutes and is acceptable given that it will provide a safe method for passing.

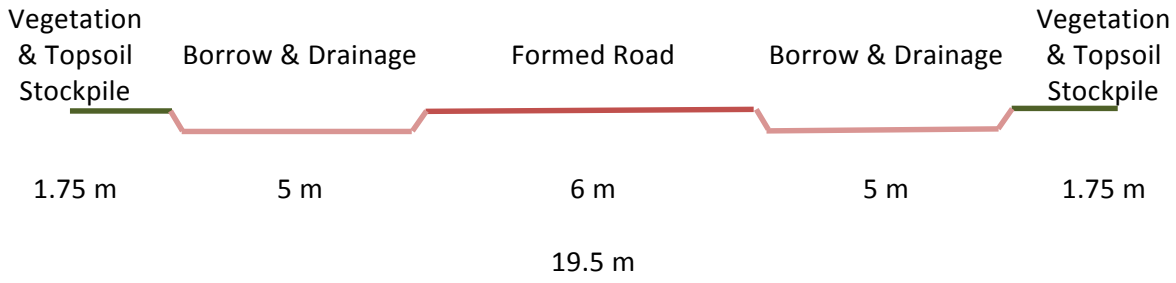

Figure 2-4: Conceptual Road Profile Design

When constructing the road, cleared vegetation will be stacked in discontinuous windrows at the edge of the road clearing. The road construction method is to use borrow material from each side of the road to raise the road profile by approximately 0.5 m and create drainage channels beside the road. Drainage pipes will be laid under the road and the drainage channels will be open to natural drainage systems to prevent water accumulating in these channels. Borrow material will be blended as necessary to provide a suitable road base material and road binding and dust suppressant materials will be incorporated into the running surface during compaction. A major component of road maintenance will be ongoing applications of dust suppressant to the running surface by the water truck. The overburden at the mine contains areas of calcrete which is a good road base material and will be used as necessary to maintain the road. In excess of 10 million tonnes of overburden will be handled at the mine area and it is estimated that in the order of a few hundred tonnes of this may be used per year for road maintenance.

Samples of the full range of potential road construction materials have been tested by a roads engineering company that specialises in road construction using binders and dust suppressants for road construction where good quality road base material is not locally available. The road binder

that is ultimately used will be selected on its ability to minimise impacts to surrounding vegetation and surface water, whilst providing effective consolidation of the road material.

The WCP will produce a wet mineral concentrate in stockpiles which will drain and evaporate to between 3% and 5% moisture on site before being top loaded into half height containers. The containers will hold 33 t each and will be sealed with lids before being loaded onto triple road trains for transport to Forrest. Two trucks will each make two round trips per day and each round trip will take about eight hours. Routine road maintenance including regular grading and addition of binders and dust suppressants is planned.

The haul road will remain a private road, however will be available for use by DPaW and the Pila Nguru. Signage that indicates that the road is unauthorised for public use will be installed. A system will be implemented for monitoring and controlling unauthorised usage of the road and truck drivers will be responsible for reporting sightings of any vehicles that are not regular authorised users.

Forrest is a suitable siding for the Project as there is some existing infrastructure and an existing redundant rail siding loop that could be refurbished for train loading and unloading. The siding is on the northern side of the main line and the trucks will not cross the rail line. The containers will be unloaded from the trucks and stacked at the siding using a rubber tyred mobile container handler. Empty containers returning from the port, fuel and general supplies will be back loaded to the Project area.

2.6 Other Infrastructure

The Project will require an onsite power station to meet the power demands of the mine, WCP, workshops, offices, amenities, the accommodation village and landfill and bioremediation facility. There is no grid based power supply near the Project. The average power demand that will be supplied by the power station for normal operations is approximately five megawatts.

An efficient fuel delivery system is envisaged using a combination of rail and road transport to deliver diesel fuel from the port to the Project area each week. Trucks will be back loaded using the road and rail concentrate transport system from the port to the Project.

The number of employees required to manage and operate the mine and site facilities is approximately 60. Operations employees will normally work a 12 hour continuous shift roster and management and administration staff will work a day only roster. Rosters may include up to 14 continuous days followed by extended breaks to reduce the time involved traveling to and from the site.

In addition to the 60 employees, contractors will be required for general earthworks, mobile mining equipment, HMC transport, camp operation and maintenance. It is expected that up to 40 contractors will be accommodated at the mine site at any time. A village capable of accommodating 100 people will be established close to the mine. Recreation facilities will be provided in keeping with normal standards for fly-in fly-out operations. The village will be used for the construction period when construction personnel numbers are expected to reach close to 100.

A suitable landfill and bioremediation facility will be constructed as part of the waste and contaminated soils management for the site.

An all-weather airstrip will be constructed close to the village with a small terminal building for the management of arriving and departing personnel. The dimensions of the airstrip will be approximately 30 m wide and 1.5 km long to be suitable for 18 seat aircraft. There will be at least two regular flights per week to cater for the work rosters.

2.7 Water Supply

Water supply for the Project will be sourced from a deep aquifer in the Officer Basin sediments which underlay the mine area. Shallow paleochannel water sources were test drilled and found to be of high salinity, poor reliability and low flow rate per bore. Water investigation drilling in the paleochannels was based on an initial hydrogeological study but the results were poor.

Lost Sands constructed a deep bore on the western side of the proposed mine area and intersected a high yielding aquifer at 530 m depth. The total depth of the bore is 800 m and an airlift test estimated a potential flow rate of 40 litres per second (L/s). Pump testing will be conducted to determine the safe long term yield of the bore and obtain other data for design of a borefield.

A reliable groundwater supply of 8 gigalitres (GL) per year will be required for the mine, supporting infrastructure and village. Up to 16 bores capable of pumping 20 L/s each will be required for a reliable supply including a contingency allowance for bore and pump maintenance. These bores are proposed to be located within mine development enveloped and are shown in **Figure 2-5**. The water supply system will include bores, bore pumps, pipeline, transfer pumps, WSF, tanks and a treatment plant for the potable water supply. A water balance for the Project during the construction and operational phases is depicted in **Figure 2-6** and **Figure 2-7** respectively.

Saline wastewater from the potable water supply treatment plant will be disposed via a pipeline running from the accommodation village to the mine into the WSF, where it will be diluted and re-used with the processing plant (**Figure 2-8**).

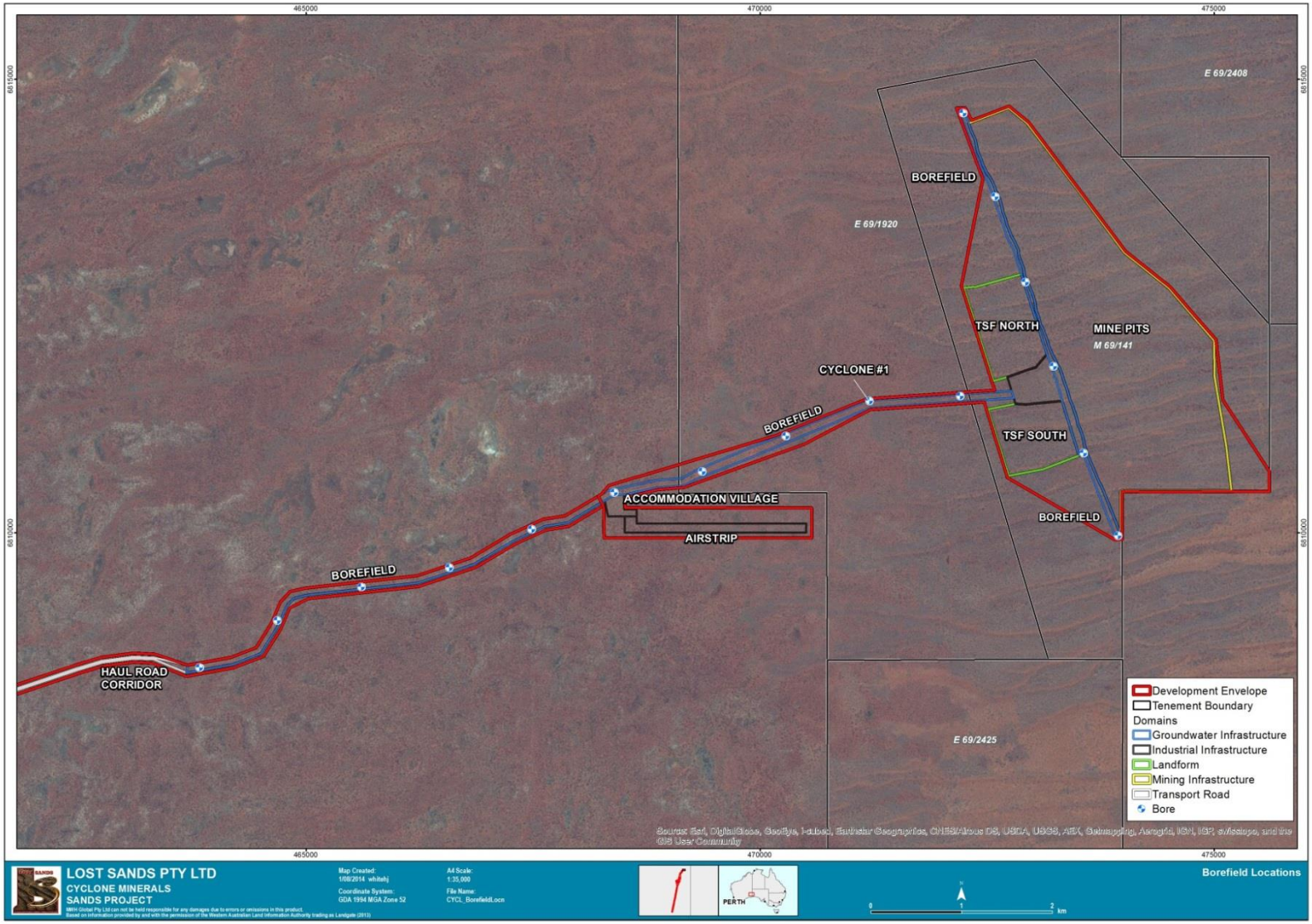

Figure 2-5: Borefield Locations

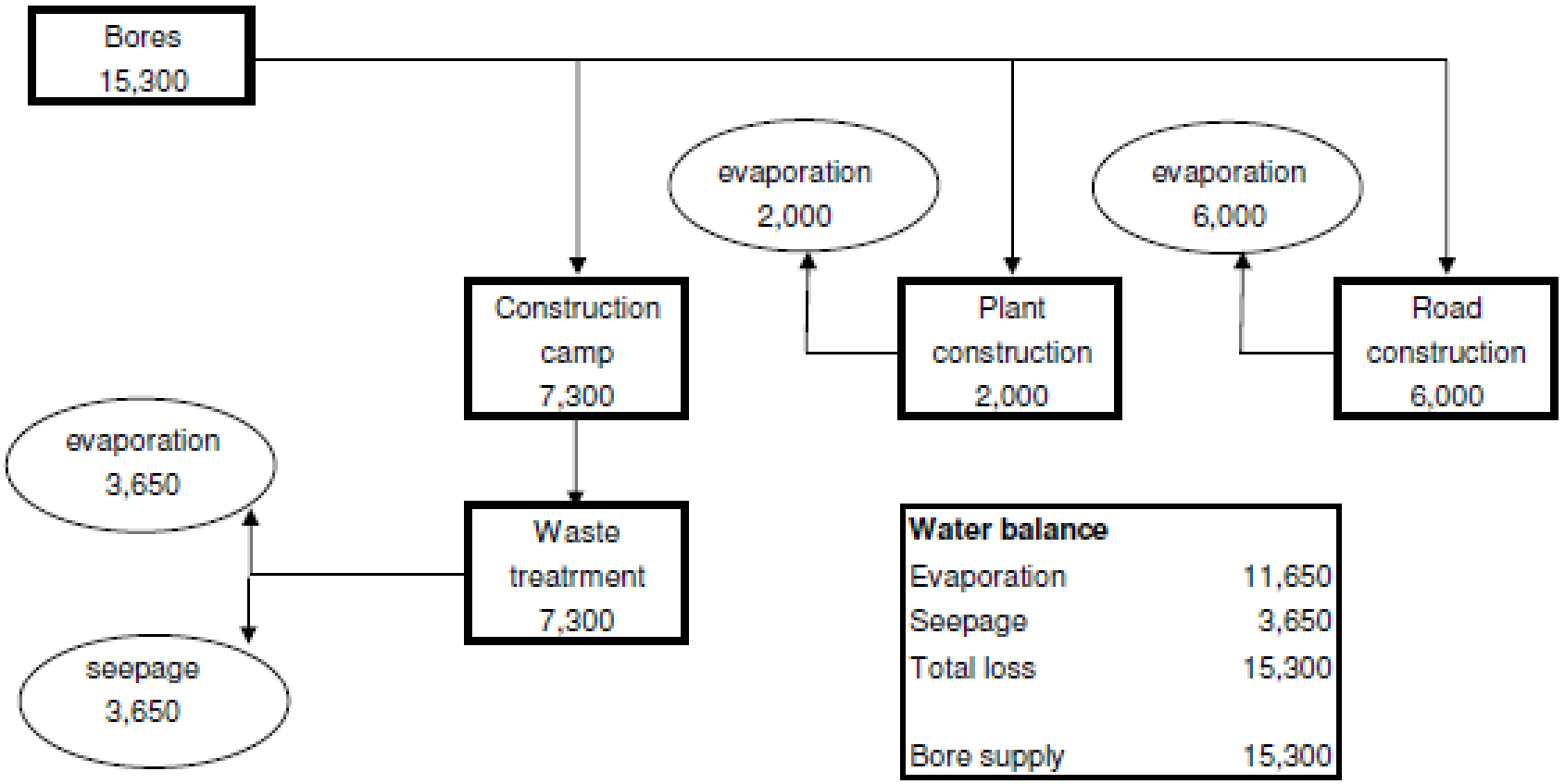

Figure 2-6: Construction Phase Water Balance (m^3 per year)

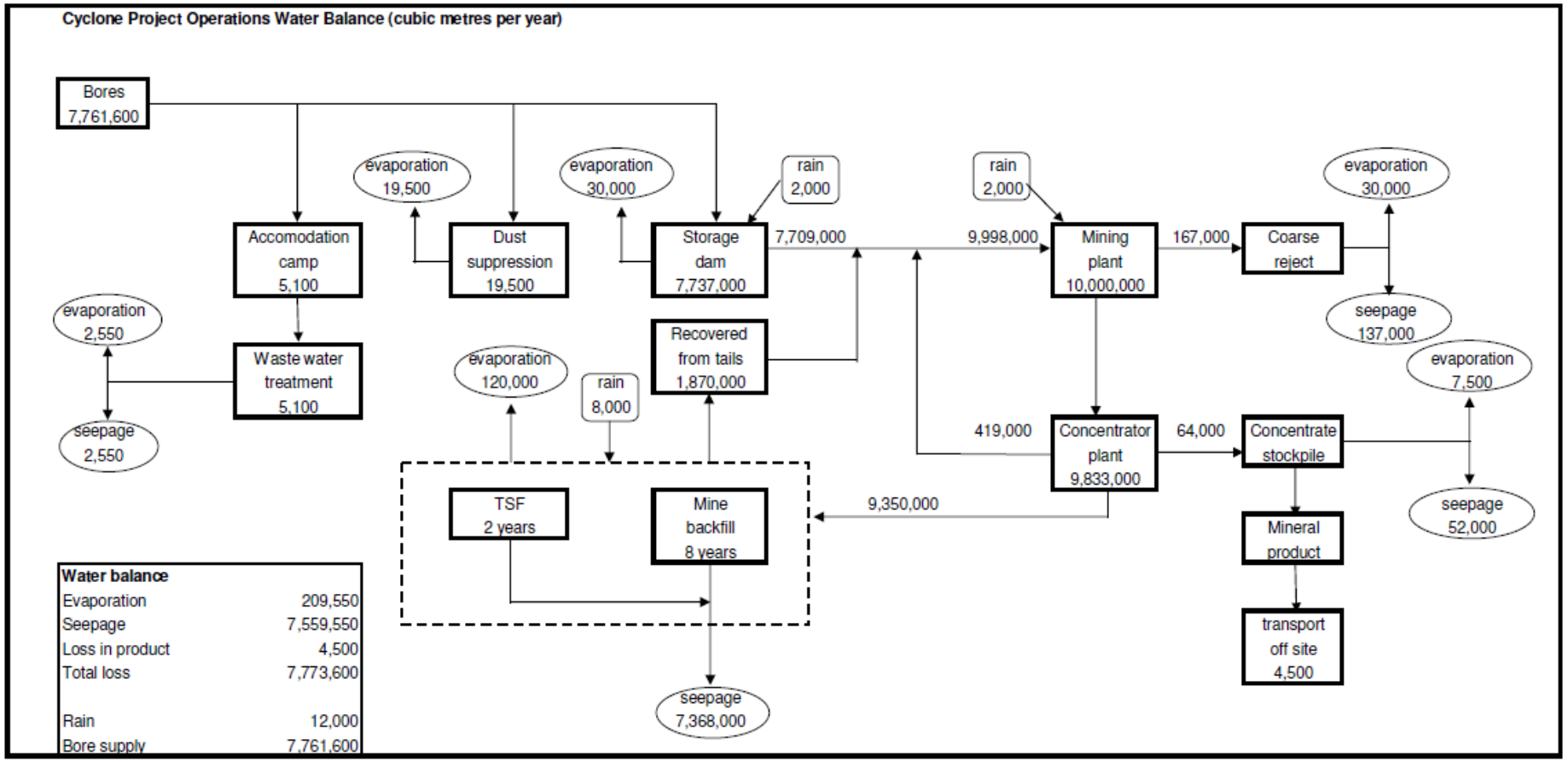

Figure 2-7: Operational Phase Water Balance (m^3 per year)

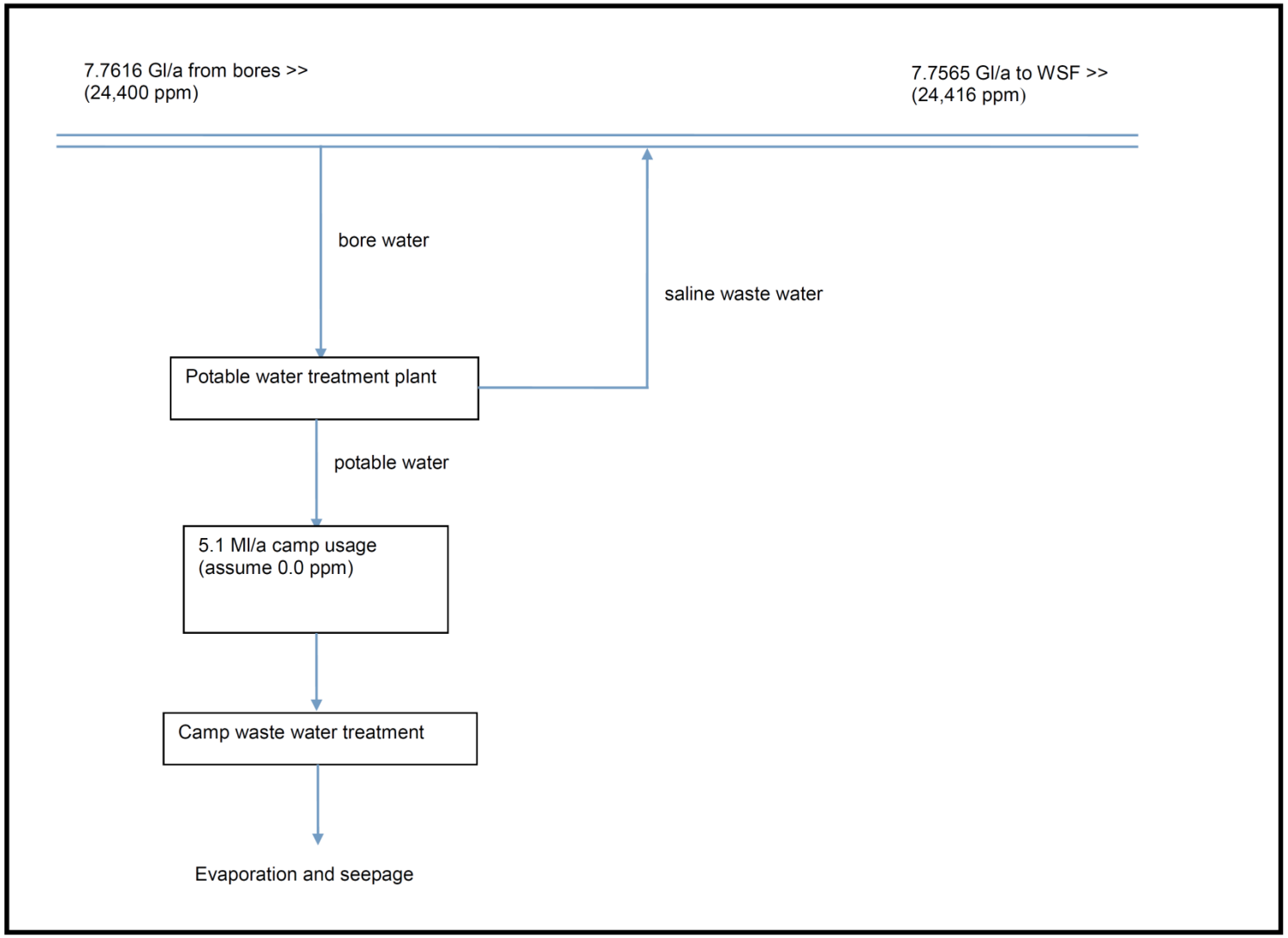

Figure 2-8: Water Disposal Flowchart

3 EMS, Principles of Environmental Protection, Legislative Framework and Environmental Factors

3.1 Environmental Policy

Lost Sands' Environmental Policy is included in **Appendix C**.

3.2 Environmental Management System

Lost Sands is developing an environmental management system (EMS) to assist with managing environmental responsibilities at the Project, across both construction and operational phases, to enable continuous improvement of the company's environmental performance. Over the life of operation the EMS will enable Lost Sands to systematically assess and review its environmental impacts, in addition to implementing programs to manage impacts and obligations.

The Lost Sands EMS will be based on the AS/NZ ISO 14001:2004 Environmental Management System Standards, which are recognised worldwide and include a continuous improvement model.

Fundamental to the implementation of the EMS at an operational level is the development of environmental management plans (EMPs). These EMPs relate to specific environmental aspects relevant to the Project, and include Lost Sands' objectives for management, consideration of legal and other obligations, a list of actions and monitoring, and targets to measure environmental performance. The following Project EMPs have been developed and are included in **Appendix C**:

- Overarching EMP
- Vegetation and Flora Management Plan
- Fauna Management Plan
- Weed Management Plan
- Fire Minimisation Plan
- Dust Management Plan
- Water Management Plan
- Aboriginal Cultural Heritage Management Plan
- Haul Road Management Plan

Other EMPs will be developed as required during the Mining Proposal and Works Approval processes.

The Mine Closure Plan (MCP) has been developed in accordance with EPA's objective for rehabilitation and closure 'To ensure that premises are closed, decommissioned and rehabilitated

in an ecologically sustainable manner, consistent with agreed outcomes and land uses, and without unacceptable liability to the State.' The MCP includes the identification of closure risks, as well as closure objectives and completion criteria, which environmental performance will be measured against. The MCP will be a 'live' document and will be updated every three years over the life of the mine in accordance with the joint Department of Mines and Petroleum (DMP) and EPA Guidelines for Preparing Mine Closure Plans (2015).

3.3 Principles of Environmental Protection

The *EP Act* includes a core set of principles that are applied by the EPA in assessments, known as the Principles of Environmental Protection (EPA, 2004). These Principles have been considered in the development and design of this Project (**Table 3-1**) and will be adhered to throughout construction, operation and closure.

Table 3-1: Principles of Environmental Protection

Principle	Consideration
1. The Precautionary Principle Where there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by: • careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and • an assessment of the risk-weighted consequences of various options.	A risk-based approach has been adopted in the development of the Project with the intention of identifying issues early in the process to enable planning for avoidance and/or mitigation. Early in the process it was determined which investigations were required to be undertaken to reduce scientific uncertainty regarding the potential for environmental impact, including: • Level 2 flora and fauna surveys undertaken for both the mine and haul road; • Groundwater investigation; • Surface water investigation; • Subterranean fauna investigation; • Heritage survey; • Noise assessment; and • Dust assessment. Where these investigations identified significant environmental issues, the Project design was modified to avoid or reduce potential impacts, where reasonably practicable. Management measures have been developed to avoid serious or irreversible impact to the environment. If potential impacts cannot be avoided, such as the impact on the GVDNR from the development of the haul road, offsets have been proposed.

Principle	Consideration
2. The Principle of Intergenerational Equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	Lost Sands is responsible for ensuring that all land impacted within the Project area is rehabilitated or managed in accordance with agreed closure strategies to ensure that land is preserved for future generations. The company commits to managing those environmental factors within its control such that future adverse impacts are minimised and that, wherever possible, the quality of the environment is maintained or enhanced. Where impacts upon the GVDNR from the development of the haul road cannot be avoided, offsets have been proposed.
3. The Principle of the Conservation of Biological Diversity and Ecological Integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Lost Sand has undertaken extensive biological studies to determine the biological context of the impacts upon biological diversity from the proposed Project. The studies were undertaken over a larger area than is proposed to be disturbed to provide a greater understanding of the biological context of the impacts. The effects of the proposed operations, both direct and indirect, on the biological environment have been adequately assessed and measures to protect biodiversity will be implemented.
4. **Principles Relating to Improved Valuation, Pricing and Incentive Mechanisms**	The need to provide sufficient capital and operating funds to ensure environmental management measures are implemented throughout the Project life is acknowledged. Provision has also been made for costs associated with closure and decommissioning and it is acknowledged that these costs form part of the cost of production. Lost Sands recognises its obligations under the *Mining Act 1978* to continually update the closure strategy.
5. The Principle of Waste Minimisation All reasonable and practical measures should be taken to minimise the generation of waste and its discharge into the environment. Wastes should be managed in accordance with the following order of preference: 1. avoidance; 2. re-use; 3. recycling; 4. recovery; 5. treatment; 6. containment; and 7. disposal	All reasonable and practicable measures to minimise the generation of waste and its discharge to the environment will be taken Lost Sands will implement an 'avoid, reduce, re-use, reprocess, recycle, recovery and dispose' hierarchy of waste management approach to waste management across all components and phases of the Project, in accordance with the objectives of the *Waste Avoidance and Resource Recovery Act 2007*.

3.4 Legal Framework

3.4.1 State Legislation

This Project is being assessed at the level of PER by the EPA in accordance with Part IV of the *EP Act*; the process for the assessment of the Project is outlined in **Figure 3-1**.

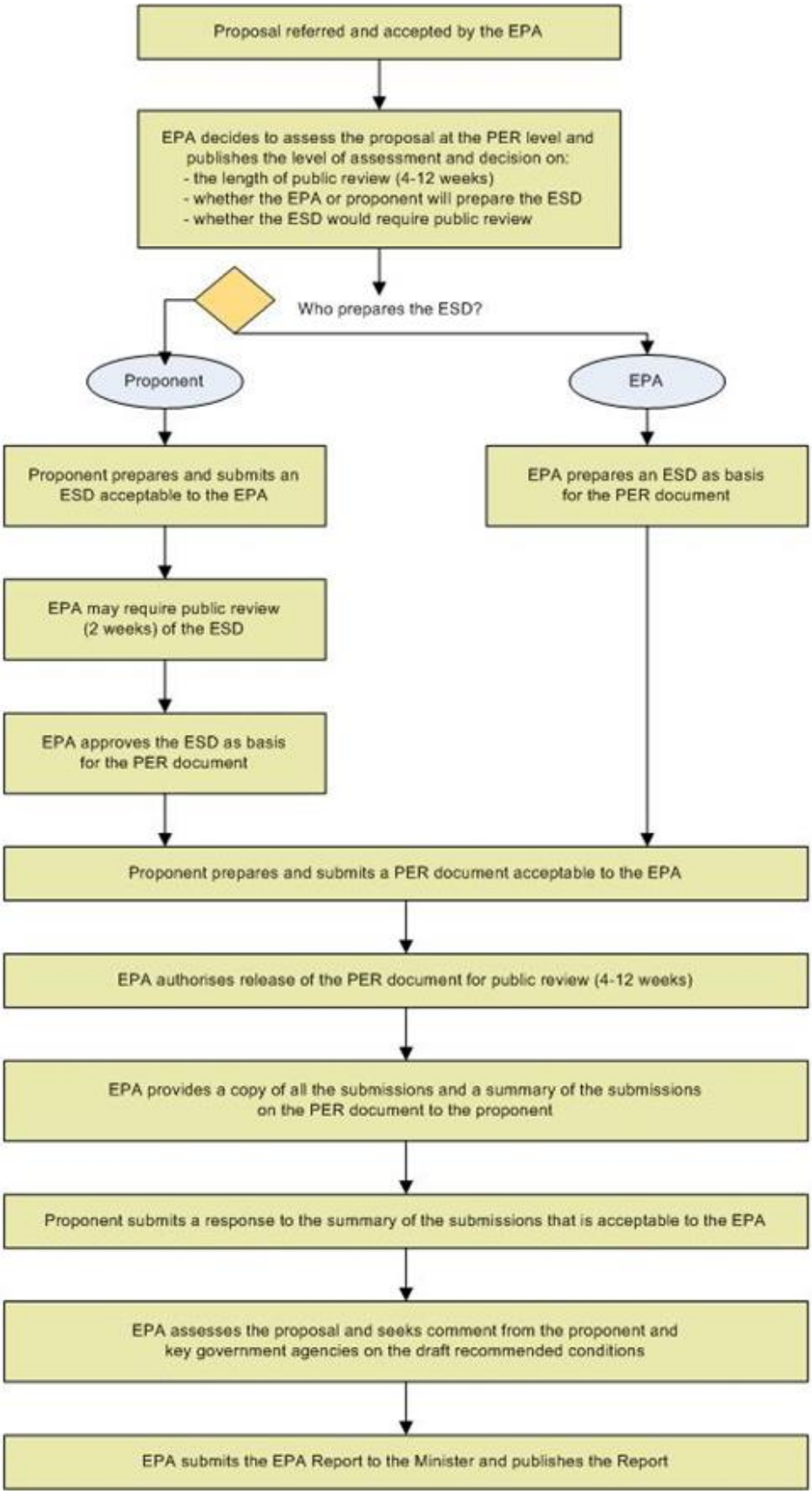

Figure 3-1: Process for the EPA assessment of a Project at the level of PER (www.epa.wa.gov.au)

Numerous additional decision making authorities and agencies will be involved in other environmental approvals required for the Project, in accordance with relevant legislation, as outlined in **Table 3-2** below. Key statutory requirements, environmental policy and guidance for the preliminary key environmental factors are discussed in further detail in **Section 5**.

Table 3-2: Decision making authorities and agencies involved in environmental approvals for the Project

Decision Making Authority/ Involved Agency	Approval	Legislation
Department of Environmental Regulation (DER)	Works approval Operating Licence Provide advice on compliance with National Pollution Inventory, Noise and unauthorised discharge regulations	*Environmental Protection Act 1986* Environmental Protection (NEPM-NP) Regulations 1998 Environmental Protection (Noise Regulations) 1997 Environmental Protection (Unauthorised Discharges) Regulations 2004
Department of Parks and Wildlife (DPaW)	Provide advice on potential impacts and management of conservation reserve and unallocated Crown land Permit to take declared threatened flora and fauna (if required)	*Conservation and Land Management Act 1984* *Wildlife Conservation Act 1950*
Conservation Commission	Clearing within a Class A Nature Reserve	*Conservation and Land Management Act 1984*
Department of Mines and Petroleum (DMP) Minister for State Development	Mining Proposal Mine Closure Plan Project Management Plan Approval from the Minister for State Development for granting of a Miscellaneous Licence within a Class A Nature Reserve Compliance with dangerous goods safety regulations	*Mining Act 1978* *Mines Safety and Inspection Act 1994* *Dangerous Goods Safety Act 2003* Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007
Department of Water (DoW)	Construction of a bore Abstraction of groundwater	*Rights in Water and Irrigation Act 1914*
Department of Aboriginal Affairs (DAA)	If an Aboriginal site is to be excavated, damaged, destroyed or concealed, approval is required under Section 18 of the Act.	*Aboriginal Heritage Act 1972*

Decision Making Authority/ Involved Agency	Approval	Legislation
Department of Health (DoH)	Approval to construct or install an apparatus for the treatment of sewage	*Health Act 1911* Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974
Shire of Laverton Shire of Menzies City of Kalgoorlie/Boulder	Approval of buildings including workshops, administrative buildings and camp Provide advice on haul road construction	*Planning and Development Act 2005* *Local Government Act 1995*
Main Roads Western Australia (MRWA)	Approval to construct haul road	*Main Roads Act 1930*
Department of Agriculture	Management of declared weeds	*Agriculture and Related Resources Protection Act 1976*

3.4.2 Federal Legislation

The Project was referred to the Commonwealth Department of the Environment (DoE) for a decision on whether it requires assessment in accordance with the *Environmental Protection Biodiversity Conservation Act 1999* (EPBC Act). Three species listed under the EPBC Act, the Central Marsupial Mole (*Notoryctes typhlops*), Malleefowl (*Leipoa ocellata*) and Princess Parrot (*Polytelis alexandrae*) are potentially impacted by the project, thereby triggering the EPBC Referral process. The Project has been deemed to be "not a controlled action" and requires no further assessment by the DoE.

3.5 Environmental Factors

3.5.1 Preliminary Key Environmental Factors Identified in Environmental Scoping Document

The EPA identified the preliminary key environmental factors for the PER within the ESD (see **Appendix B**), as detailed below:

- Flora and vegetation – clearing of vegetation for mining and infrastructure including the haul road, proposed borefield and associated pipeline;
- Terrestrial fauna – the potential impact on conservation significant species and the loss and fragmentation of fauna habitat associated with clearing for mining and infrastructure including the haul, proposed borefield and associated pipeline;
- Subterranean fauna – the potential impacts of groundwater abstraction from the borefield on stygofauna;
- Heritage – the potential impacts on Aboriginal heritage;

- Hydrological processes – the potential changes to groundwater regimes and groundwater dependent ecosystems associated with groundwater abstraction at the borefield;
- Amenity – noise and dust associated with the transport and storage and loading of product near Forrest residences and Forrest railway siding;
- Rehabilitation and closure (integrating factor); and
- Offsets (integrating factor).

The ESD stipulated work required for each of these factors. In some cases, results of the surveys undertaken post release of the ESD have meant that some of the work outlined in the ESD is no longer required. **Table 3-3** lists all of the work required, where it is addressed in this PER, and if not, reasons for not undertaking the work.

Table 3-3: Environmental Scoping Document requirements, and where aspects are addressed in the PER

Factor	Work Required	Addressed in PER	Justification for not addressing in PER
Flora and Vegetation	Detailed description of the clearing associated with the proposal, including from direct and indirect impacts. The description is to include the direct and indirect impacts of clearing for the borefield and pipeline including any impacts of groundwater drawdown on groundwater dependent ecosystems.	Section 4.6, **Appendix D**	
	Figures showing the extend of clearing or loss of vegetation and conservation significant flora species, including but not limited to Threatened and/or Priority Ecological Communities (PEC), Declared Rare Flora (DRF), Priority Flora and new flora species from direct and indirect impacts.	Section 4.6, **Appendix D**	
	Level 2 flora and vegetation surveys conducted in areas that are likely to be directly or indirectly disturbed as a result of the proposal. Surveys are to be undertaken in accordance with Guidance Statement 51. Follow up targeted or additional Level 2 surveys may be required based on the results of this survey. Previous studies including but not limited to Woodman 2011 and Woodman 2012, should be gathered and into the Level 2 flora and vegetation survey report to provide local and regional context.	Section 4.6, **Appendix D**	
	Analysis of the extent of clearing and conservation status of vegetation and/or flora species to be cleared. This includes quantifying the impacts to vegetation types and/or conservation significant species, such as Threatened and/or PEC, DRF, Priority Flora and new flora species, to be cleared to assist in the determination of the significance of impacts.	Section 4.6, **Appendix D**	
	Baseline mapping of weed affected areas in any area likely to be directly or indirectly impacted by the proposal.	No	Weed mapping was undertaken opportunistically as part of the Level 2 flora and vegetation survey. Detailed weed mapping of the proposed disturbance areas will be undertaken prior to construction.
	Discussion of proposed management, monitoring and mitigation methods to be implemented.	Section 5.1, **Appendix D**	
	Information regarding whether haul roads are to be sealed or unsealed, and discussion of the direct and indirect impacts, including dust, associated with both options.	Section 5.1 and 5.6, **Appendix D** and **J**	
Terrestrial Fauna	Desktop study of information available to provide a comprehensive listing of fauna known or likely to occur in the habitat present within the proposal area and proposed haul road, and identification of conversation significant fauna species likely to occur in the proposed area.	Section 4.7, **Appendix E**	
	Reconnaissance survey including mapping of habitats within areas to be cleared and identification of important, rare or unusual habitat types in accordance with Guidance Statement 56 and Technical Guide – Terrestrial Vertebrate Surveys for Environmental Impact Assessment.	Section 4.7, **Appendix E**	
	Conduct targeted Level 2 surveys in the Great Victorian Desert Nature Reserve in the proposed road alignment in accordance with Table 3 in Guidance 56 and the Technical Guide – Terrestrial Vertebrate Surveys for Environmental Impact Assessment.	Section 4.7, **Appendix E**	
	In accordance with EPA Guidance Statement 20, assess the potential significance of impacts to Short-Range Endemic (SRE) invertebrate species. Carry out further survey work if required, in accordance with EPA Guidance Statement 20.	Section 4.7, **Appendix E**	
	Discussion of potential impacts to Fauna as a result of the proposal and provision of quantitative data on impacts of the proposal to species of conservation significance.	Section 5.2, **Appendix E**	
	Discussion of proposed management, monitoring and mitigation methods to be implemented.	Section 5.2, **Appendix E**	
Subterranean Fauna	Desktop study and description of the potential impacts from water abstraction from a borefield and determination of the likely presence of subterranean fauna (Stygofauna) habitat.	Section 4.8, **Appendix F**	
	Survey of all areas likely to be directly or indirectly impacted by the proposal should be undertaken in accordance with EAG 12 (EPA 2013) and Guidance Statement 54a (EPA 2007). The results of desktop study will be used to determine whether further survey will be undertaken in accordance with criteria in EPA (2013) and EPA (2007).	Section 4.8, **Appendix F**	

Factor	Work Required	Addressed in PER	Justification for not addressing in PER
	A description of boreholes sampled will be provided together with maps showing their locations indication bores samples including those where no specimens were recorded.	No	Habitat available within the Project area was not deemed to be prospective for subterranean fauna.
	Mapping should show the extent of known or predicted subterranean fauna habitat and the extent of impact area including drawdown/reinjections contours.	No	Habitat available within the Project area was not deemed to be prospective for subterranean fauna.
	Conduct a Level 1 survey according to the criteria in EAG 12 to determine if karst or other suitable geology likely to provide habitat for troglofauna is present in the area proposed to be mined. If habitat suitable for troglofauna is present a Level 2 survey consistent with criteria in EAG 12 should be conducted.	No	Habitat available within the Project area was not deemed to be prospective for subterranean fauna.
	There should be a discussion of potential impacts to subterranean fauna as a result of the proposal.	No	Habitat available within the Project area was not deemed to be prospective for subterranean fauna.
Heritage	Undertake a desktop review to identify whether or not an adequate Aboriginal heritage survey has been completed. As noted in Guidance Statement 41, an Aboriginal heritage survey will be required if it is noted from desktop review than an adequate survey has not been undertaken.	Section 4.11, **Appendix I**	
	It is recommended the Traditional Owners are consulted to understand cultural associations, and document this consultation.	Section 4.11, **Appendix I**	
	Have regard to the Aboriginal Heritage Due Diligence Guidelines which outline matters to be considered and to assist land users to be more aware of how their activities could adversely impact an Aboriginal site.	Section 4.11, **Appendix I**	
	The proposal involves multiple ground-disturbing activities over a large area, and may require the preparation of an integrated plan to manage Aboriginal heritage. Liaise with the Department of Aboriginal Affair regarding a need for, and the development of, if required an integrated plan to manage Aboriginal heritage	No	Given that the development impacts on Aboriginal culture and heritage from the Project are likely to be low and that consultation with and engagement of the traditional owners in the survey and assessment process has been extensive, it is not considered necessary to prepare an integrated plan to manage Aboriginal Heritage (Cane 2014)
	Consult with the Department of Aboriginal Affairs regarding the form and content of any proposed investigation and the outcome of any investigations.	The DAA was not consulted on the form and content of the investigations (see box right) but has reviewed the draft PER Version 2 and provided comment.	The Department of Aboriginal Affairs have not previously been consulted on the investigation and its outcomes. This is due to the rights and interests of the Spinifex People recognised under their traditional law and custom in regard to their religious beliefs, provision of sacred information and associated issues of site protection recognised by the Federal Court of Australia in *Mark Anderson on behalf of the Spinifex People v State of Western Australia* {2000} FCA 1717 (28 November 2000) (Cane 2014)
	Discuss and provide information about the extent to which the requirements of the *Aboriginal Heritage Act 1972* (AH Act) is satisfied and whether any potential impacts on Aboriginal heritage can be regulated and managed.	Section 4.11, **Appendix I**	
	Document the magnitude of the impacts on Aboriginal culture and heritage matters, and how these impacts will be managed, including under the AH Act, or through other proposed management mechanisms including an integrated management plan as indicated above.	Section 5.5, **Appendix I**	
Hydrological Processes	Determine and identify the location of potential water resource available to meet water requirement for the proposal for life of mine.	Section 4.9, **Appendix G**	
	Assess the sustainability of these identified resources for their proposal use and means through which water can be minimised. Identify the preferred water supply for the proposal.	Section 4.9, **Appendix G**	The proposed resource is part of a high yielding extensive deep confined aquifer within the Officer Basin. Airlift tests have demonstrated that a sustainable yield will be available for the Project, and this will be confirmed through pump-tests of a series of bores, which will be undertaken at the conclusion of the PER process.
	Develop a conceptual model of the groundwater systems, incorporation groundwater quality and extent of connectivity between aquifer systems.	Section 4.9, **Appendix G**	A conceptual model of the groundwater systems has not been developed as pump tests have not been undertaken. However, a water balance for the project has been developed in order to

Factor	Work Required	Addressed in PER	Justification for not addressing in PER
			understand the Project's water requirements. Results from the air lift of Cyclone #1 bore show that there is unlikely to connectives between the shallow and deep aquifers. Water quality characteristics of the shallow and deeper aquifers were analysed during bore construction activates. Hydrogeological modelling of groundwater systems will be completed after pump test has been undertaken at conclusion of PER process during the DFS stage.
	Hydrogeological investigations/modelling and analysis to provide baseline hydrology and predictions of change and impacts as a result of abstraction and dewatering.	No	Hydrogeological modelling has not been undertaken as pump tests have not been undertaken. Hydrogeological modelling will be completed after pump test has been undertaken at conclusion of PER process.
	Undertake a hydrological investigation to determine what effect the proposal will have on the groundwater quality of the area.	Section 4.9, **Appendix G**	
	Assess groundwater drawdown associated with the proposal and analyse and discuss any impacts to groundwater quality and quantity, groundwater dependent ecosystems, and Styofauna expected as a result of the proposal.	Section 4.9, **Appendix G**	
	Provide a water balance for the mining operations demonstrating that there is sufficient water for the duration of the mining operations.	Section 4.9, **Appendix G**	
	Provide a discussion of potential impacts to surface hydrological processes, with particular regard to northern areas of the Great Victoria Desert Nature Reserve.	Section 4.9, **Appendix G**	
	Provide a description of any emissions and discharges likely to occur from rail sidings and loading facilities associated with the proposal and demonstrate that appropriate management actions would be implemented in relation to these.	Section 5.4	
	Discussion of proposed management, monitoring and mitigation methods to be implemented.	Section 5.4, **Appendix G**	
	Assess any impacts to existing and potential users of the proposed abstraction of groundwater.	Section 5.4, A**ppendix G**	
Amenity	Undertake a noise assessment as specified by the draft EPA Guidance Statement No.8 and demonstrate that the proposal can be managed to comply with the Noise regulations at residential properties	**Appendix K**, Section 5.6.2	
	Identify any new freight handling facilities such as land-based freight storage and freight interchanges. These facilities are to be assessed in accordance with State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning and against the criteria specified in the Noise Regulations.	No	The proposed loading facility is not classified as a "freight handling facility" in accordance with State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning. The loading facility has been assessed against the criteria in the Noise Regulations (**Appendix K**)
	Assess noise impacts associated with the proposed haul road at any sensitive receptors against criteria specified in the Noise Regulations.	**Appendix K**, Section 5.6.2	
	Provide a map showing the locations of all noise sensitive premises affected or likely to be affected by the proposed haul road, transport route, stockpile area and rail loading facilities.	**Appendix K**	
	Undertake environmental noise monitoring at representative noise-sensitive premises	No	Given that any noise associated with the Project is predicted to comply with the assigned levels under the regulations at all times, it is not considered necessary to undertake environmental noise monitoring for the purposes of the PER
	Provide noise predictions for noise-sensitive premises in relation to the proposed transport route, stockpile areas and rail loading facilities Propose noise controls including design and management measures to be put in place when transporting product and loading and unloading at the rail siding	**Appendix K**, Section 5.6.2	

Factor	Work Required	Addressed in PER	Justification for not addressing in PER
	The majority of any airborne particulates from the proposal are likely to be visible dust, with a potential for some fine particulate matter (PM10 and PM2.5). Visible dust cannot be measured and therefore cannot be modelled and monitored. The proponent is expected to outline the extent to which there is history of existing dust issues at the proposed stockpile storage area and rail siding, and the extent to which buffer distances and proposed management are adequate to manage potential impacts of dust.	**Appendix J**, Section 5.6.1	
Rehabilitation and closure	Desktop study of successful mine rehabilitation procedures in comparable environmental conditions.	**Appendix L**	
	Identify and propose completion criteria.	**Appendix L**	At this stage of the Project, qualitative completion criteria have been developed; these will be refined and become quantitative completion criteria throughout the life of mine.
	Prepare a workable, site specific mine closure plan, including information relating to the following: Likely tailings characteristics, including chemical, physical consolidation rates, drying rates and potential erosions rates; Tailings facility construction, including suitability of overburden material relative to tailing characteristics; Waste Landform construction methods; Mobilisation of radionuclides/heavy metals and the potential impacts on rehabilitation and closure; and General assessment on the potential for any form of radiation to impact the environment, including during rehabilitation and closure.	**Appendix L**	A workable site specific mine closure plan (MCP) has been prepared (Appendix L). Requirements are addressed as follows: 1. information relating to the likely tailings characteristics, including physical, chemical, consolidation rates, drying rates and potential erosion rates.: 2. The proposed method for construction of the tailings storage facilities (TSFs) is presented within the MCP. The two TSFs will be permanent features and will be constructed to be a stable rehabilitated landform. A detailed TSF design will be developed during the Definitive Feasibility Study (DFS). 3. Representative samples of the four major waste lithologies, namely; 'calcrete', 'iron sandstone', 'sandstone' and 'iron cemented sand' were assessed for their physical and chemical characteristics and are described in Appendix L. 4. There will be no permanent waste rock landforms. The initial waste generated from the mine will be utilised in the construction of the TSFs and roads. Subsequent to construction of the TSFs mine waste will be progressively backfilled into the pits throughout the life of mine, hence the storage of waste temporarily on the surface will be very minimal. 5. The levels of radioactive elements uranium and thorium in the tailings are very low; these low levels are attributed to the age of the Cyclone deposit (~35 million years old), and the associated decay. Due to the low levels of radioactive elements, and no process that will result in mobilisation of radionuclides, it is not anticipated that there will be any impacts on the rehabilitation and closure outcomes from the mobilisation of radionuclides. 6. The radiation level post mining will be lower than pre-mining due to removal of the higher radiation minerals in the concentrate. The potential for any form of radiation to impact the environment, including rehabilitation and closure is considered unlikely
Offsets	Examination of residual impacts and, if required, development of draft program of environmental offsets.	Section 5.8	
	Inclusion in the PER of the completed Environmental Offsets Reporting Form and any offsets required and proposed.	Section 5.8	

3.5.2 Other Matters

The EPA also identified environmental factors that are likely to be affected by the proposal that are not significant or can be regulated and managed to meet the EPA's objectives and therefore do not require further evaluation in this PER. These factors are as follows:

- Landforms;
- Terrestrial environmental quality;
- Inland waters environmental quality;
- Air quality; and
- Human health

4 Existing Environment

4.1 Investigations Undertaken for the Project

There have been numerous assessments undertaken at the Project in order to provide a comprehensive overview of the existing environment and to identify any potential impacts that may occur; these are presented in **Table 4-1**.

Table 4-1: Investigations Undertaken for the Cyclone Project

Environmental Factor	Report Title and Author	Date Completed	Report location
Flora and Vegetation			
Flora and Vegetation	Cyclone Project Preliminary Flora and Vegetation Survey by Woodman Environmental	September 2012	Appendix D
Flora and Vegetation	Level 2 Vegetation and Flora Survey and Impact Assessment by Outback Ecology/MWH	May 2014	Appendix D
Terrestrial Fauna			
Fauna	Desktop Fauna Assessment of the Cyclone Deposit Project by Bamford Consulting Ecologists	September 2011	Appendix E
Fauna	Fauna Assessment of Transport Corridor Options for the Lost Sands Project (Cyclone Deposit) by M.J. & A.R. Bamford Consulting Ecologists	June 2012	Appendix E
Fauna	Level 2 Terrestrial Fauna Impact Assessment by Outback Ecology/MWH	July 2014	Appendix E
Subterranean Fauna			
Subterranean Fauna	Subterranean Fauna Desktop Assessment by Outback Ecology/MWH	April 2014	Appendix F
Heritage			
Aboriginal Heritage	Heritage Report by Scott Cane	August 2014	Appendix I
Hydrological Processes			
Surface Water	Cyclone Lost Sands Hydrology Assessment by MWH Australia	March, 2014	Appendix H
Groundwater	Groundwater Feasibility Study by Australia Groundwater Technologies	February 2012	Appendix G

Environmental Factor	Report Title and Author	Date Completed	Report location
Groundwater	Desktop Review of Groundwater Supply Targets by Australasian groundwater & Environmental Consultants	December 2010	Appendix G
Groundwater	Cyclone Investigation Production Bore #1 – Bore Completion Report by Graham Ride	February 2014	Appendix G
Groundwater	Hydrogeological report by Graham Ride	June 2014	Appendix G
Amenity			
Noise	Environmental Noise Assessment Proposed Cyclone Mineral Sands Deposit by Lloyd George Acoustics	February, 2014	Appendix K
Dust	Dust Management Plan For The Cyclone Zircon Project Rail Siding (Forrest WA) by Metreo Consulting	January, 2014	Appendix J
Soil and Waste Characterisation			
Soil and Waste Characterisation	Soil resources and mine waste assessment by Outback Ecology/MWH.	August 2014	Attachment to Appendix L

The flora and terrestrial fauna investigations undertaken by Outback Ecology/MWH included field surveys in the same 134,535 ha study area, which incorporates the proposed mine development and haul road development envelopes (Study Area). Both the flora and terrestrial fauna surveys consisted of two phases: September/October 2013 and April 2014. Phase One of the fauna survey had two parts, with a second round of field surveys in November 2013.

4.2 Biogeographic Region

The Study Area is located in the Eremaean botanical district. It straddles two bioregions, as defined by the Interim Biogeographic Regionalisation of Australia (IBRA) classification system: the Great Victoria Desert (GVD) bioregion and the Nullarbor bioregion (McKenzie et al. 2003). The mining development envelope and northern part of the haul road development envelope lie in the Maralinga subregion (GVD 3) of the GVD bioregion. The haul road development envelope traverses the Carlisle and Nullarbor Plain subregions of the Nullarbor bioregion (NUL01 and NUL02, respectively) (**Figure 4-1**).

The Maralinga subregion (5,051,155 ha) is characterised by extensive sandplains of Aeolian sands, underlain by Devonian sediments of the Gunbarrel Basin. Landforms consist of salt lakes and major valley floors with lake derived dunes. Sand plains provide minor relief with extensive seif dunes

running east-west, occasional outcropping and quartzite hills. The climate is arid, with summer and winter rain averaging 150 to 180millimetres (mm). Vegetation is primarily composed of:

- tree steppe of *Eucalyptus gongylocarpa*, Mulga and *E. youngiana* over hummock grassland;
- *Triodia basedowii* dominating the aeolian sands;
- Acacia species dominating the colluvial soils with Eremophila and Santalum species; and
- Halophytes confined to edges of salt lakes and saline drainage systems (Barton and Cowan 2002a, McKenzie et al. 2003).

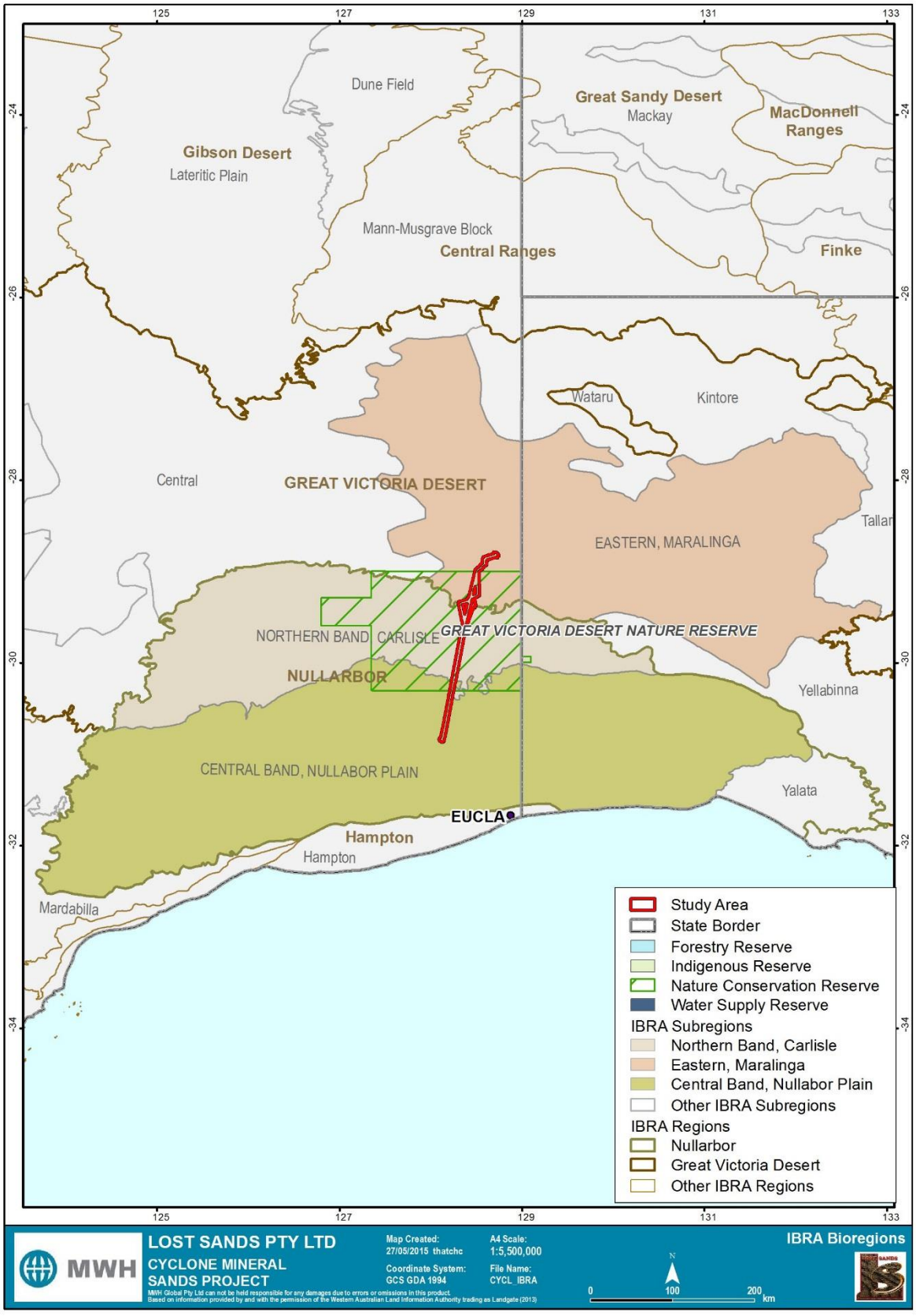

Figure 4-1: Great Victoria Desert and Nullarbor Plain Biogeographic regions underlying the Cyclone Project and surrounds

The Carlisle subregion (5,442,741 ha) lies along the northern edge of the Bunda Plateau where the soils have well-developed profiles with a high proportion of red quartz-rich sand mixed with loams and calcareous clays which is partly cemented over calcareous sandstone. The northern part of the subregion has extensive seif dunes supporting a tree steppe of *Eucalyptus gongylocarpa*, Mulga and *E. youngiana* over hummock grassland with occasional breakaways and quartzite hills providing minor relief. The central and southern parts are dominated by woodlands of *Acacia papyrocarpa* (Western Myall) over *Maireana sedifolia* (Bluebush). As for GVD3, the subregion has salt lakes supporting samphire communities and major valley floors with lake derived dunes. Few karst systems are found in this subregion, mostly in southern areas systems (Barton and Cowan 2002a, McKenzie et al. 2003).

The Nullarbor Plain subregion (10,169,146 ha) is a tertiary limestone plain with subdued, arid karst features. It is a vast treeless plain with shallow, calcareous soils, and thinly mantling massive limestone. Relief is slight, with small scale patterns of clay-filled depressions that alternate with rises of thin stony soils or bare limestone. The subregion supports a bluebush-saltbush steppe with some woodlands of *Acacia papyrocarpa* over *Maireana sedifolia* present in peripheral areas. It includes one of the largest karst systems in the world with shallow depressions and ridge and corridor terrain, among other features systems (Barton and Cowan 2002a, McKenzie et al. 2003).

4.3 Land Systems

Land systems in the region tend to follow broad lateral bands running east-west and consequently, this results in the north-south oriented Study Area traversing several land systems. Most of these land systems are limited in their extent within the Study Area (**Table 4-2**, **Figure 4-2**) except for AB49, DD31 and AB81 which comprise more than 10% cover.

4.4 Climate

The GVD and Nullarbor bioregions are both characterised by having an arid climate with low variable rainfall. The GVD bioregion can receive large rainfall events in both summer and winter whereas the Nullarbor bioregion typically has unreliable coastal rainfall associated with weather patterns that rarely reach the Nullarbor interior (Australian Natural Resource Atlas 2009).

Long term climate data for the Project is limited. The closest Bureau of Meteorology (BOM) weather stations to the southern part of the Project are Forrest Aerodrome (site 011004) now closed, which has temperature and rainfall data for 1930 to 1995 and Forrest (site 011052) which has temperature data for 1994 to 2013 and rainfall data for 1994 to 2014. Forrest is located in the southern most portion of the Project. The nearest station to the northern part of the Project is Ilkurlka (site 12240) which has rainfall data for 2005 to 2013 and is located 130 km northwest of the Project.

Table 4-2: Land Systems of the Study Area

Land System	Description	Area within Study Area (ha)	Proportion of Study Area (%)	Proportion of land system in Study Area (%)**
AB48	Very gently undulating plain traversed by longitudinal dunes	34,513.8	25.7	0.8
DD31	Uneven plain with low calcrete (kankar) rises and tracts of dunes	34,043.0	25.3	11.3
AB81	Uneven plains on limestones	18,305.5	13.6	2.6
Rabbit	Flat clay and kankar plain with infrequent small claypans, supporting mostly forbs and perennial grasses.	12,570.3	9.3	35.9
Jubilee1	Undulating plains with kankar crests, drainage floors and infrequent dongas, supporting myall and bluebush on crests and saltbush and grasses in drainage floors.	10,761.3	8.0	11.4
Nyanga	Level loamy calcrete plains supporting myall or *Casuarina* woodland over chenopod understorey.	10,097.4	7.5	0.6
Gafa	Very gently undulating stony plains with wide drainage floors, infrequent large claypans which are sometimes scalded, supporting bluebush and saltbush on the rises and a mosaic of grassland and saltbush in the drainage floors and claypans.	6,374.0	4.7	0.7
Colville	Gently undulating plateau of sand and kankar with many small dongas and claypans, supporting Myall woodland with a chenopod shrub understorey.	3,408.4	2.5	5.0
B42	High sand dunes with narrow corridor plains and occasional small open plain areas; occasional outcrops of sandstones, laterites, and silcretes; some calcareous mounds	2,317.8	1.7	0.1
Bullseye	Gently undulating stony plain supporting bluebush and saltbush with numerous small claypans and large dongas with prominent annuli.	1,971.4	1.5	0.2
SV13	Saline plains with salt pans and lakes; some fringing dunes	172.1	0.1	0.1
	Total	**133,058**	**100**	

* The term ‘donga’ refers to shallow depressions common on the Nullabor Plain. These depressions will fill with water during rainfall events.

** Western Australian Land System data.

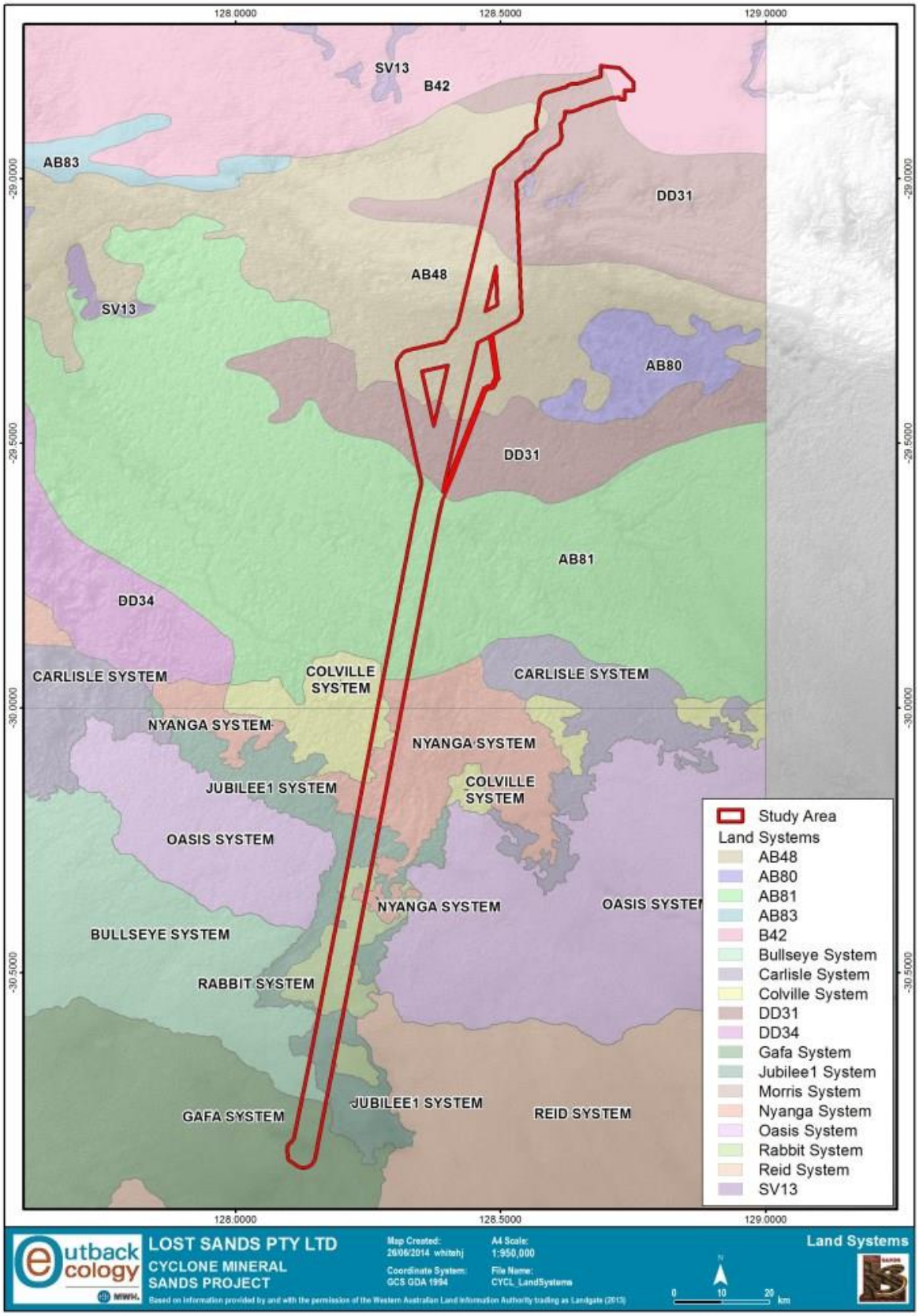

Figure 4-2: Land Systems of the Cyclone Project and surrounds

The Forrest meteorological stations (011004 and 011052) have a mean annual rainfall of approximately 197 mm with higher rainfall tending to occur during summer months of February and March. Temperatures recorded at the Forrest meteorological stations have mean maximum temperatures ranging from 37°C in January and February to 21.2°C in June, and mean minimum temperatures ranging from 12.1°C in January to 2°C in July (BOM 2014). The Ilkurlka meteorological station has a mean annual rainfall of approximately 232.2 mm with variable rainfall occurring in both summer and winter.

4.5 Land Use

Land tenure within and surrounding the Project area is primarily comprised of Aboriginal Reserves, Livestock Grazing, Nature Reserves, Unallocated Crown Land (UCL) and Unmanaged Reserves. Land use includes traditional Aboriginal activities, nature conservation, grazing and mineral exploration (**Figure 4-3**).

The mining area is located in the Shire of Laverton, approximately 600 km east of the town of Laverton. The transport corridor passes through the Shire of Laverton, in addition to the Shire of Menzies and the City of Kalgoorlie-Boulder.

The nearest communities are the Tjuntjuntjara Aboriginal community (130 km west of the Project area, within the GVDNR) and the community at Forrest (**Figure 4-3**). The town of Forrest consists of dwellings, a rail siding on the Trans-Australian Railway and an airstrip; there are few permanent residents. The Tjuntjuntjara Aboriginal community was established in 1988 and members are part of a larger group known as Pila Nguru, or Spinifex People.

The mining area development envelope and the northern section of the haul road development envelope are located within the Spinifex Native Title Determination area (WC95/51; WAD6043/98) which is listed on the National Native Title Register and protected under the *Native Title Act 1993* (Cwth). The Spinifex People, represented by the Paupiyala Tjarutja Aboriginal Corporation, are the traditional custodians.

4.5.1 Great Victoria Desert Nature Reserve

The proposed haul road development envelope passes through the GVDNR, a Class A Nature Reserve gazetted on the 21/08/1970 following recommendations from the Reserves Committee to the EPA in 1962, which include “This large area of country includes regions which are representative of all the geological formations of the northern Nullarbor area, and their associated vegetation which ranges from the typical almost treeless flat-lying marine limestone of the Nullarbor to the Precambrian areas further north.” (Conservation Through Reserves Committee, 1974). The reserve was established for the conservation of fauna and flora, however it was not gazetted with the intention of protecting a single species of flora or fauna, rather the inclusion of 2,495,777 ha of

under-represented land systems into reservation and management for conservation (John Lizamore DPaW, *pers. comm*) It is vested with the Conservation Commission of Western Australia. The GVDNR is classified as an IUCN 1a area which is strictly protected and set aside to protect biodiversity and geological/geomorphological features where human visitation, use and impacts are strictly controlled and limited to ensure protection of conservation values.

The GVDNR covers three IBRA sub-regions and their transition zones:

- Maralinga sub-region of the GVD bioregion;
- Carlisle sub-region of the Nullarbor bioregion; and
- Nullarbor Plain sub-region of the Nullarbor bioregion.

These sub-regions are described above and shown in **Figure 4-1**.

4.5.2 Great Victoria Desert Conservation Estate

The existing reserve system within the WA portion of the Great Victoria Desert comprises seven reserves, including five class A nature reserves and one class C nature reserve with a total area of 1.9 million hectares (McKenzie et al. 2003). Overall 9.4% of the GVD Bioregion is reserved in IUCN I-IV reserves and the bioregion is IBRA reservation class five, with greater than 30% of native vegetation cover remaining There are few major conflicting land uses because much of the desert is unallocated crown land, Aboriginal reserve or conservation reserve. In addition, the Spinifex Native Title Determination Area sees extensive areas (approximately 5,418,087 hectares) of the desert managed for conservation (McKenzie et al. 2003). Feral herbivores (camels and rabbits) and large intense summer wildfires have reduced vegetation biomass throughout the region. Therefore management priorities are:

- Feral herbivore and carnivore control;
- Fire management regimes that reduce the size and impact of summer wildfires; and
- Ecological surveys to gain more knowledge of the bioregion (McKenzie et al. 2003).

Immediately east of the GVDNR is the Mamungari Conservation Park which lies entirely in SA. It is a UNESCO World Biosphere Reserve, managed by a partnership between traditional owners and the South Australian Department of Environment, Water and Natural Resources. Other reserves in the region include the Neale Junction Nature Reserve (200 km to the northwest), the Plumridge Lakes Nature Reserve (250 km to the west) and the Nullarbor Regional Reserve (80 km to the southeast in SA).

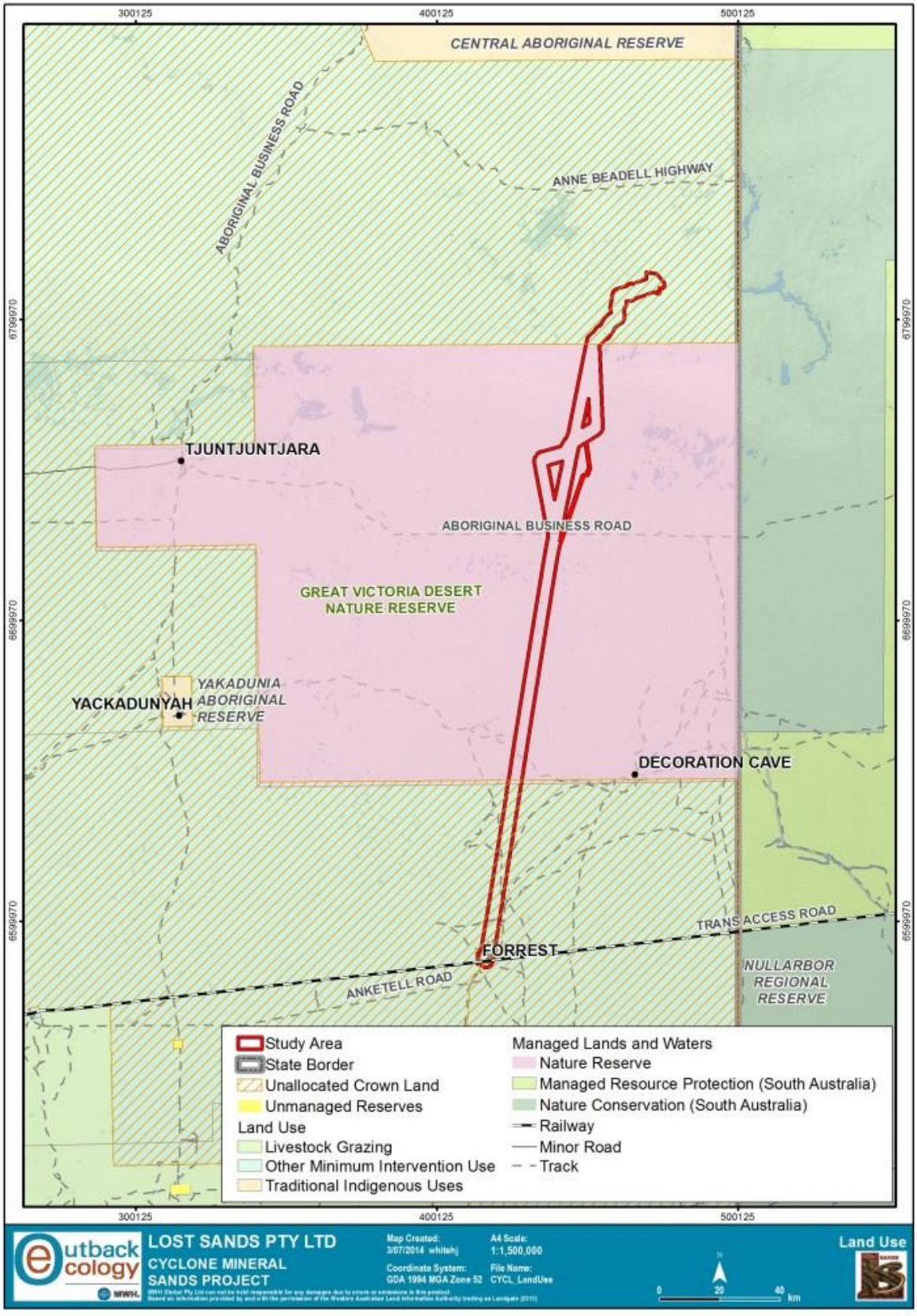

Figure 4-3: Land Use Surrounding the Cyclone Project

4.6 Flora and Vegetation

Outback Ecology/MWH were commissioned to undertake a Level 2 Vegetation and Flora Survey and Impact Assessment (the Flora Assessment) at the Project, following a preliminary desktop and reconnaissance survey in 2012 by Woodman Environmental Consulting Pty Ltd (see **Table 4-1**). **Appendix D** incorporates these two Flora and Vegetation assessments.

4.6.1 Vegetation Associations

Ten major vegetation groups were identified; these were divided into 40 vegetation associations that were mapped across the Study Area from which 144 sites were surveyed. Mapping of the vegetation associations is given in **Appendix D**. The vegetation condition recorded across the majority of the Study Area was generally considered to be 'Excellent' within the GVD regions and 'Very Good' to 'Good' within the Nullarbor Plain (**Figure 4-4**). Some areas could be considered 'Degraded'; however, it is also possible that poor conditions encountered on the Nullarbor Plain are the result of normal climatic conditions. Completely degraded areas were limited to clearing around rail and airstrip infrastructure around Forrest at the southern end of the haul road development envelope and some isolated access tracks. Grazing from camels and rabbits was evident, particularly in the Nullarbor Plain where vegetation structures had been altered at a number of sites.

4.6.2 Flora

The field component of the Flora Assessment recorded 369 species of vascular plants. The GVD bioregion is relatively floristically diverse with 979 taxa recorded on FloraBase (DPaW 2014), however, only 110 of these have been recorded in the Eastern Maralinga subregion in which the majority of the mine area development envelope is located. This contrasts with the Central subregion to the west of the Eastern Maralinga with 620 species listed, and the Kintore subregion which only has five. This may be attributed to lower floristic diversity in central Australia but also to the level of survey effort in these subregions. This assertion is supported by the outcomes of the Flora Assessment for the Eastern Maralinga subregion, which resulted in over double the number of species of the subregion recorded within the relatively small Study Area (**Table 4-3**).

Floristic diversity recorded within the Nullarbor Plain was much less than predicted from the number of species known to occur in each subregion. However, the haul road development envelope is a relatively narrow north-south running corridor bisecting east-west oriented subregions and the size of these subregions is very large; thus it is likely that the Study Area bisects only a very small subset of the available habitats throughout the Nullarbor bioregion as a whole. Furthermore, the long Nullabor Plain bioregion lies adjacent to many other bioregions resulting in a high diversity as flora intrude along bordering bioregions. Surveys within the subregions are also relatively limited.

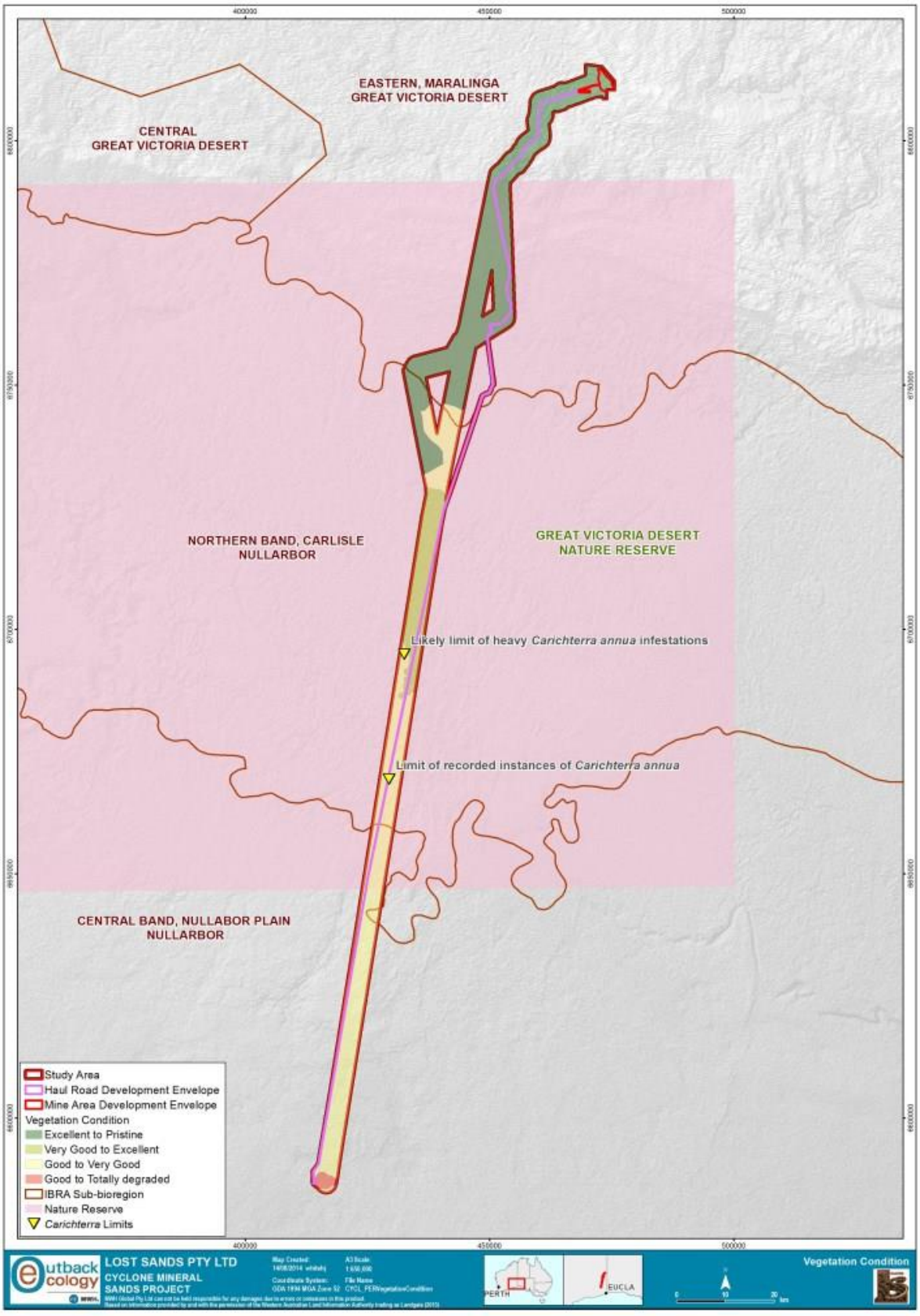

Figure 4-4: Vegetation condition of the Study Area

Table 4-3: Comparison of subregional floristic data

IBRA Subregion	Number of species recorded during the Flora Assessment	Number of species identified as occurring in the subregion by FloraBase (DPaW 2014)
Eastern Maralinga (GVD3)	251	110
Nullarbor Northern Band (NUL1)	162	285
Nullarbor Central Band (NUL2)	64	413

The most species rich families within the Flora Study Area were:

- Chenopodiaceae with 51 taxa, of which the genus Maireana contributed 18 taxa;
- Fabaceae with 48 taxa of which Acacia was the most common genus, contributing 29 species;
- Asteraceae with 44 taxa; and
- Poaceae with 43 taxa.

4.6.3 Flora Species of Conservation Significance

No Threatened Flora listed under the WC Act, or Threatened Flora species listed under the Commonwealth EPBC Act have been recorded in the Study Area. Ten flora taxa recorded within the Study Area were identified as conservation significant, with one taxa recorded in Phase 2 being flagged as a potential new species (**Table 4-4**).

Table 4-4: Priority Flora recorded within the Flora Study Area

Taxon	Conservation Status (WA)	Number of populations (individuals) recorded in Flora Study Area	Distribution within Flora Study Area
Eremophila decussata	Priority 1	15+ (700+)	Restricted to two small calcrete rises in the Nullarbor Plain section of the haul road development envelope.
Dampiera ? eriantha	Priority 1 (if D. eriantha), or Unknown status	1 (20)	Restricted to one dune within Study Area.
Eremophila undulata	Priority 2	2 (31)	Restricted to one dune system adjacent mining development envelope.
Acacia eremophila numerous-nerved variant (A.S. George 11924)	Priority 3	10+ several extended populations (116+ recorded. Subdominant in some understoreys, likely 1,000's)	Extensive populations with multiple individuals within homogenous sand plains dominated by Eucalyptus Mallee over Triodia.

Taxon	Conservation Status (WA)	Number of populations (individuals) recorded in Flora Study Area	Distribution within Flora Study Area
Eucalyptus canescens subsp. beadellii	Priority 3	Multiple populations as co-dominant upper story component 100's+	Common within homogenous Sand plains dominated by Eucalyptus Mallee over Triodia. Apparent affiliation to dunes.
Eucalyptus canescens subsp. canescens	Priority 3	Multiple populations as co-dominant upper story component +100's	Common within homogenous Sand plains dominated by Eucalyptus Mallee over Triodia. Apparent affiliation to dunes.
Eucalyptus pimpiniana	Priority 3	Multiple populations (Estimated 10,000+)	Extensive populations with multiple individuals within homogenous sand plains dominated by Eucalyptus Mallee over Triodia.
Lepidium fasciculatum	Priority 3	0 (One historical record)	Unknown. Historical records report single population/ individual in degraded area adjacent Forrest Airstrip as southern terminus of Study Area.
Austrostipa nullanulla	No WA status	2 (Sub-dominant understory component 10s to 100s)	Restricted to two gypsum lunettes adjacent Tecticornia dominated lakebeds.
Eucalyptus vokesensis	Unknown status	2 (likely co/sub-dominant)	Unknown. Two collections 140m and 450 m haul road development envelope
Microcorys sp. 1	Unknown status	3 (3 unknown populations)	Unknown. Three collections between 140 m to over 1 km from development envelope.

No groundwater dependent ecosystems were recorded in the Study Area. No permanent standing, flowing or major ephemeral water flow lines were observed within the Study Area. Some vegetation associations appeared to be reliant on surface water including several small lakes and shrublands associated with small depressions on the Nullarbor Plain.

4.6.4 Introduced Flora Species

The Flora Assessment also recorded 12 introduced species in the Flora Study Area, two of which are Declared Pests within Western Australia: *Heliotropium europaeum* and *Echium plantagineum.* A further weed species *Carrichtera annua* (Ward's Weed) is not a Declared Pest; however, it is considered invasive and was widespread across the Nullarbor Plain bioregion.

4.7 Terrestrial Fauna

A Terrestrial Fauna Impact Assessment was undertaken by Outback Ecology/MWH to assess the impact of the Project on fauna habitats and assemblages. This assessment was in addition to the previously completed fauna surveys at the Project, both coincident with, and surrounding, the Project area (see **Table 4-1**). All of the reports relating to terrestrial fauna are included in **Appendix E**.

4.7.1 Vertebrate Fauna Habitats

There were eight broad fauna habitat types identified in the Study Area (**Figure 4-5**, **Figure 4-6**). These are widespread and typical of the GVD and Nullarbor bioregions, with the exception of the Claypan and Mallee over Spinifex types, which may be more limited. The Project footprint does not require any clearing in the Claypan habitat type.

4.7.2 Vertebrate Fauna

The desktop component of the terrestrial fauna assessment established that there were 338 species of vertebrate fauna that could potentially occur within the Study Area. The desktop study considered 13 previous surveys that were relevant to the Study Area and five databases to compile the potential species list. The field component of the terrestrial fauna assessment identified 178 fauna species, 171 of which were native. This included one species, the Orange-naped Snake (*Furina ornata*), which was not identified in the desktop component, therefore increasing the potential species list from 338 to 339 species (**Table 4-5**).

Figure 4-5: Broad Habitat Areas North

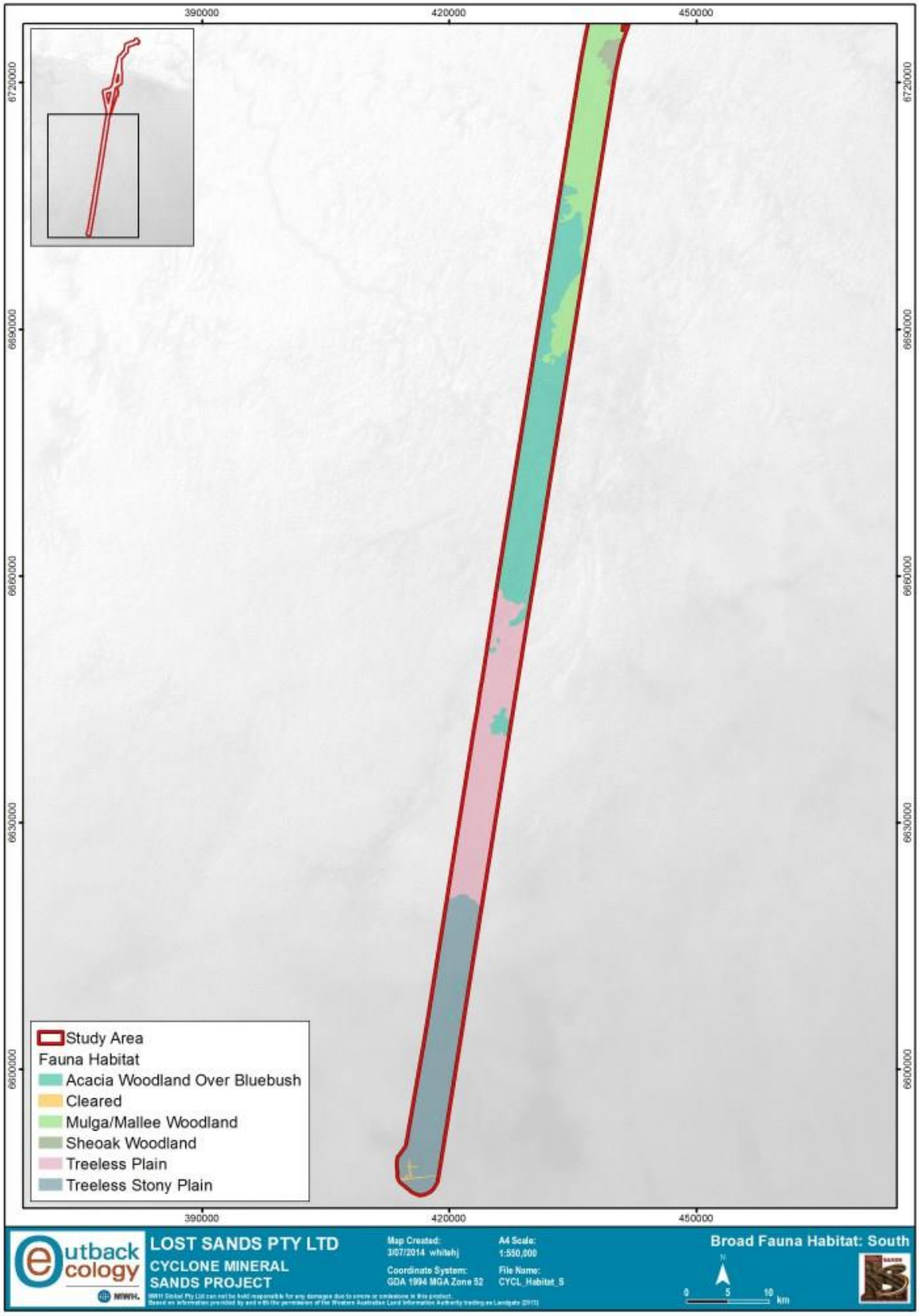

Figure 4-6: Broad Habitat Areas South

Table 4-5: Vertebrate fauna species richness by class in the Fauna Study Area and surrounds

Fauna	Cyclone Terrestrial Fauna Assessment	Desktop Study			Total for field and desktop studies
		Previous surveys	Database searches	Desktop total	
Native mammals	17	33	24	37	**37**
Introduced mammals	6	10	6	10	**10**
Native Birds	87	150	126	160	**160**
Introduced Birds	1	3	1	3	**3**
Native Reptiles	66	109	82	122	**123**
Introduced Reptiles	0	1	0	1	**1**
Amphibians	1	5	1	5	**5**
Total Native Fauna	**171**	**297**	**233**	**324**	**325**
Total Fauna	**178**	**311**	**240**	**338**	**339**

4.7.3 Fauna Species of Conservation Significance

The desktop component of the terrestrial fauna assessment reported 29 species of conservation significance that could potentially occur in the Study Area: seven mammal species; 19 bird species; and four reptile species. This includes species listed under the EPBC Act, the WC Act and the DPaW Priority fauna listings. The field component of the terrestrial fauna assessment recorded 13 species of conservation significance: two mammal species and 11 bird species (**Table 4-6**).

Table 4-6: Fauna of conservation significance found during the terrestrial fauna assessment

Common name (Species name)	Status†		No. of records#	Record types
	EPBC	In WA		
Central Marsupial Mole (*Notoryctes typhlops*)	EN	S1	15	Surface tracks following rain, tunnels observed in trenches
Malleefowl (*Leipoa ocellata*)	VU	S1	1	Tracks
Princess Parrot (*Polytelis alexandrae*)	VU	P4	1	Visual observation
Peregrine Falcon (*Falco peregrinus*)	-	S4	1	Visual observation
Major Mitchell's Cockatoo (*Lophochroa leadbeateri*)	-	S4	1	Visual observation

Common name (Species name)	Status†		No. of records#	Record types
	EPBC	In WA		
Blue Bonnet (*N. haematogaster narethae*)	-	S4	7	Visual and aural observation
Brush-tailed Mulgara (*Dasycercus blythei*)	-	P4	1	Tracks
Striated Grasswren (*Amytornis striatus striatus*)	-	P4	6	Visual and aural observation
Bush Stone-curlew (*Burhinus grallarius*)	-	P4	3	Tracks
Nullarbor Quail-thrush (*C. cinnamomeum alisteri*)	-	P4	1	Visual observation
Australian Bustard *(Ardeotis australis)*	-	P4	10	Tracks and visual observation
Southern Crested Bellbird (*Oreoica gutturalis gutturalis*)	-	P4	134	Visual and aural observation
Rainbow Bee-eater (*Merops ornatus*)	M	S3	16	Visual and aural observation

† See **Appendix E** for full definitions of conservation status.

Note that number of records does not equate to number of individuals, as some survey methods only provide presence/absence information and some records consist of sighting or capture of more than one individual; see **Appendix E** for the complete list of records and accompanying explanatory notes.

4.7.4 Introduced Fauna Species

The desktop study identified 14 species of introduced fauna that potentially occur in the Study area, with seven (50%) of these species recorded during the field survey component of this Assessment. Camel, Dog/Dingo, Fox, Rabbit and Asian House Gecko are all listed as 'Declared Pests' under the *Biosecurity and Agriculture Management Act 2007* (WA), which calls for reduction in their numbers when they are running wild or feral.

4.7.5 Invertebrate Fauna

The presence of SRE invertebrate fauna was also considered during the terrestrial fauna assessment. A further two SRE specific surveys and two database searches relevant to the Study Area also considered during the desktop component of the fauna assessment.

Surveying for SRE was undertaken at all vertebrate fauna systematic survey sites, yielding a total of 210 invertebrate specimens from 32 species, 22 of which were consider to be SREs based on

current scientific knowledge. Millipedes were the most numerous group to be collected although they had the lowest species richness; whereas Mygalomorph spiders yielded the highest number of species from comparatively few specimens (**Table 4-7**).

Table 4-7: Invertebrate taxa collected during the terrestrial fauna assessment survey

Target group	Number of specimens	Number of identifiable
Millipedes	71	2
Scorpions	54	6
Mygalomorph spiders	32	13
Snails	30	5
Pseudoscorpions	12	3
Slaters	11	3
Total	**210**	**32**

None of the potential SRE species collected during this Assessment were obtained from within a restricted habitat. All the SRE species were collected either from multiple habitats in the Study Area, or from habitats that were not considered to be restricted to the Study Area (**Appendix E**). Consequently, the potential SRE status of these species does not necessarily represent a restricted distribution, but may instead represent a lack of taxonomic resolution or lack of regional records.

4.8 Subterranean Fauna

A Subterranean Fauna Assessment was completed for the Project by Outback Ecology/MWH. This assessment consisted of a desktop component and a field reconnaissance survey, completed between 4 and 6 October, 2013 (**Appendix F**).

Information regarding subterranean fauna in the GVD bioregion and the surrounding areas is limited. It is thought that the inland western desert areas, while not as prospective as surrounding areas like the Pilbara, may still support diverse stygofauna communities, particularly when associated with geological units such as groundwater valley calcrete and alluvium. The paucity of regional studies means there has not been the research to support or dispute this. Of the surveys that have been completed in the area, limited stygofauna or troglofauna species have been identified.

Examination of State and Federal lists and database search results did not identify any Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs). The WA Museum's databases were searched, these searches covered an area much larger than the Project area, the searches of both the crustacean and arachnid/myriapod database did not identify any records of subterranean fauna.

The Project area is considered to contain limited prospective habitat for either stygofauna or troglofauna for the following key reasons:

- the proposed mining will remain above the water table;
- the fine grained nature of the geological facies below the ore means the voids and spaces commonly associated with stygofauna habitat will not be available;
- the fine grained nature and absence of voids also means resources (such as oxygen and nutrients) would be restricted from flowing into the aquifers;
- the red sand and interdune loam in the upper metres of the overburden are likely to represent a desiccated environment with humidity levels too low for troglofauna populations to persist;
- the uppermost stratum lacks the vugs and voids typically associated with prospective troglofauna habitat; and
- the calcrete that is present within the Project is pedogenic (formed with soil), as compared to valley calcrete (formed with water). Valley calcrete contains the voids that provide suitable subterranean habitat in other calcrete deposits in WA.

The strata underlying the southern part of the haul road development envelope is associated with the Eucla Basin Tertiary limestone and sandstone sediments. This stratum is sited between Forrest and the southern sector of the GVDNR, approximately 100 km north of Forrest. These sediments are more prospective for subterranean fauna, particularly the karst systems of the Nullarbor Plains. A limestone cave system, named Decoration Cave, is present approximately 38 km to the west of the proposed transport corridor and 80 km northeast of Forrest. Both stygofauna and troglofauna species have been recorded from the Nullarbor Plains Karst system so are highly likely to be present in the area of the southern part of the transport corridor.

4.9 Groundwater

Several desktop groundwater studies have been undertaken for the pre-feasibility stages of the Project to determine potential groundwater sources (see **Table 4-1**). The Project lies within the Officer Basin; one deep investigation bore has been drilled in the mining area, and a Bore Completion Report (Ride, 2014a) and associated Hydrogeological Report (Ride, 2014b) have been prepared by Graham Ride (**Appendix G**).

4.9.1 Regional Groundwater

The Officer Basin (410,000 square kilometres (km^2)), is one of Australia's large sedimentary basins; it encompasses: the Carnarvon Basin (115,000 km^2 onshore, and 535,000 km^2 offshore), the Amadeus Basin (170,000 km^2), the Georgina Basin (330,000 km^2), and the Wiso Basin (160,000 km^2) (Ride, 2014b). Each of these basins has extensive major aquifer systems with varying groundwater quality both spatially and with depth. There are large volumes of groundwater in storage in the different aquifer systems.

Each basin is structurally complex and there are different natural recharge and discharge characteristics in different areas of each of these basins. They all overlie very old basement rock, with thickness varying spatially across the basins. The Officer Basin is estimated to be 10 km thick in its deepest part to the north of the Project (Laurie J. R. Geoscience Australia 2013; Ride 2014b).

The Officer Basin can be visualised schematically as a northwest-southeast trending trough up to 550 km wide and 1,100 km long. Hydrogeologically it can be divided from west to east into several sub-basins (Ride, 2014b).

The Project is within the southern central area of the Waigen area and linked Birksgate sub-basin of the Officer Basin (**Figure 4-7**). These two areas cover approximately 80,000 km^2, about one fifth of the total area of the Officer Basin. The regional groundwater movement in the deep aquifers is from recharge areas around 200 km north of the Project to the south (Ride, 2014b).

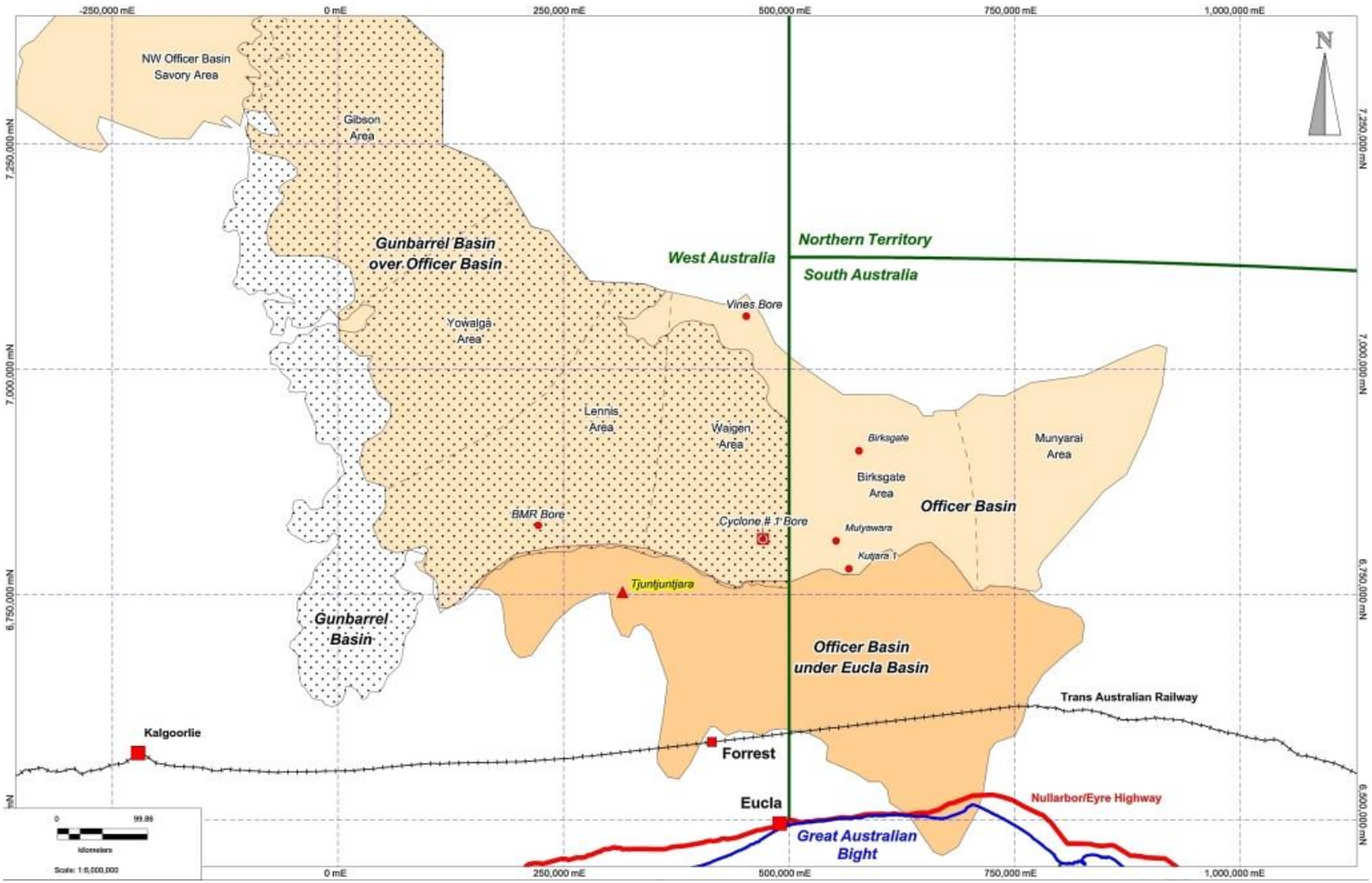

Figure 4-7: Regional Hydrogeology (source: Ride, 2014a)

Shallow, saline to very saline low yielding aquifers occur in paleochannels within the Gunbarrel Basin which overlies the Officer Basin and are also associated with distant salt lakes and playas within the GVD. Major regional paleochannels occur below major surface water drainage lines. Occasional localised shallow aquifers with fair to poor quality groundwater occur in the region the closest known being at the Tjuntjuntjara Community and the Ilkurlka Roadhouse (130 km northwest of the mine site on the Anne Beadell Highway).

Salinity within the region varies greatly but is largely considered as highly saline to hyper saline (>30,000 milligrams per litre (mg/L)). There are a number of bores that display low salinities (<10,000 mg/L) that are associated with shallow bores drilled into locally recharged perched aquifers. However, shallow bores do not necessarily display low salinity. Below 150 m the groundwater is reported to be less saline (<30,000 mg/L). This lower salinity water is associated with Officer Basin Sediments (AGT, 2012).

4.9.2 Local Groundwater

An investigation production bore (Cyclone #1) was drilled into the high yielding saline Officer Basin aquifer within the proposed mine development envelope, and was airlifted on completion to assess aquifer yield and groundwater quality (**Figure 2-5**). The deep aquifers are part of an extensive regional aquifer system and are confined by overlying clay beds. The standing water level within Cyclone #1 was approximately 87 meters below ground level (mbgl) (Ride, 2014b).

Three shallow low yielding drilling water supply production bores were constructed approximately 20 km west of Cyclone to provide water for the construction of Cyclone # 1. These bores intersected fractures in hard fine grained sandstone at less than 36 mbgl. These shallow water table aquifers have a standing water level around 27 m below ground level. The bores are not capable of sustaining a continuous yield of 0.5 litres per second (L/sec). The conductivity of water from the low yielding aquifers intersected in these three shallow production bores varied between 33,700 and 37,900 microsiemens per centimetre (uS/cm) when drilled (Ride, 2014b).

During the construction of Cyclone # 1 very minor shallow aquifers were possibly encountered near the surface just above 36 m and deeper at 44 m and 47 m. The drill cuttings from these depths were damp but when drilling the rest of the hole until 80 m the cuttings were dry. With the large volume of air being used to drill the bore it is not possible to identify whether they were very minor aquifers or only seepage water. The seepage water was saline as the three sets of shallow damp cuttings included white salt when dried (Ride, 2014b).

A saline low yielding aquifer was intersected at 80 m with a field conductivity of 27,220 uS/cm during drilling. The initial airlift yield was 1 L/sec but the rate dropped to a minor amount quickly during drilling operations (Ride, 2014b).

Major aquifers in the Cyclone # 1 were intersected between 527 m and the bottom of the hole at 812 m. These aquifers consisted of fine to coarse sandstone with fine pebble beds in places, generally friable but with hard bands often cyclic. The aquifer thickness is 250 m with generally high permeability and high transmissitivity. The aquifer had not bottomed out at the end of the hole (i.e. the thickness of the main aquifer intersected in this bore is greater than 250 m thick at this location). Drilling ceased at the target depth as clearly the bore had achieved its objective of locating a major aquifer with a yield of at least 20 L/sec (Ride, 2014b).

The upper section of the deep aquifer in Cyclone #1 had a field conductivity of 16,550 µS/cm. Following casing, (and installation of a formation stabiliser and cleaning out of the drilling mud), the airlift yield was estimated at 40 L/sec with a field conductivity 33,150 µS/cm (laboratory conductivity 33,000 µS/cm). On completion of borehole development there was insufficient air capacity on site to airlift the bore from the bottom of the hole. The bore was airlifted at different depths within the production casing (above 250 m) for 12 hours to ensure that stable borehole conditions had been achieved from the air-surging development operation and to confirm the airlift yields were above 20 L/sec. Only very minor sand was airlifted from the hole during this testing operation (Ride, 2014b).

In addition to the careful grouting of the surface casing, the production casing was pressure cemented off to 292 m to prevent contamination of the shallow aquifers from groundwater from deep aquifers or from surface water (Ride, 2014b).

The extensive exploration drilling and limited water supply drilling in the area was assessed to identify shallow aquifers. The drilling indicates that within the mine and adjacent areas these aquifers are occasional, intermittent, localised, low yielding, saline aquifers (Ride, 2014b).

4.10 Hydrology

A surface water assessment of the Project area was undertaken by MWH in March 2014 (**Appendix H**). The assessment describes the surface water catchments at a regional, local and inter-dunal scale.

4.10.1 Regional Catchments

The Project area lies within the central portion of the South Western Plateau region as defined in Australian Water Resources 2005. The entire region covers over 1 M km^2 and stretches over three states: WA, Northern Territory and SA. The Western Plateau region includes the Nullarbor Plain to the south and a large component of the GVD bioregion. The Project area lies 40 km to 50 km north of the northern edge of the Nullarbor Plains where the ground elevation rises distinctly some 80 m over 20 km or less. The drainage lines around the Project are located within the southern part of the GVD bioregion, which eventually flow into the Nullarbor Basin.

The low relief and lack of sufficient rainfall to generate significant drainage patterns gives rise to an absence of regionally significant creeks or water courses. Surface water expressions are restricted to salt plains, pools, non-perennial lakes and short-reach water courses. **Figure 4-8** demonstrates that the mine area is located near the catchment divide between regional catchment areas. From the proposed camp area, the ground falls to the northwest and a salt lake system, which in turn drains southwards towards the Nullarbor Plains. **Figure 4-9** shows the catchment area draining across the haul road along its 250km length.

4.10.2 Great Victoria Desert Nature Reserve

The GVDNR is located to the south of the proposed mine site, with the proposed haul road running north to south through the nature reserve, while the Warburton-Nullarbor basin divide runs east west through GVDNR. The GVD forms the southern part of the large anti-clockwise whorl of dunefields that covers much of central Australia. Sand plains and dunefields are typical of the dominant landforms of the GVD, with the longitudinal dunes typically trending east-west. Dunes can be up to hundred kilometres long, reaching up to 30 m in height and have average spacing of between 200 m and 500 m, however with local variations (Watt and Berens 2011).

The dunes are a key feature of the northern parts of the GVDNR. Topography in the central and southern sections of the GVDNR is flat, with slopes of less than 0.3 m/km. Drainage systems are poorly defined, with an absence of regionally significant creeks or water courses.

There are no permanent creeks or rivers within the GVDNR and most watercourses are short and ephemeral. Surface water expressions are restricted to salt plains, pools and non-perennial lake systems. Due to the combination of flat topography and arid climate, watercourses will flow infrequently and only following heavy rain. Depending on intensity of the rainfall event, flow may occur for only a short period. The dunefields are the key topographical features of the GVDNR and will impact potential flow paths during high rainfall events. Surface water flows in flood events will likely flow along the line of the sand dunes and eventually attenuate due to a combination of flat topography, poorly defined drainage, infiltration and evaporative losses.

4.10.3 Local Catchments

Following a review of available aerial imagery, 10 m and 20 m contour data and anecdotal information obtained during flora and fauna surveys it was ascertained that the local surface water catchments are small, locally limited and not well defined. Surface water expressions when present are typically trapped pools or gullied ruts from local slopes.

There are no permanent creeks/rivers due to the combination of topography and arid climate. Notable lake systems are: the Serpentine Lakes 30 km to the east, the Wanna Lakes 30 to 40 km northwest of the campsite area, and the Forrest lakes 55 km south of the Project area. **Figure 4-10**

shows that the Mine area is just within the extreme edge of a dunefield and just west of a nearby catchment dividing ridgeline (to the east). The catchment areas in the vicinity of the proposed minesite and camp area are shown. A high level desktop approximation of the location of the flood watercourse past the airstrip and camp area is estimated from the contour information and the sand dune locations shown on the aerial image – the actual flowpath during a flood event may be broad and shallow over a wide extent past the airstrip, but it is understood that this flood occurrence has not been reported in recent history.

Figure 4-11 shows the catchment boundaries surrounding the haul road.

Figure 4-8: Regional Surface Water Catchments around the Mine Area

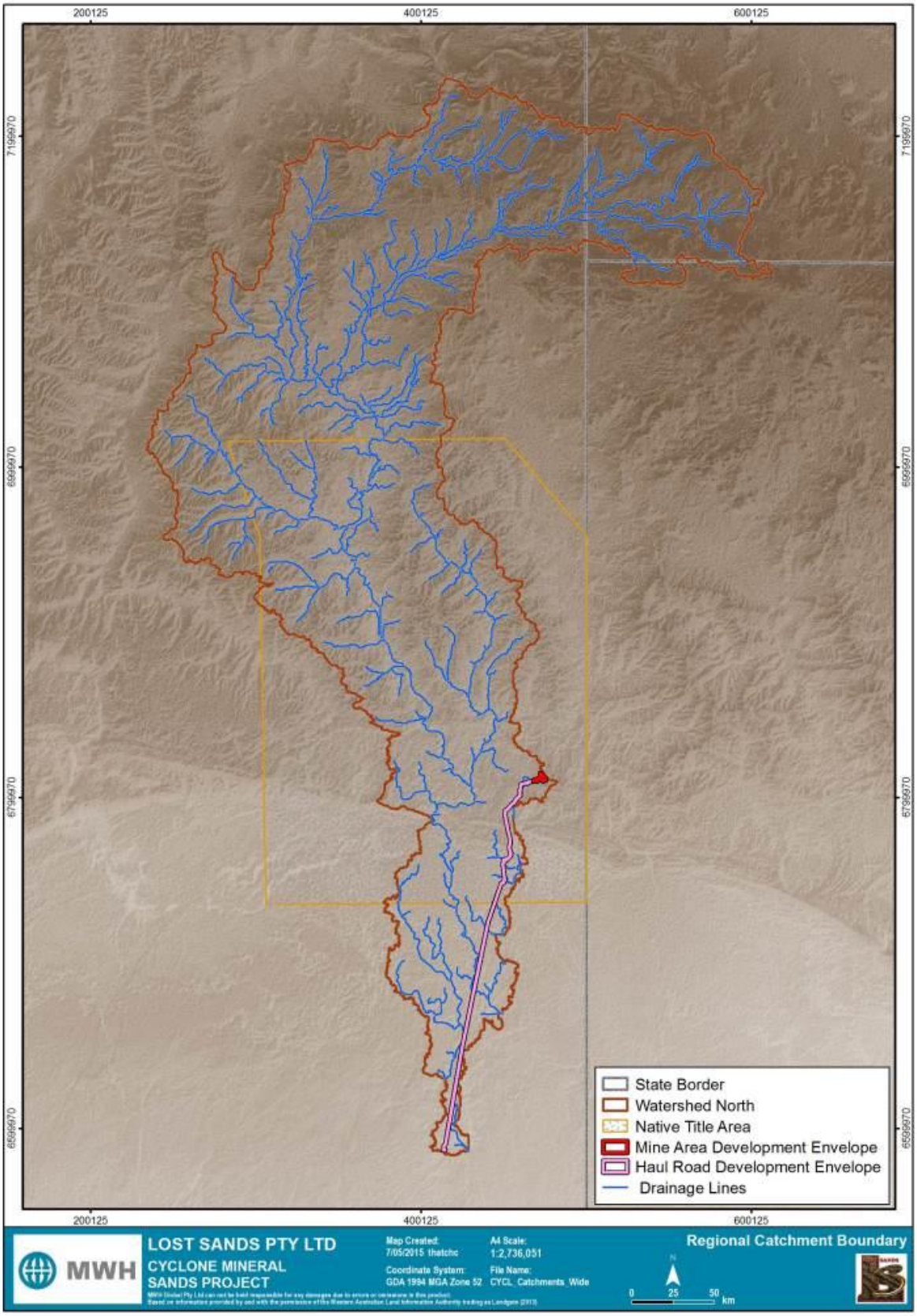

Figure 4-9: Regional Surface Water Catchments around the Haul Road

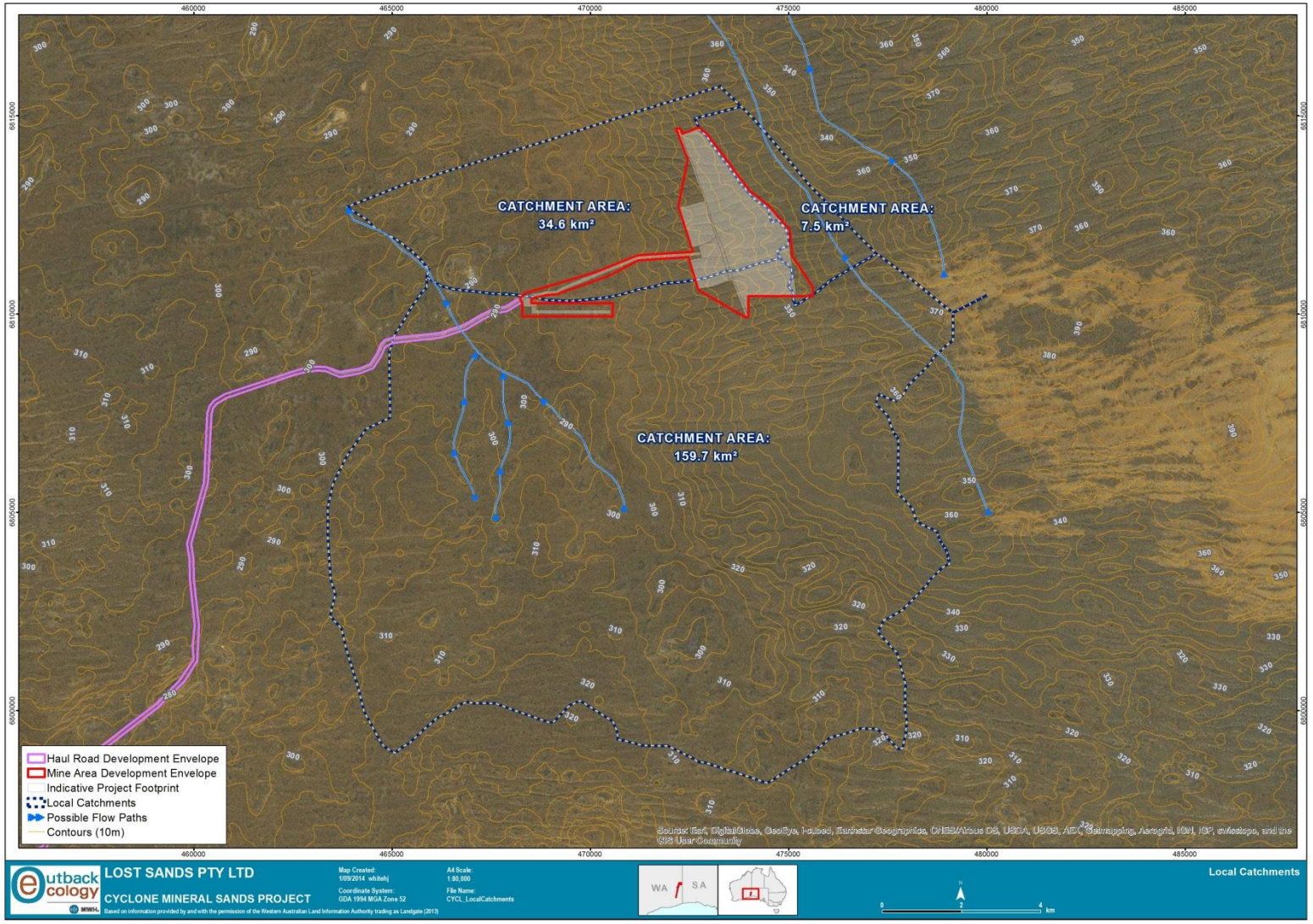

Figure 4-10: Surface Hydrology Local Catchments of the Mine Area

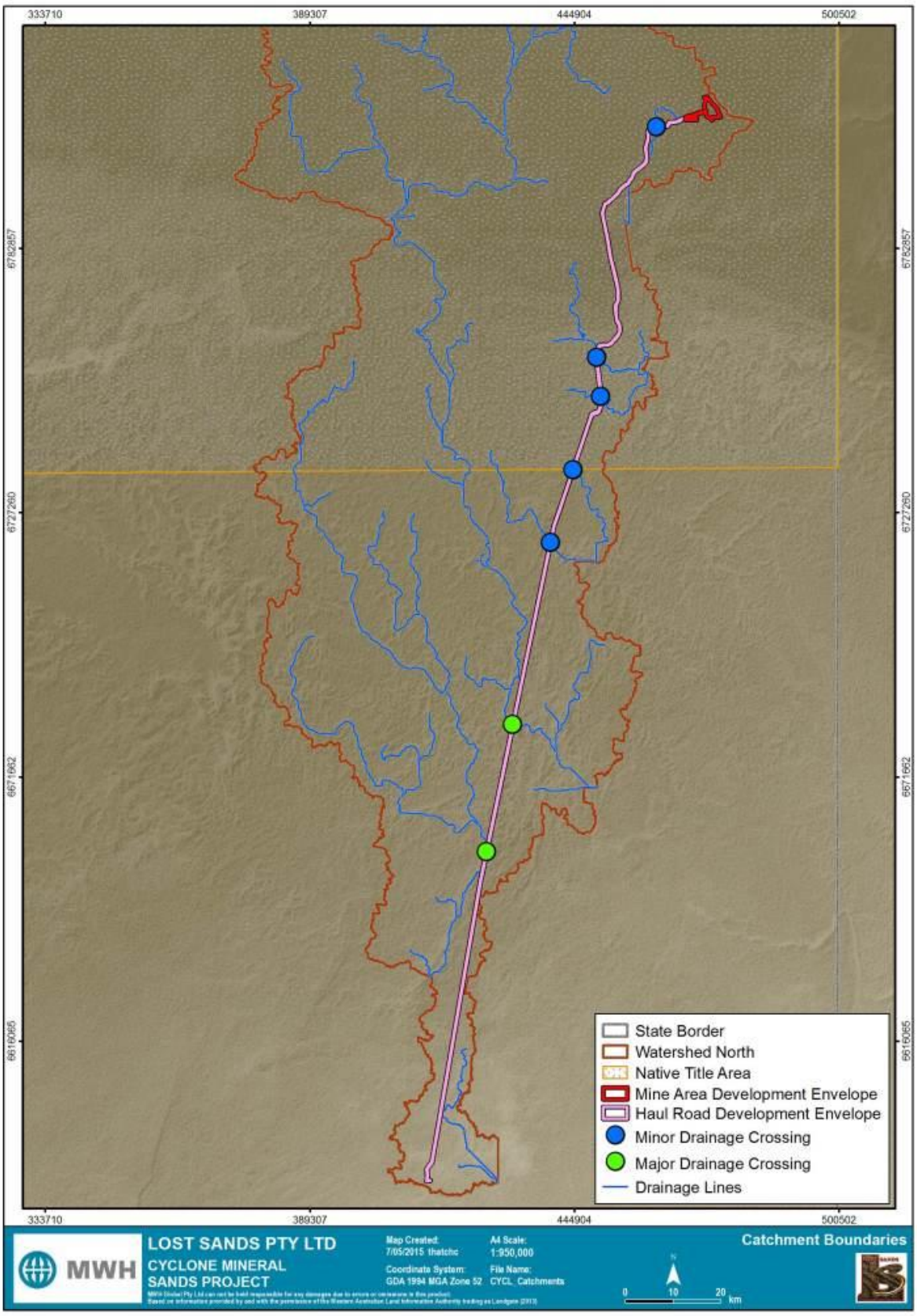

Figure 4-11: Local Hydrology of the Haul Road Area

4.10.4 Inter-Dunal Catchments

Sand plains and dunefields are typical of the dominant landforms of the GVD bioregion, with the longitudinal dunes typically trending east-west. Dunes can be continuous up to 100 km long, reaching up to 30 m in height and have average spacing of between 200 m and 500 m, however, with local variations (Watt *et. al*. 2011; MWH 2014). The sand dune features are understood to have been created by climatic conditions that prevailed some tens of thousands of years ago; they have remained largely unchanged up to the present day. This implies that the dunes are inherently stable and can be expected to be stable, local features over the life of mine.

From east to west across the Project area there is a fall of approximately 80 m. The local topographic high is approximately 2.5 km east of the centre of the proposed minesite footprint and is at a height of approximately 370 m Australian Height Datum (mAHD). The accommodation camp is located approximately 7 km west-southwest of the centre of the minesite and is at approximately 290 mAHD. The airstrip lies on relatively flat ground approximately 1.5 km east from the camp and 5.5 km from the centre of the minesite footprint. Any runoff generated off this local topographic high will flow across the minesite and towards the camp. There is a slight depression at around 280 mAHD approximately 6 km northwest of the camp.

Figure 4-12 depicts the sand dunes that intersect the Project area; these have been identified with numbers (0 to 25) from north to south, their extent and location have been estimated from vegetation and shadow patterns on aerial images, as the contour data is too coarse to represent the sand dunes. Hence, the end of the sand dunes will need to be verified on site.

From experience of other wind-blown sand dune areas in Australia, the sand dune feature can be assumed to absorb an initial depth of rainfall as infiltration and then be effectively impermeable due to the density of the sand particles. This implies that surface water flows in high rainfall events will flow along the line of the sand dunes rather than soak in or infiltrate into the sand dune. Therefore over the Project site, the runoff is expected to run along the base of the sand dunes towards the Project area and across to the open ground that is west of the Project.

Estimations of the location of flow paths past the airstrip and the camp site have been made based on aerial image interpretation, but these require verifying on the ground or more assessment from a highly detailed aerial survey dataset.

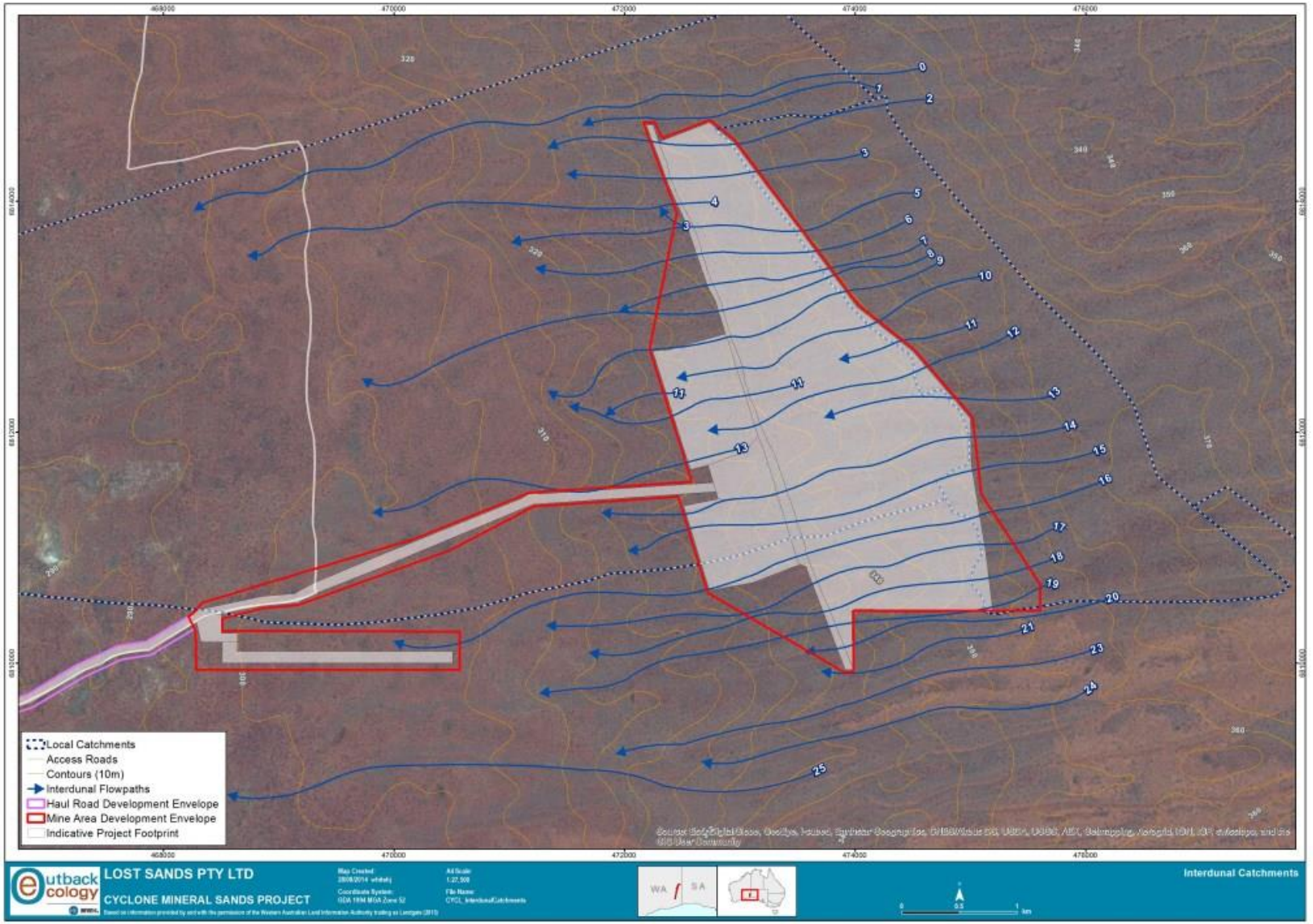

Figure 4-12: Surface Hydrology Interdunal Catchments

4.11 Heritage

On 15th November 2014, a signing ceremony took place on site at Tjuntjuntjara, after which Lost Sands executed the Cyclone Zircon Project Native Title and Mining Agreement (and ancillary documentation) with the Pila Nguru (Aboriginal Corporation)(RNTBC) representing the Spinifex People, the traditional owners of the land containing the Project.

A report detailing Aboriginal Heritage over the Project area was prepared for Lost Sands by Scott Cane in August 2014 (**Appendix I**). The report described previous heritage investigations of the area and gave a summary of the Aboriginal Heritage values of the proposed mine area and haul road. Extensive consultation with and engagement of the traditional owners was undertaken during the survey and assessment process.

4.11.1 Mine Area

No places of significance have been recorded within the mine development envelope although the possibility exists that occasional archaeological finds (manuports, or manually transported objects left on the plains in the past) may be located in the development envelope (Cane 2014).

4.11.2 Haul Road

The haul road development envelope does not directly impact any areas of cultural significance (Cane 2014). Three clay pans are located to the west and east of the haul road (**Figure 4-13**) that are thought to be part of a religious narrative and have cultural significance (Cane 2014).

Figure 4-13: Location of clay pans with Aboriginal Heritage significance

5 Environmental Impact Assessment – Key Environmental Factors

5.1 Flora and Vegetation

The EPA's objective in relation to flora and vegetation is:

'to maintain representation, diversity, viability and ecological function at the species, population and community level'.

5.1.1 Key Statutory Requirements, Environmental Policy and Guidance

Vegetation and flora are protected under state and federal legislation, primarily governed by three Acts:

- Wildlife Conservation Act (WA) (WC Act);
- Environmental Protection Act 1986 (WA) (EP Act); and
- Environmental Protection and Biodiversity Conservation Act 1999 (Cwlth) (EPBC Act).

The following policy and guidance statements were considered in undertaking each of the flora and vegetation surveys and conducting impact assessments:

- EPA Position Statement No. 2, Environmental Protection of Native Vegetation in Western Australia;
- EPA Position Statement No. 3, Terrestrial Biological Surveys as an Element of Biodiversity Protection; and
- EPA Guidance Statement No. 51, Terrestrial Vegetation and Flora Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004).

5.1.2 Assessment of Potential Impact

Specific studies undertaken to assess the impacts of the Project on the flora and vegetation include:

- Cyclone Project Vegetation and Flora Desktop Review (Woodman Environmental Consulting 2011);
- Cyclone Project Preliminary Vegetation and Flora Survey (Woodman Environmental Consulting 2012); and
- Level 2 Vegetation and Flora Survey and Impact Assessment (Outback Ecology/MWH 2014) (**Appendix D**).

This assessment of the potential impact is taken directly from the *Level 2 Vegetation and Flora Survey and Impact Assessment* (Outback Ecology/MWH 2014).

The flora and vegetation recorded within the Cyclone Project Study Area during 2013 and 2014 was relatively rich and diverse, covering variable topography and geology. At least 56% of the flora recorded

in the GVD bioregion section of the Study Area is currently not listed as occurring in the Eastern Maralinga subregion of the GVD (FloraBase 2014). This likely reflects the lack of biological survey effort in the area. A summary of the vegetation and floristic values of the Cyclone Project Study Area is provided in (**Table 5-1**).

Table 5-1: Summary of vegetation and flora of the Cyclone Study Area

Aspect	Biological Values
Vegetation	• No TECs or PECs; • 40 vegetation associations; • Some locally significant vegetation associations based on their extent in the Cyclone Project area (1, 19, 20, 27, 48, 29, 46, 39, 30, 3, 5, 6 and 40); • Vegetation associations 1, 20, 3, 6, 40 have some dependence on maintenance of surface water; and • No obligate groundwater dependant vegetation.
Flora	**Floristic Diversity:** 369 taxa **Priority Flora** • *Eremophila decussata* (P1) (650+ individuals); • *Dampiera ? eriantha* (P1/potential new species) (20 individuals); • *Eremophila undulata* (P2) (31 individuals); • *Acacia eremophila* numerous-nerved variant (A.S. George 11924) (P3) (200+ individuals); • *Eucalyptus pimpiniana* (P3) (650+ individuals); • *Lepidium fasciculatum* (P3) (historically recorded, not located); • *Eucalyptus canescens subsp. beadellii* (P3) *(*co-dominate in multiple locations*);* and • *Eucalyptus canescens subsp. canescens* (P3) *(*co-dominate in multiple locations*).* **Flora of Other Conservation Significance** • *Austrostipa nullanulla* (not previously recorded in WA, Conservation significant in SA and NSW – may represent 2012 misidentification of *Austrostipa vickeryae*); • *Eucalyptus vokesensis* (new record for WA); • *Microcorys* sp. 1 (potential new species); and • 93 Range extensions (nine rated high, 32 rated medium severity). **Weeds** • Extensive distribution of *Carrichtera annua* on Nullarbor Plain; and • Limited numbers of Acetosa vesicaria, Asphodelus fistulosus, Echium plantagineum, Erodium cicutarium, Erodium aureum, Heliotropium europaeum, Malvastrum americanum, Nicotiana glauca, Sonchus oleraceus and Tribulus terrestris.

Clearing will be a direct potential impact to flora and vegetation from the Project. Indirect potential impacts to flora and vegetation from the Project include:

- modification of surface and groundwater flows;
- introduction and spread of weeds;
- generation of dust from mining activities and haul road;
- use of saline water and binding agent along the haul road; and
- alteration of fire regime;

In addition, the Project will potentially have a direct impact to the Class A GVDNR, which is considered separately.

These potential impacts are discussed further in the following sections.

5.1.2.1 Clearing

Vegetation

No TECs, PECs or vegetation communities of conservation significance were recorded in the Project area. Highly variable vegetation communities resulted in 40 vegetation associations being recorded in very low proportions across the Study Area; these are presented in **Table 5-2**.

Vegetation within the Project area tends to follow east-west lateral bands influenced by geologic and climatic variations and gradients. The north-south nature of the Project area results in a thin north-south slice of these vegetation bands, as evidenced in both Land System and Beard Vegetation Mapping. A consequence of this lateral vegetation banding is that vegetation cleared along the vertically aligned footprints of the Project is unlikely to be significantly impacted on a regional scale.

Of the 40 vegetation associations described within the Study Area; 27 (including mosaics) lie under the Project Envelope; four within the Mining Area development envelope and 24 within the haul road development envelope.

Vegetation associations 9 (*Eucalyptus* steppe on Northern red sand dune) and 14 (*Eucalyptus* and Acacia on Northern dune swale) have more than 5% of their total mapped area within the mining area footprint (31.22% and 12.49% respectively). The principal reason for this is that only a small proportion (1.4%) of the Study Area is within the B42 land system which is characterised by dune fields such as those exemplified by vegetation association 9 and 14. Land system B42 extends for a considerable distance to the north, east and west, and is a major land system within the GVD. As sand dunes are a principal feature of the GVD it can be inferred that Project development does not pose a threat to this landform as a whole.

Table 5-2: Vegetation associations within the Project area

Broad vegetation type	Vegetation association	Description	Extent in Study Area (ha)	Extent in Mining Area Envelope (ha) and (% of VA)	Extent in Mining Area Footprint (ha) and (% of VA)	Extent in Haul Road Envelope (ha) and (% of VA)	Extent in Haul Road Footprint (ha) and (% of VA)
Mulga woodlands	12	Mulga Woodland on plain	1,196.52	90.41 (8.8)	33.56 (2.8)		
	16	Southern Mulga	1,236.43			38.94 (3.15)	7.79 (0.63)
	21	Mulga shrubland adjacent dunes.	161.79			25.62 (15.84)	5.65 (3.49)
	41	Burn Scars in mulga woodland	7,172.66			117.49 (1.64)	23.58 (0.33)
	25	Sparse Mulga on Nullarbor Boundary	120.11			23.76 (19.78)	4.74 (3.94)
	42	*Mulga*, *Casuarina* Eucalyptus woodland	615.17			71.83 (11.68)	14.38 (2.34)
Casuarina woodlands	15	Northern *Casuarina* on orange plains	5,257.64	50.83 (4.94)	21.65 (0.41)	108.32 (2.06)	49.22 (0.94)
	22	*Casuarina* patches in Euc sandplain between dune swales	12,062.63			270.76 (2.24)	39.49 (0.33)
	26	Extensive *Casuarina* woodlands (Middle Casuarina)	7,473.09			150.21 (2.01)	29.73 (0.4)
Depressions in *Casuarina* woodlands	36	*Frankenia* and *Atriplex* in *Casuarina* depressions	317.74			3.78 (1.19)	2.91 (0.92)

Broad vegetation type	Vegetation association	Description	Extent in Study Area (ha)	Extent in Mining Area Envelope (ha) and (% of VA)	Extent in Mining Area Footprint (ha) and (% of VA)	Extent in Haul Road Envelope (ha) and (% of VA)	Extent in Haul Road Footprint (ha) and (% of VA)
Eucalyptus gonglyocapra woodlands	9	*Eucalyptus* steppe on Northern red sand dune	1,417.92	205.79 (20.02)	177.08 (12.49)	12.77 (0.9)	2.35 (0.17)
	13	*Eucalyptus* steppe on Southern red sand dune				22.58 (0.5)	2.87 (0.06)
	14	*Eucalyptus* and *Acacia* on Northern Dune swale	1,815.68	680.9 (66.24)	566.83 (31.22)		
Mixed *Eucalyptus* Mallee Woodlands	8	Extensive flat *Eucalyptus* Sandplains	4,513.01			50.81 (1.04)	7.29 (0.15)
Degraded dune at Nullarbor boundary	46	*Acacia* ligulata shrubland	22.13			3.96 (17.9)	0.8 (3.61)
Myall (*Acacia papyrocarpa*) Woodlands	4a	Undulating calcrete plain supporting Myall communities	15,419.62			296.84 (1.91)	59.83 (0.38)
	4b		362.68			3.06 (0.84)	0.59 (0.16)
Shrublands within Nullarbor plain	39	*Muehlenbeckia* depressions in Myall plains	12.58			2.23 (17.77)	0.45 (3.58)
Mosaic	10/15	*Eucalyptus* and Mulga on eroded dunes and plains /15	1,911.25			39.37 (2.06)	7.89 (0.41)
	21/26	See above	27.45			5.79 (2.11)	0.88 (0.32)
	25/41/44	See above/Burn Scars in mulga woodland/*Casuarina* over bluebush	1,189.68			32.86 (2.76)	6.58 (0.55)

Broad vegetation type	Vegetation association	Description	Extent in Study Area (ha)	Extent in Mining Area Envelope (ha) and (% of VA)	Extent in Mining Area Footprint (ha) and (% of VA)	Extent in Haul Road Envelope (ha) and (% of VA)	Extent in Haul Road Footprint (ha) and (% of VA)
	25/44	25/*Casuarina* over bluebush	13,108.37			293.91 (2.24)	58.84 (0.45)
	31/32/38	Low lying drainage areas in Nullarbor plain/Atriplex plains and undulations on Nullarbor Plain/Open plains of *Sasola australis*	15,768.59			354.24 (2.25)	71.71 (0.45)
	38/31	See above	13,952.28			361.35 (2.59)	72.4 (0.52)
	7/8/47	Undulating *Eucalyptus* Sandplains/Extensive flat *Eucalyptus* Sandplains/Old Eucalypt mallee woodland	14,304.14			209.85 (1.21)	41.97 (0.29)
	7/8/47/22	See above	7,598.71			58.96 (0.78)	8.62 (0.11)

No vegetation association within the haul road footprint stands to have more than 5% of its extent within the Study area impacted. This is primarily a result of lateral banding of vegetation associations across the landscape and relatively large size of the study area in comparison to the comparatively thin footprint. Five vegetation associations have more than 2% but less than 4% of their extent within the Study Area under the haul road footprint (21, 25, 42, 46 and 39), and it is unlikely that these would be regionally restricted to the degree that clearing for haul road development would represent a significant impact.

Flora

Potential impacts to conservation significant flora species from the Project are summarised in **Table 5-3.**

Ten flora taxa recorded within the Study Area have been identified as conservation significant. Of the ten, eight are identified as WA Priority Flora species and have been recorded within the Study Area either historically or during surveys for the Project:

- Eremophila decussata (Priority 1);
- Dampiera ? eriantha (Priority 1);
- Eremophila undulata (Priority 2);
- Acacia eremophila numerous-nerved variant (A.S. George 11924) (Priority 3);
- Eucalyptus pimpiniana (Priority 3);
- Eucalyptus canescens subsp. beadellii (Priority 3);
- Eucalyptus canescens subsp. canescens (Priority 3);
- Lepidium fasciculatum (Priority 3);
- Eucalyptus vokesensis (Unknown status - New record to WA); and
- Microcorys sp. 1 (Unknown Status - Potential new species).

Austrostipa nullanulla, is a conservation significant taxa known from New South Wales (NSW) and SA; it was previously unknown to WA, however, it was recorded during the 2012 survey.

Specimens representing an anomalous *Microcorys* (*Microcorys* sp. 1) were collected during Phase 2 in April 2014 and may represent new taxa. Representative specimens have been submitted to the Herbarium of Western Australia for formal classification.

Individuals of the following three species lie within the haul road footprint; distributions of these priority species are known to be widespread both within and outside the Study Area on sand plain areas:

- *Acacia eremophila* numerous-nerved variant (A.S. George 11924) (Priority 3);
- *Eucalyptus pimpiniana* (Priority 3); and
- *Eucalyptus canescens* subsp. *canescens* (Priority 3).

Table 5-3: Summary of potential impacts to conservation significant flora species

Taxon (Status)	Number of populations/individuals recorded				Distribution within the Study Area		Extent of Vegetation Associations hectares (%)				Assessment of Potential Impact			Potential Management Actions
	Study Area	Haul Road Dvlpmnt Envelope	Haul Road Footprint	Mine Area Dvlpmnt Envelope	General Comments	Found within Vegetation Associations	Within Study Area	Within Haul Road Dvlpmnt Envelope	Within Haul Road Footprint	Within Mine Area Dvlpmnt Envelope	Known species records according to Atlas of Living Australia and/or Florabase	Potential impact to known populations (Estimated % of individuals in Study Area within footprint)	Impact Justification	
Eremophila decussata (Priority 1)	(700+)	0	0	0	Restricted to two small calcrete rises in Nullarbor plain section of Study Area.	37 - Extensive Open Plains On Nullarbor Plain: Undulating plain of *Salsola australis*	879.73 (0.65%)	0	0	0	32 records, 1 within Western Australia	Negligible to none (0%)	No records found within the area proposed for development for the haul road or mine area. No known suitable vegetation associations within the area proposed for development for the haul road or mine area. Other records for this species exist inside outside of the Study Area.	
						5 - Shrublands Within Nullarbor Plain: Low calcrete rise on Nullarbor Plain	69.02 (0.055%)	0	0	0				
Dampiera ? eriantha (Priority 1/Status unknown)	1(20)	0	0	0	Restricted to one dune within Study Area.	13 - *Eucalyptus gongylocarpa* Woodlands: Eucalyptus steppe on Southern red sand dune habitat	4513.01 (3.35%)	0	0	0	24 records, all within WA	Negligible to none (0%)	No records found within the area proposed for development for the haul road or mine area. No known suitable vegetation associations within the area proposed for development for the haul road or mine area. Other records for this species exist inside and outside of the Study Area. This species is unlikely to be affected by the development as it was located more than a kilometre from the proposed Haul Road Development Footprint.	
Eremophila undulata (Priority 2)	2(31)	0	0	0	Restricted to one dune system adjacent to the Mining Development Envelope.	14 - *Eucalyptus gongylocarpa* Woodlands: *Eucalyptus* spp. and *Acacia* spp. on Northern Dune swale	1,815.68 (1.355)	0	566.83	680.9	18 records, all within WA	Moderate to negligible (without mitigation) Low to Negligible (if clearing and other impacts avoided) (0%)	Eremophila undulata was recorded adjacent to a sand dune within 350 m of the Mining Development Envelope The second ‘population’ was represented by a single individual some 285 m to the west of the Mining Development Envelope. No records found within the area proposed for development for the haul road or mine area. Suitable vegetation associations exist within the area proposed for development for the haul road or mine area. Suitable vegetation associations exist within the Study Area outside of the area proposed for development for the haul road or mine area. Other records for this species exist inside and outside of the Study Area.	Targeted search of suitable habitat to be conducted prior to commencement of clearing. Populations within the Study Area to be identified and tagged so they can be avoided wherever possible.

Taxon (Status)	Number of populations/individuals recorded				Distribution within the Study Area		Extent of Vegetation Associations hectares (%)				Assessment of Potential Impact			Potential Management Actions
	Study Area	Haul Road Dvlpmnt Envelope	Haul Road Footprint	Mine Area Dvlpmnt Envelope	General Comments	Found within Vegetation Associations	Within Study Area	Within Haul Road Dvlpmnt Envelope	Within Haul Road Footprint	Within Mine Area Dvlpmnt Envelope	Known species records according to Atlas of Living Australia and/or Florabase	Potential impact to known populations (Estimated % of individuals in Study Area within footprint)	Impact Justification	
Acacia eremophila numerous-nerved variant (A.S. George 11924) (Priority 3)	10+ several extended populations (116+ recorded plus sub-dominant in multiple locations, likely 1000's)	0	5/67	0	Extensive populations with multiple individuals within homogenous sand plains dominated by Eucalyptus Mallee over Triodia.	7/8/47 - Mosaic of Mixed *Eucalyptus* spp.: on extensive flat or undulating sandplains and Mallee Woodlands: Old *Eucalypt spp.* Mallee woodland.	21,902.86 (16.28)	209.85	41.97	0	16 records, all within WA	Moderate to Low (without mitigation) Low (if clearing and other impacts avoided) (<1%)	The number of sites where this species was recorded suggests that it is widespread and common throughout the general vicinity, and was a dominant mid-storey shrub in two sites to the west of the Haul Road footprint. Records found within the area proposed for development for the haul road. No records found within the area proposed for development for the mine area. Suitable vegetation associations exist within the area proposed for development for the haul road. Suitable vegetation associations exist within the Study Area outside of the area proposed for development for the haul road or mine area. Other records for this species exist inside and outside of the Study Area.	Targeted search of suitable habitat to be conducted prior to commencement of clearing. Populations within the Study Area to be identified and tagged so they can be avoided wherever possible.
						8 - Mixed *Eucalyptus* spp.: Extensive flat *Eucalptyus* spp. sandplains	4881.46 (3.63)	50.81	7.28	0				
Eucalyptus canescens subsp. *beadellii* (Priority 3)	Multiple populations as co-dominant upperstorey	0	0	0	Common within homogenous Sand plains dominated by Eucalyptus Mallee over Triodia. Apparent affiliation to dunes.	7/8/47/22 - Mosaic of Mixed *Eucalyptus* spp.: on extensive flat or undulating sandplains and Mallee Woodlands: Old *Eucalypt spp.* Mallee woodland.	21,902.86 (16.28)	209.85	41.97	0	52 records one within WA in the Great Victoria Desert Nature Reserve	Moderate to Low (without mitigation) Low (if clearing and other impacts avoided) (<1%)	Impacts to this species will be minimised as the Haul Road generally avoids crossing dune systems wherever possible. No records found within the area proposed for development for the haul road or mine area. Suitable vegetation associations within the area proposed for development for the haul road or mine area. Other records for this species exist inside and outside of the Study Area.	Targeted search of suitable habitat to be conducted prior to commencement of clearing. Populations within the Study Area to be identified and tagged so they can be avoided wherever possible.
						13 - *Eucalyptus gongylocarpa* Woodlands: Eucalyptus steppe on Southern red sand dune habitat	4513.01 (3.35)	22.57	2.87	0				
						22 - *Casuarina* spp. woodlands: *Casuarina* spp. patches in *Eucalyptus* spp. sand plain between dune swales	12,062.63 (8.97)	270.78	39.5	0				

Taxon (Status)	Number of populations/individuals recorded				Distribution within the Study Area		Extent of Vegetation Associations hectares (%)				Assessment of Potential Impact			Potential Management Actions
	Study Area	Haul Road Dvlpmnt Envelope	Haul Road Footprint	Mine Area Dvlpmnt Envelope	General Comments	Found within Vegetation Associations	Within Study Area	Within Haul Road Dvlpmnt Envelope	Within Haul Road Footprint	Within Mine Area Dvlpmnt Envelope	Known species records according to Atlas of Living Australia and/or Florabase	Potential impact to known populations (Estimated % of individuals in Study Area within footprint)	Impact Justification	
Eucalyptus canescens subsp. *canescens* (Priority 3)	Multiple populations as co-dominant upper story component	0	1/co-dominant	0	Common within homogenous Sand plains dominated by Eucalyptus Mallee over Triodia. Apparent affiliation to dunes.	7/8/47/22 - Mosaic of Mixed Eucalyptus spp.: on extensive flat or undulating sandplains, Mallee Woodlands: Old Eucalypt spp. Mallee woodland and Casuarina spp. woodlands: Casuarina spp. patches in Eucalyptus spp. sand plain between dune swales	21,902.86 (16.28)	268.81	50.59	0	93 records, three within WA one within the Great Victoria Desert Nature Reserve	Moderate to Low (without mitigation)Low (if clearing and other impacts avoided) (<1%)	Impacts to this species will be minimised as the Haul Road generally avoids crossing dune systems wherever possible. Records found within the area proposed for development for the haul road. No records found within the area proposed for development for the mine mine area.Suitable vegetation associations exist within the area proposed for development for the haul road or mine area.Other records for this species exist inside and outside of the Study Area.	Targeted search of suitable habitat to be conducted prior to commencement of clearing. Populations within the Study Area to be identified and tagged so they can be avoided wherever possible.
Eucalyptus pimpiniana (Priority 3)	3019+ (Estimated 10,000+)	2/509+ Population of 500+ extending 1km+ with centre in envelope. Likely small proportion of population within haul road footprint.		0	Extensive populations with multiple individuals within homogenous sand plains dominated by Eucalyptus Mallee over Triodia.	7/8/47 - Mosaic of Mixed *Eucalyptus* spp.: on extensive flat or undulating sandplains and Mallee Woodlands: Old *Eucalypt spp.* Mallee woodland.	21,902.86 (16.28)	209.85	41.97	0	207 Records, many within WA, four within the Great Victoria Desert Nature Reserve	Moderate to Low (without mitigation) Low (if clearing and other impacts avoided) (<1%)	*E. pimpiniana* is present in the general region in great numbers and while a number of individuals would be impacted by Haul Road development this would present a negligible (<1%) impact to the general population as a whole. Records found within the area proposed for development for the haul road. No records found within the area proposed for development for the mine mine area. Suitable vegetation associations exist within the area proposed for development for the haul road or mine area. Other records for this species exist inside and outside of the Study Area.	Targeted search of suitable habitat to be conducted prior to commencement of clearing. Populations within the Study Area to be identified and tagged so they can be avoided wherever possible.
						13 - *Eucalyptus gongylocarpa* Woodlands: Eucalyptus steppe on Southern red sand dune habitat	4513.01 (3.35)	22.57	2.87	0				
Lepidium fasciculatum (Priority 3)	0 (One historical record)	0	0	0	Unknown. Historical records report single population/individual in highly degraded area adjacent Forrest Airstrip as southern terminus of Study Area.	31/32/38 - Mosaic of Extensive Open Plains On Nullarbor Plain Low lying drainage areas in Nullarbor Plain, Atriplex plains and undulations on Nullarbor Plain and Open plains of *Salsola australis*	15757.29 (11.72)	351.07	69.59	0	578 Records, many within WA, one within the Great Victoria Desert Nature Reserve	Unknown, likely Negligible (0?%)	A single historical record exists for this species within the Study Area. This species was not found within the Study Area during the current surveys.Suitable vegetation associations exist within the area proposed for development for the haul road or mine area. Other records for this species exist outside of the Study Area.	

Taxon (Status)	Number of populations/individuals recorded				Distribution within the Study Area		Extent of Vegetation Associations hectares (%)				Assessment of Potential Impact			Potential Management Actions
	Study Area	Haul Road Dvlpmnt Envelope	Haul Road Footprint	Mine Area Dvlpmnt Envelope	General Comments	Found within Vegetation Associations	Within Study Area	Within Haul Road Dvlpmnt Envelope	Within Haul Road Footprint	Within Mine Area Dvlpmnt Envelope	Known species records according to Atlas of Living Australia and/or Florabase	Potential impact to known populations (Estimated % of individuals in Study Area within footprint)	Impact Justification	
Austrostipa nullanulla (No WA status)	2 (Sub-dominant understory component)	*0*	0	0	Restricted to two gypsum lunettes adjacent Tecticornia dominated lakebeds. Possibly misidentified to A. vickeryae.	29 - Lake Bed and Margins: Calcrete/gypsum hill adjacent Lakes	22.93 (0.02)	0	0	0	146 Records, none within WA, two on the border with South Australia within the Great Victoria Desert Nature Reserve	Negligible to none (0%)	No records found within the area proposed for development for the haul road or mine area. No known suitable vegetation associations within the area proposed for development for the haul road or mine area. Other records for this species exist inside outside of the Study Area.	
Eucalyptus vokesensis (No WA status)	1 (1)	0	0	0	Unknown. Two collections 450 m and 150 m from Haul Road Envelope.	7/8/47 - Mosaic of Mixed *Eucalyptus* spp.: on extensive flat or undulating sandplains and Mallee Woodlands: Old *Eucalypt spp.* Mallee woodland.	21,902.86 (16.28)	209.85	41.97	0	68 Records, none within WA, multiple records from South Australia within the Great Victoria Desert Nature Reserve	Unknown, likely Moderate (no mitigation) Moderate to Low (if clearing and other impacts avoided (0-5%)	No records found within the area proposed for development for the haul road or mine area. Suitable vegetation associations exist within the area proposed for development for the haul road or mine area. Other records for this species exist inside outside of the Study Area.	Targeted search of suitable habitat to be conducted prior to commencement of clearing. Populations within the Study Area to be identified and tagged so they can be avoided wherever possible.
Microcorys sp. 1	3(3)	0	0	0	Unknown. One collection + 1 km from development envelope. Two collections closer to Haul Road Envelope (140m and 170m).	7/8/47 - Mosaic of Mixed *Eucalyptus* spp.: on extensive flat or undulating sandplains and Mallee Woodlands: Old *Eucalypt spp.* Mallee woodland.	21,902.86 (16.28)	209.85	41.97	0	Unknown. Potential new species under investigation by the WA Herbarium	Unknown, likely Moderate (no mitigation) Low to Negligible (if clearing and other impacts avoided (0-5%)	No records found within the area proposed for development for the haul road or mine area. Suitable vegetation associations exist within the area proposed for development for the haul road or mine area. Other records for this species exist inside outside of the Study Area.	Investigations underway at the WA Herbarium to confirm if this is a new species. If this is confirmed a targeted search of suitable habitat will. be conducted prior to commencement of clearing. Populations within the Study Area to be identified and tagged so they can be avoided wherever possible.
						22 - *Casuarina* spp. woodlands: *Casuarina* spp. patches in *Eucalyptus* spp. sand plain between dune swales	12,062.63 (8.97)	270.78	39.5	0				

Individuals of the three Priority species within the GVDNR section of the haul road are recorded as having wide distributions; numerous individuals and populations were observed in the field. Without conventional mitigation such as avoiding clearing and maintenance of surface water flows, the potential impact to these species as a whole from proposed activities is considered low to moderate. With conventional mitigation the potential impact is considered low.

Eucalyptus vokesensis and *Microcorys* sp. 1 were recorded within sand dune areas in close proximity to the haul road envelope (150 m and 141 m respectively); there exists the possibility that unrecorded populations may incur some impacts from development of the Project. Both taxa populations were also recorded some distance away from the haul road (450 m and 1 km). The potential impacts cannot be accurately predicted, but with conventional mitigation the potential impacts are likely to be low to negligible. If identifications for either of these taxa return as being conservation significant, a small scale targeted search will be conducted prior to the commencement of works, with the objective of realigning the haul road within the haul road envelope to avoid significant populations.

It should be noted that the haul road footprint has been aligned to avoid sand dune areas wherever possible, and this alignment has likely avoided significant impacts to flora with an affinity to these areas such as *Eremophila undulata* (Priority 2), *Dampiera* ? *eriantha* (Priority 1), Eucalyptus *canescens* subsp. *beadellii* (Priority 3), *Eucalyptus canescens* subsp. *canescens* (Priority 3) and *Microcorys* sp. 1 (unknown Status).

Eremophila undulata (Priority 2) was recorded in sand dune areas within 180 m of the mining development envelope. While it is not anticipated that Project activities will have any direct impact on the species or individuals, care will be taken to demarcate populations and avoid incidental access or related impacts.

Lepidium fasciculatum (Priority 3) has historically been recorded adjacent to the Forrest Airstrip, however, was not recorded despite targeted searches of the previously known location and similar vegetation within the southern terminus of the haul road and rail infrastructure footprint. Since the taxa could not be located impacts cannot be accurately quantified, however, as the Project footprint cover a small fraction of potential habitat for *L. fasciculatum* it is considered that with conventional mitigation the potential impact would be moderate to negligible.

Eremophila decussata (Priority 1), *Dampiera* ? *eriantha* (Priority 1) and *Austrostipa nullanulla* were not recorded as occurring within or in close proximity to the development footprint, and the level of impacts arising from Project development at the individual and species level are considered to be negligible.

5.1.2.2 Modification To Surface And Groundwater Flows

Several small depressions in the northern half of the haul road development envelope and a number of Shrubland associations in the Nullarbor Plain portion of the haul road development envelope appear reliant on sporadic surface water availability (vegetation associations 36, 4b, 39, 31). These locations represent shallow depressions where water accumulates during sporadic rainfall events. These vegetation associations may be impacted through interruption of surface water flows through construction of the haul road. These impacts would be considered low or moderate on a local scale, and low or negligible on a regional scale. Conventional surface water control measures that maintain surface flows will ameliorate potential risks to the vegetation and flora from changes in flows. Efforts will be made to avoid erosion and transport of material from road building activities into shallow depressions and other low lying areas.

No ground water dependent ecosystems or species were recorded within the Study Area.

5.1.2.3 Introduction and Spread of Weeds

Twelve introduced flora were recorded across the Study Area:

- Acetosa vesicaria (Ruby Dock);
- Asphodelus fistulosus (Onion Weed);
- Brassica ? tournefortii (Mediterranean Turnip);
- Carrichtera annua (Ward's weed);
- Echium plantagineum (Paterson's Curse);
- Erodium cicutarium (Common Storksbill);
- Erodium aureum;
- Heliotropium europaeum (Common Heliotrope);
- Malvastrum americanum (Spiked Malvastrum);
- Nicotiana glauca;
- Sonchus oleraceus (Common Sowthistle); and
- Tribulus terrestris (Caltrop).

The majority of these weeds were in low numbers and frequency and are unlikely to diminish the biological diversity of the Study Area as the majority are spread by fauna and water vectors. Development and use of the haul road may result in the transport and spread of weed species, predominantly in a south to north direction. The use of vehicle washdown bays at the southern end of the haul road at the rail siding will reduce the potential for weed spread into the GVDNR and along the haul road. Pooling of water in borrow pits adjacent to the haul road may be a potential source for weed spread. However, given the proposed shallow nature of the borrow pits, low rainfall, high evaporation rate and high soil infiltration rate, any pooling will be short-lived and not sufficient for uncontrollable

weed growth. Borrow pits will be inspected regularly and any weeds will be controlled in accordance with the Weed Management Plan (**Appendix C**)

Development and implementation of a weed management and monitoring program will allow the potential spread of any introduced species to be observed and managed. Should monitoring indicate an increase in the weed populations, remedial action such as spraying or manual removal may be implemented (appropriate to the species being targeted).

Carrichtera annua was recorded in vast numbers throughout the Nullarbor Plains section of the Study Area. It is likely that the spread of this species has been facilitated by the high numbers of Camels and Rabbits seen in these areas. Additionally, in Australia *C. annua* is typically restricted to calcrete soils. For these two reasons it is probable that *C. annua* has reached the northern limit of its potential distribution within the Study Area, and barring isolated patches of suitable ground it is unlikely to spread further north from its current distribution. The extent of *C. annua* could not be mapped during the Phase 2 April 2014 Survey as germination had not yet begun, hence mapping will be conducted prior to Project construction.

Heliotropium europaeum and *Echium plantagineum* are listed as declared pests within WA but were not found to be widely distributed across the Study Area. *Echium plantagineum* was recorded in one location adjacent to the Forrest airstrip. A survey and subsequent spraying for these species will take place prior to development of the Project to reduce the likelihood of spread.

5.1.2.4 Generation of Dust

The haul road will be unsealed, and haulage trucks and light vehicles utilising the haul road will generate dust. Anticipated truck movements equate to two (2) truck movements (a return trip from Cyclone to Forrest), in any four hour period, or 12 truck movements in any 24 hour period; this incorporates both haul trucks and water-truck movements. Impacts to vegetation from dust are likely to be limited to within 50 to 100 m of the roads. Dust is unlikely to result in the loss or significant impact to any particular vegetation association; however, the population of Priority 2 Flora *Eremophila undulata* may be affected by excessive dust under certain conditions.

The potential impacts from dust to the population of *Eremophila undulata* and other vegetation and flora will be mitigated through the use of dust suppression and utilisation of a binding agent along the haul road. Monitoring of this species will be undertaken in accordance with the Vegetation and Flora Management Plan (**Appendix C**).

5.1.2.5 Use of Saline Water and Binding Agent on Haul Road

A binding agent will be used in construction of the road in order to minimise dust generation. Depending on the nature of the binding agent, it is possible that contaminants could be released to the surrounding soils and vegetation. In addition, saline water will be used to suppress dust along the haul road. Incidental spraying of saline water on the vegetation alongside the haul road and runoff from the road may potentially result in a decline in vegetative health.

The road will be constructed such that drainage swales will be present on either side, which will ensure that there is a buffer between the road and the vegetation, therefore reducing the potential direct impact to vegetation. Potential impacts to vegetation and flora from saline water and binding agent are considered to be lower than those from the generation of dust; hence dust mitigation is considered to be a necessary management action.

5.1.2.6 Alteration to the Fire Regime

Construction and operation of the Project may potentially result in the initiation of fire that may spread to the surrounding vegetation if not controlled. A Fire Minimisation Plan has been developed (**Appendix C**) to ensure that should a fire be initiated, it can be promptly brought under control and not spread outside the Project area.

5.1.2.7 Potential Impact to the GVDNR

The GVDNR is a Class A nature reserve that is of great importance for conservation of biological and landscape values and maintenance of Aboriginal culture and traditional usage (Chapman *et al.* 1994).

An expected 306 ha of clearing will be required to build the haul road within the GVDNR, which amounts to 0.012% of the total reserve. In addition to direct clearing, indirect potential impacts may occur to vegetation and flora within the GVDNR due to:

- modification of surface and groundwater flows;
- introduction and spread of weeds;
- generation of dust from mining activities and haul road;
- use of saline water and binding agent along the haul road; and
- alteration of fire regime;

These potential impacts are discussed in detail in the preceding sections. In addition, the construction of the haul road may result in unauthorised public use of the road and the creation of additional tracks through the GVDNR. This will be mitigated through the use of signage that indicates that the haul road is for use by Project personnel, DPaW and Traditional Owners only. A system will be implemented for monitoring and controlling unauthorised usage of the road and truck drivers will be responsible for

reporting sightings of any vehicles that are not regular authorised users. Through on-ground surveys it was discovered that there are already numerous rough tracks throughout the reserve. It is considered that the construction of one good road would eliminate the need to continue to use many of the rough tracks, which would allow them to regenerate.

As discussed in **Section 1.2** and **4.5.2**, immediately east of the GVDNR is the South Australian Mamungari Conservation Park which has been classified as a UNESCO world biosphere reserve. The common border of these conservation reserves is the WA-SA state border, and the combined size of the two reserves is an estimated 4,627,104 ha of continuous conservation reserve (GVDNR is 2,494,504 ha and Mamungari is 2,132,600 ha (UNESCO, 2014)) (see **Figure 4-3**).

The design phase of the Project initially considered eight options for the haul road, and three of these were subsequently selected for further consideration. These included two alternative routes for the haul road, western and eastern options, in addition to the central option discussed in this PER (see **Appendix A**). All three haul road options were found to have similar vegetation types. The western option, which skirts the western boundary of the GVDNR, was ruled out due to the unacceptable impacts to Aboriginal heritage that would result in the development of this route. In addition, this route would have been significantly longer, resulting in 405 km of road and an estimated clearing of 810 ha of native vegetation, creating a substantially larger disturbance area than the other two options.

If administrative boundaries are not taken into account, both the central haul road option and eastern haul road option would result in fragmentation of an extensive continuous conservation reserve. The eastern haul road option will partially impact both the GVDNR and the Mamungari Conservation Park, as well as pass through the Forrest Lakes system and a large area of sand dune habitat between Cyclone and Forrest Lakes, suggesting there will not be any conservation benefit of using this option and potentially an impact to a greater diversity of habitats. In addition, 33 km of the northern section of the proposed haul road is an existing road. For these reasons the central haul road option through the GVDNR was chosen as the preferable haul road route.

The haul road will remain a private mine road throughout the operation and therefore public access to the GVDNR and associated potential impacts will be prevented. However, construction and operation of the haul road will result in potential impacts to the vegetation and flora of the GVDNR as described above, including clearing, introduction and spread of weeds, spread of dust and increased fire risk. These potential impacts may occur until such time as the road is successfully rehabilitated. The Project has a ten year mine life; the haul road will be the first feature to be developed and the last feature to be rehabilitated; hence will remain cleared for approximately 12 years. It is anticipated that a large

percentage of the environmental values will be returned within five years of rehabilitating the road (as described in the Mine Closure Plan, **Appendix L**).

Indirect impacts to the GVDNR from construction and operation of the road will be mitigated through implementation of the management plans (Appendix C). Given that the GVDNR is a class A nature reserve, it may be considered that the clearing of 306 ha for the haul road is a significant residual impact, until such time as the road is successfully rehabilitated. This has been estimated as a total of 17 years. Given that this impact cannot be mitigated for the period of 17 years, Lost Sands has proposed an offset package as detailed further in **Section 5.8** below.

5.1.3 Management Measures

A vegetation and flora management plan, weed management plan, water management plan, dust management plan, fire minimisation plan and haul road management plan have been developed (**Appendix C**) and include, but are not limited to, management actions that relate to the following:

- minimising clearing at all times;
- demarcating and avoiding conservation significant flora where possible;
- mapping of weeds prior to Project construction and ongoing monitoring;
- prevention of weeds being introduced into the GVDNR, including ongoing weed monitoring and management, weed hygiene measures and eradication techniques;
- development of a conservation significant flora and weed identification guide, to be made available to all personnel that are managing clearing activities;
- stockpiling vegetation and topsoil appropriately;
- maintaining surface water flow where possible;
- incorporating a binding agent into the construction of the haul road in order to minimise dust;
- implementing regular dust suppression along the haul road and internal mine roads;
- design and implementation of a vehicle washdown station at the southern end of the haul road at the rail siding. This could ensure that all vehicles travelling into the Project area do not carry in any new introduced weeds species. This would be especially relevant for earth moving equipment during construction;
- avoiding transport of material from road building activities into shallow depressions and other low lying areas;
- personnel education and awareness training;
- monitoring of vegetation, flora and priority flora in appropriate locations along the haul road and surrounding the mine site;
- progressive rehabilitation techniques, and trials to determine the best means to restore vegetation as close as possible to pre-mining state; and
- fire prevention, response and reporting.

5.1.4 Predicted Outcome

Through assessment of potential impacts to flora and vegetation arising from clearing, modification to surface and groundwater flows, spread of weeds, generation of dust and initiation of fire, it has been determined that with application of suitable management measures and rehabilitation techniques there is not likely to be a significant impact to vegetation and flora from construction and implementation of the Project. Within the GVDNR, potential indirect impacts to flora and vegetation will be mitigated through implementation of management plans. However, due to the status of the GVDNR, the short term loss of 306ha of vegetation may be considered significant and therefore require offsets. Therefore, it is expected that the EPA's objective to 'maintain representation, diversity, viability and ecological function at the species, population and community level' will be satisfied, subject to the implementation of suitable offsets.

5.2 Terrestrial Fauna

The EPA's objective in relation to terrestrial fauna is:
'to maintain representation, diversity, viability and ecological function at the species, population and assemblage level'.

5.2.1 Key Statutory Requirements, Environmental Policy and Guidance

Terrestrial fauna are protected under state and federal legislation, primarily governed by three Acts:

- Wildlife Conservation Act (WA) (WC Act);
- Environmental Protection Act 1986 (WA) (EP Act); and
- Environmental Protection and Biodiversity Conservation Act 1999 (Cwlth) (EPBC Act).

The following guidance and policy have been considered in undertaking fauna surveys and impact assessment:

- Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection;
- Guidance Statement No. 56 Terrestrial Fauna Surveys for Environmental Impact Assessment;
- Guidance Statement No. 20 Short Range Endemic Invertebrate Fauna; and
- Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment

5.2.2 Assessment of Potential Impact

Specific studies (**Appendix E**) undertaken to assess the potential impacts of the Project on terrestrial fauna include:

- Desktop Fauna Assessment of the Cyclone Deposit Project by Bamford Consulting Ecologists, September 2012;
- Fauna Assessment of Transport Corridor Options for the Lost Sands Project (Cyclone Deposit) by Bamford Consulting Ecologists, June 2012; and
- Level 2 Terrestrial Fauna Impact Assessment by Outback Ecology/MWH, July2014.

The Terrestrial Fauna Impact Assessment by Outback Ecology/MWH is referred to in the following sections unless otherwise stated.

Habitat removal and modification will be a direct potential impact to fauna and fauna assemblages. Indirect potential impacts to fauna and fauna assemblages include:

- habitat removal and modification;
- altered fire regime;
- collision with vehicles;
- noise and vibration;

- artificial light;
- increased dust generation;
- introduced flora; and
- introduced fauna.

In addition, the Project will potentially have a direct impact to the Class A GVDNR, which is considered separately.

These potential impacts are discussed further in specific sections relating to fauna habitats, vertebrate fauna, conservation significant fauna and invertebrate fauna below.

5.2.2.1 Impacts to Fauna Habitats

Eight broad fauna habitats were mapped within the Study Area (**Table 5-4**). Each of the habitats that occur in the Project area were assessed to determine the area of the habitat within the Study Area and the importance of that habitat type to fauna of conservation significance. Widespread habitats are those that occupy more than 2% of the Study Area, and significant habitats are capable of supporting fauna of conservation significance or distinct faunal assemblages (**Table 5-4**).

Seven of the eight broad fauna habitats identified in the Study Area may be affected by land clearing during the construction and operation of the Project, as they intersect either one or both of the development envelopes. The Dune Field, Sheoak Woodland and Mulga-Mallee Woodland habitats would be subject to the greatest direct impact, however, they only represent a potential disturbance of 3.1%, 0.6% and 0.6% respectively within the Study Area.

Within broad habitat types there are also significant habitat features comprising sand dune crests and drainage depressions that will be impacted. The specific impacts of clearing these significant fauna habitats is discussed in further detail in the Terrestrial Fauna Impact Assessment (**Appendix E**).

Table 5-4: Habitat extents in the Study Area and proposed disturbance areas

Broad fauna habitat	Context #	Extent in^		
		Study Area~	Development envelopes†	Indicative Project
Dune Field	Widespread Significant	25,292 ha (18.8%)	1,101 ha (4.4%)	776 ha (3.1%)
Mulga/Mallee Woodland	Widespread Significant	16,387 ha (12.2%)	407 ha (2.5%)	97 ha (0.6%)
Sheoak Woodland	Widespread Significant	30,244 ha (22.5%)	755 ha (2.5%)	183 ha (0.6%)
Claypan	Limited extent Significant	103 ha (0.1%)	0 ha (0.0%)	0 ha (0.0%)
Mallee over Spinifex	Limited extent Significant	12,106 ha (9.0%)	230 ha (1.9%)	43 ha (0.4%)
Acacia Woodland Over Bluebush	Widespread Limited significance	19,431 ha (14.4%)	380 ha (2.0%)	76 ha (0.4%)
Treeless Plain	Widespread Limited significance	15,020 ha (11.2%)	361 ha (2.4%)	72 ha (0.5%)
Treeless Stony Plain	Widespread Limited significance	15,808 ha (11.8%)	351 ha (2.2%)	72 ha (0.5%)
Cleared areas	N/A	143 ha (0.1%)	5 ha (3.2%)	< 1 ha (0.3%)
Totals		134,535 ha (-)	3,588 ha (2.7%)	1,319 ha (1.0%)

^ Due to rounding, individual column and row totals may not correspond exactly with other column and row totals

Widespread and/or significant habitats are those that occupy more than 2% of the Study Area and/or are capable of supporting fauna of conservation significance or distinct faunal assemblages; habitats of limited extent and/or significance are those that occupy less than 2% of the Study Area and/or are of no particular value in supporting fauna of conservation significance or distinct faunal assemblages.

~ Percentages denote extent of that habitat type as a proportion of the total area of the Study Area.

† Percentages denote extent of that habitat type as a proportion of the total area of that habitat type known to occur in the Study Area; data in these columns refer to the Mine Area Development Envelope and Haul Road Development Envelopes collectively, for individual breakdowns refer to **Appendix E**.

5.2.2.2 Impacts to Vertebrate Fauna

In relation to vertebrate fauna assemblages, the diversity of the Study Area was on par with what is expected from the broader GVD and Nullarbor bioregions. Thus, any regional impacts of the Project on general biodiversity are unlikely to be substantial. Clearing of vegetation is likely to result in the direct loss of individual fauna during initial clearing activities; however, many assemblages occur across multiple habitats, and the habitats in the Project footprint are generally widespread and well-connected with those in the surrounding landscape. The Claypan habitat type is an exception to this, but this habitat is not within either the mine area development envelope or the haul road development envelope.

There are several threatening processes that may impact fauna and fauna assemblages as a result of development of the Project. These are discussed in detail in the Terrestrial Fauna Impact Assessment and are listed below:

- Habitat removal and modification - land clearance will result in a reduction in the size and quality of habitats, increased edge effects and habitat fragmentation (Watson and Woinarski 2003, Davis et al. 2013). Other threatening processes may also be increased as a result of land clearing. Land clearance has a particular impact on habitats when significant habitat features, such as drainage depressions and sand dune crests, are removed in addition to vegetation, because these changes leave limited opportunities for habitat rehabilitation post-closure. In addition to habitat loss, it is expected that individual animals will also be lost during clearing. The degree of subsequent impact is dependent on the availability of suitable habitat elsewhere in the vicinity and the ability of species to disperse to these habitats.
- Altered fire regime - the increase in human activities in the Project area may lead to an altered fire regime. Introduction of too frequent, hot or extensive fires at dry times of year can eliminate age mosaics in vegetation and reduce the capacity of habitats to support vertebrate and invertebrate fauna.
- Collision with vehicles - the light and heavy vehicle movements associated with the construction and operation of the Project has the potential to increase vehicle-fauna collisions, particularly at night. In addition, pooling of water along the side of the road which may attract fauna may also increase fauna collisions. Ground-dwelling species of conservation significance that forage within these habitats, including species of conservation significance such as the Malleefowl, Brush-tailed Mulgara, Sandhill Dunnart, Bush-stone Curlew, Australian Bustard, Common Death Adder and Woma are at risk of collision with vehicles. Low-flying birds, including raptors feeding at the road side, may also be at risk.
- Noise and vibration - noise and vibration can upset communication, feeding and resting behaviours, lead to reduced population densities in small mammals and nest failures and decreased population densities in birds. Species that may be especially at risk of disturbed communication are those that

use calls to communicate over larger distances, such as the Bush Stone-curlew which is likely to occur in low densities within the Study Area.

- Artificial light - temporary and permanent light used at the Project may interfere with biological and behavioural fauna activities that are governed by the length of day, including adverse effects on the natural foraging behaviour of bats. Migratory birds may be disoriented by artificial light sources when flying in the vicinity of the Project, especially given the almost total lack of artificial light in the broader surrounds.
- Increased dust generation - dust that may be generated during Project activities can impact vegetation, resulting in damages to the overall ecosystem and reducing the available food resources and shelter for fauna. Fauna may also be impacted through physical irritation of eyes and respiratory systems. Dust impacts are often localised, and can fluctuate considerably due to seasonal variations such as predominant wind direction.
- Introduced flora - the use of earth moving equipment and other vehicles during the construction and operation of the Project has the potential to spread weeds already present in the development envelopes, as well as introduce new weeds from outside the Project area.
- Introduced fauna - seven species of introduced fauna were recorded in the Study Area during the field component of this Assessment, and an additional seven species were assessed as having the potential to occur within the Study Area. Those that pose the greatest threat to fauna and fauna habitats in the Study Area are the Rabbit and Camel, which compete with native fauna and cause habitat degradation, and the Fox and Cat, which prey upon native fauna.

5.2.2.3 Impacts to Vertebrate Fauna of Conservation Significance

There are 29 fauna species of conservation significance that potentially occur within the Study Area, 11 of which were considered unlikely to occur in the Study Area. Of the remaining 19 species of conservation significance, 13 were identified during the field components of the fauna assessment, (**Figure 5-1 Figure 5-2** and **Figure 5-3**) and the other six are considered likely to occur in the Project area. The impact of the Project on each fauna species of conservation significance was assessed using the ranking criteria shown in **Table 5-5**. The highest risk ranking for the Project was 'moderate' for two species: Central Marsupial Mole (*Notoryctes typhlops*) and Princess Parrot (*Polytelis alexandrae*) (**Appendix E**). The impact for the remaining 17 species is considered to be low, minimal or negligible.

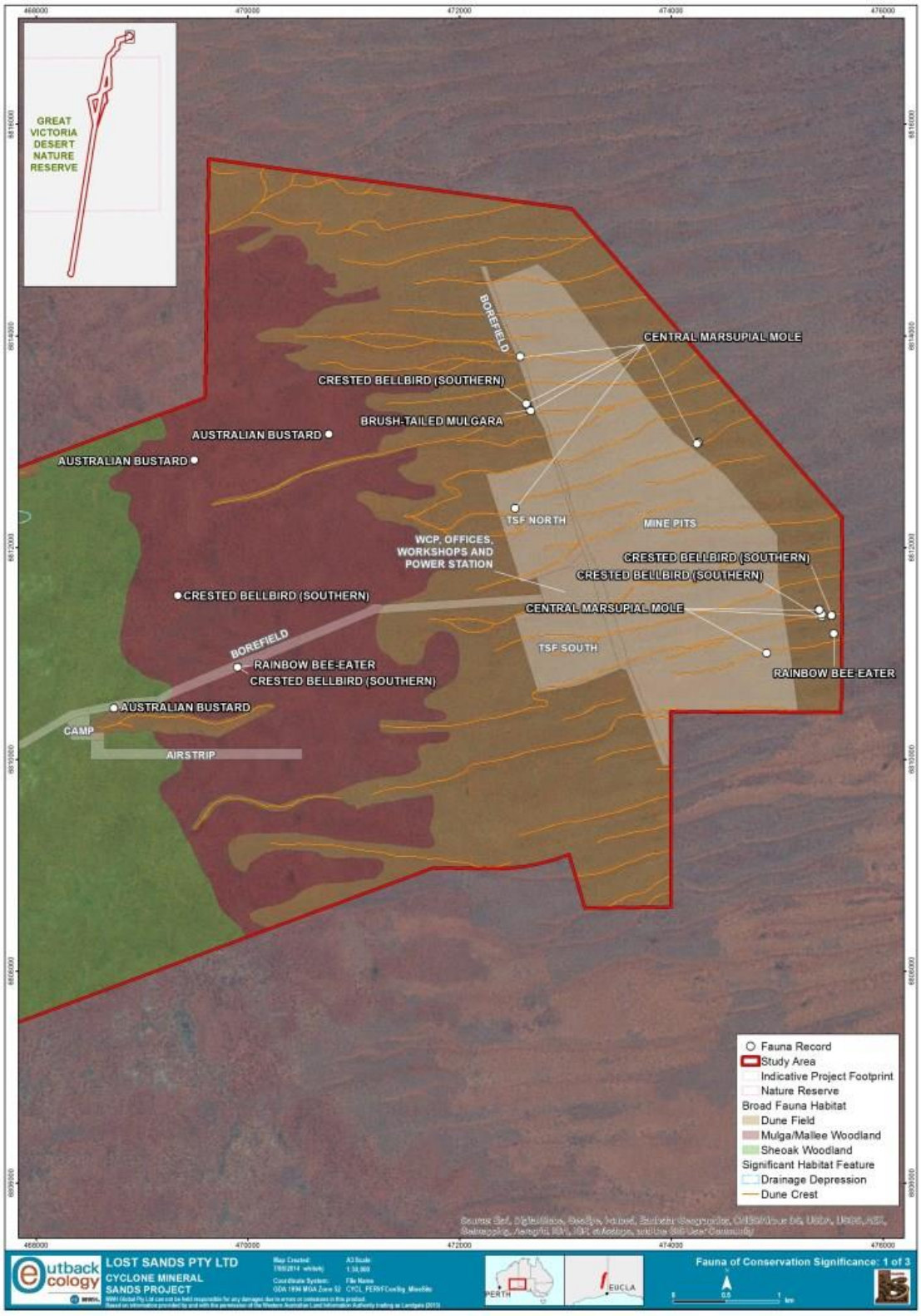

Figure 5-1: Locations of fauna of conservation significance (map 1 of 3)

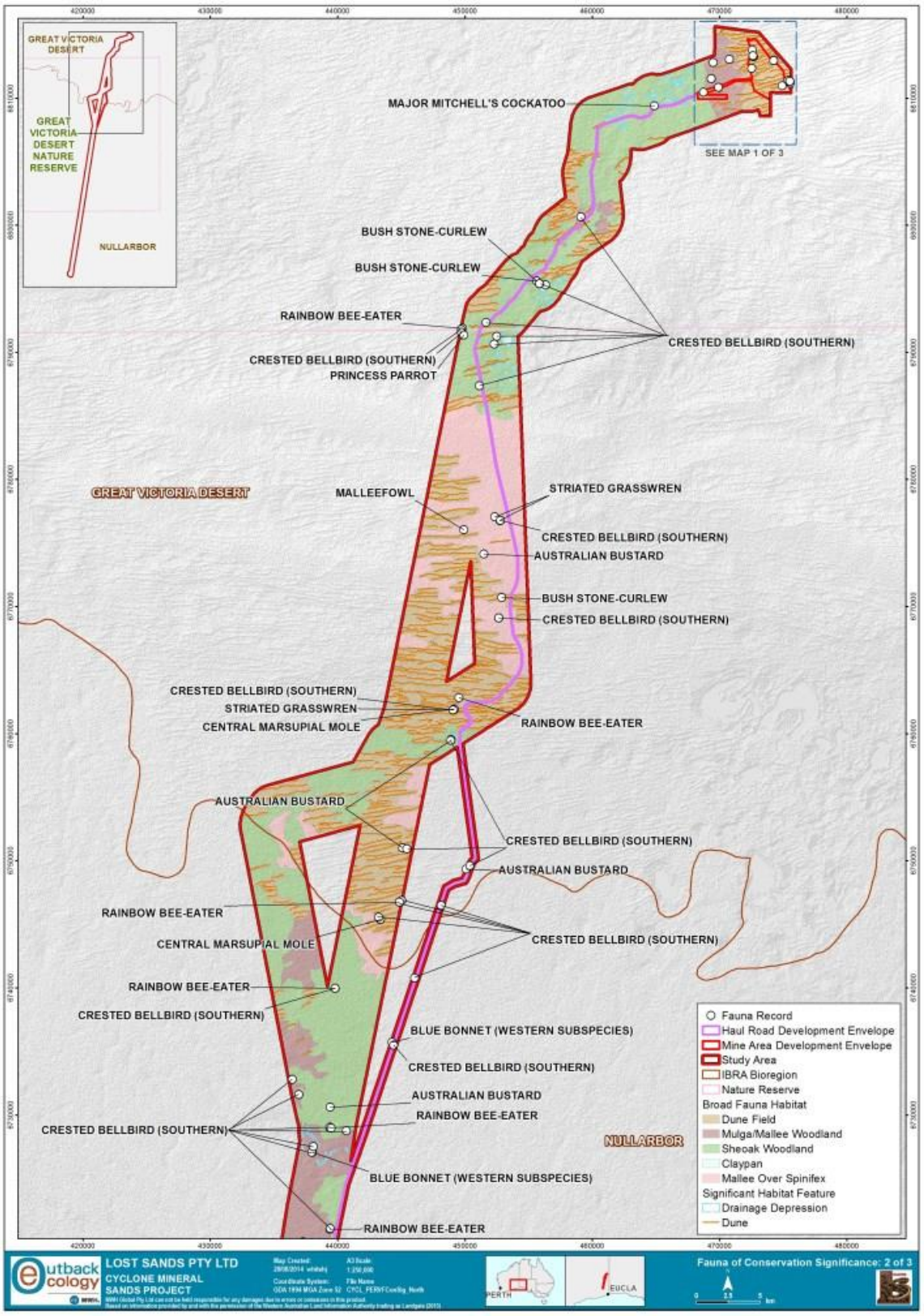

Figure 5-2: Locations of fauna of conservation significance (map 2 of 3)

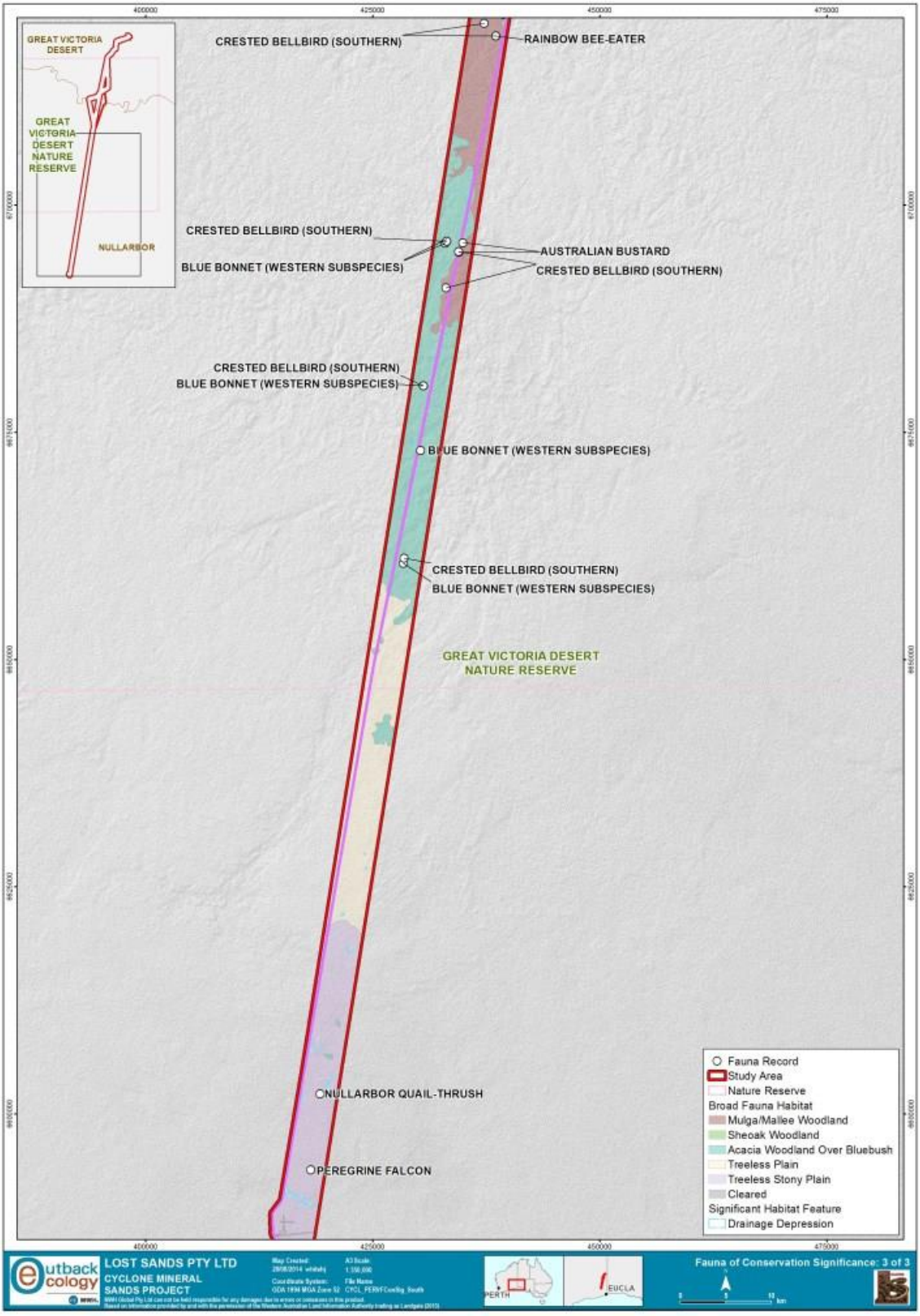

Figure 5-3: Locations of fauna of conservation significance (map 3 of 3)

Table 5-5: Ranking Criteria for Project impacts on fauna of conservation significance

Local impact	Description
Negligible	No discernible effect on population
Minimal	No population decline expected
Low	Short-term population decline expected within Application Area – recovery expected after life of the Project
Moderate	Permanent population decline expected – no perceived threat to population persistence
High	Permanent population decline expected – persistence of local population threatened
Extreme	Local population extinction likely

Impacts to Central Marsupial Mole

Tracks from the Central Marsupial Mole were found in the sand dune crests of the Dune Field habitat type during the Terrestrial Fauna Impact Assessment, and is unlikely to be found in other habitat types in the Project area. Although the development envelopes contain 1,101 ha of Dune Field habitat and 33 km of sand dune crests, this is a relatively small proportion of what is available in the local area. The Dune Field habitat in the development envelopes represents only 4.4% of the total amount of this habitat type mapped in the Study Area, which represents a very small portion of the GVD bioregion.

The sand dune crests (which are a significant habitat feature), in the development envelopes represent only 4.8% of the total amount of this feature mapped in the Study Area. The Dune Field habitat and sand dune crests are widespread in the GVD bioregion – thus, although the Central Marsupial Mole's habitat preferences are highly restricted, it may nonetheless be widespread in the surrounding landscape.

It is likely that individual Central Marsupial Moles will be lost during construction and operations of the Project, as this species presumably has limited ability to disperse away from disturbance to non-impacted habitats. Direct loss of Dune Field habitat, specifically the due crests, through clearing will be a permanent impact of the Project as this habitat type is unlikely to be able to be returned to its pre-disturbance state through post-mining land rehabilitation. Soil compactions (through vehicle movements and construction) as well as increased predation from introduced animals are further potential impacts to the Central Marsupial Mole that may result from the development of the Project. However, these potential impacts are not likely to be considered a threat to the persistence of the local population.

Five of the studies considered for the literature review in the Terrestrial Fauna Impact Assessment identified Central Marsupial Moles during field surveys including studies that were over 300 km to the

west and approximately 80 km to the northeast. This supports the above statements that the suitable habitat for the Marsupial Mole is widespread in the GVD bioregion, and that populations are likely to be widespread outside of the Project area. Given that potential impacts are not likely to be considered a threat to the persistence of the local population, and that habitats and populations are likely to be widespread outside of the Project area, the Project is not likely to have a significant impact on the Central Marsupial Mole.

Impacts to the Princess Parrot

The core breeding habitat of the Princess Parrot within the Study Area is mature Marble Gums, located in the sand dune crests of the Dune Field habitat type. This species is also likely to forage at several other habitat types across the Study Area. The greatest impact to the Princess Parrot from the development of the Project would be the loss of Dune Field habitat, and specifically mature Marble Gums and nesting hollows within it. This impact will most likely be permanent as post-mining rehabilitation will be unlikely to restore this habitat to a pre-disturbance state. Foraging habitat may be restored to some degree following Project closure, but specific habitat features such as well-developed woodlands are likely to take a long time to recover (if at all).

Broadly, individual Princess Parrots within the Project disturbance footprint are unlikely to be lost during Project construction and operation, as this species has a high dispersal capability (except during nesting, when eggs and chicks may be at risk).

Impacts to the Sandhill Dunnart

Dune Field habitat, and specifically the spinifex grass understorey of the dune crests and swales, may host the Sandhill Dunnart in the Study Area. This species may also occur in Mallee over Spinifex habitat, but this is sub-optimal. The development envelopes contain 1,101 ha of Dune Field habitat and 230 ha of the more marginal Mallee over Spinifex habitat. If this species is present, individuals in the Project disturbance footprint will likely be lost during construction and operation of the Project. The loss of Dune Field habitat, and specifically sand dune crests within it, will be permanent – post-mining rehabilitation will not restore this habitat to a pre-disturbance state. Predation by feral cats, foxes and wild dogs is a potential impact of the Project if these species are introduced or supported.

Altered fire regimes are also of particular importance, as they reduce structural diversity and in particular destroy mature spinifex which may not recover after intense burns.

Habitats within the development envelopes are connected directly to areas of habitat outside the development envelopes, which represent:

- areas in which individuals displaced by the Project may take up residence temporarily;
- refuges for any local population to persist; and

- a source of individuals for recolonisation of habitat following Project closure and rehabilitation.

Although the development envelopes contain 1,402 ha of potentially suitable Dune Field and Mallee over Spinifex habitat, this is a relatively small proportion of what is locally available. Dune Field and Mallee over Spinifex in the development envelopes represents only 3.7% of the total amount of these habitats mapped in the Study Area.

Impacts to the Great Desert Skink

The Great Desert Skink was not collected during the field survey of this Assessment but is considered to possibly occur based on the presence of potentially suitable habitat, Mallee over Spinifex, that host this species in the Study Area. It may also occur in Dune Field habitat, specifically the spinifex grass understorey of the dune crests and swales, but this is less optimal. The development envelopes contain 230 ha of Mallee over Spinifex habitat and 1,101 ha of the more marginal Dune Field habitat.

If present, individuals in the disturbance footprint will be lost during construction and operation of the Project – this species presumably has limited ability to disperse. Mallee over Spinifex habitat may be restored to some degree following Project closure, but the loss of Dune Field habitat will be permanent – post-mining rehabilitation will not restore this habitat to a pre-disturbance state.

Predation by feral Cats, Foxes and wild Dogs is a potential impact of the Project if these species are introduced or supported. Altered fire regimes are also of particular importance, as they reduce structural diversity and in particular destroy mature spinifex which may not recover after intense burns.

Impacts to the Grey Falcon

The Grey Falcon may nest in the woodland habitats of the Study Area (Sheoak Woodland, Mulga/Mallee Woodland, Acacia Woodland over Bluebush and, to a lesser extent, Dune Field). Collectively, these comprise 2,643 ha of the development envelopes; however, suitable nest sites will be sparsely distributed. The species is widespread across much of Australia, and the development envelopes encompass only a small portion of its range.

This species is highly mobile. It may forage throughout the development envelopes and region, and is unlikely to rely solely on the habitats within the Study Area. Adults, during the non-breeding season, would disperse ahead of clearing.

Nesting habitat, although more patchy and fragmented than breeding habitat, is similarly widespread (particularly in the wooded interzone between the Nullarbor and Great Victoria Desert bioregions).

Impacts to the Woma

The Woma may use the Dune Field, Mallee over Spinifex, Sheoak Woodland and Mulga/Mallee Woodland habitats, comprising 2,564 ha of the development envelopes. There will be localised habitat loss, with direct mortality of individuals possible if present in the development envelopes. The Woma is only likely to occur at low densities and such losses are thus unlikely to be large. There is increased potential for road kill of individuals, particularly at night in Dune Field and Mallee over Spinifex habitats. Juveniles may be at risk of predation from introduced predators.

The Woma inhabits sandy shrublands and woodlands, which are abundant in the region. Suitable Woma habitats in the development envelopes represent only 3.1% of those habitats locally available in the Study Area, and instances inside the development envelopes are well-connected with those outside.

Impacts to the Death Adder

The Common Death Adder may use Treeless Stony Plain habitat in the Study Area, of which 351 ha is in the Haul Road Development Envelope. There will be localised habitat loss, with direct mortality of individuals possible. If present the Common Death Adder is only likely to occur at low densities and large losses of individuals are therefore unlikely. There is increased potential for road kill of individuals, particularly at night in the Haul Road Development Envelope.

Suitable Common Death Adder habitat in the Haul Road Development Envelope represents only 2.2% of this habitat locally available in the Study Area, and instances inside the Haul Road Development Envelope are well-connected with those outside.

Further in-depth consideration of the localised impact, the regional context and the suggested management actions of the remaining fauna of conservation significance are included in **Table 30** of the Terrestrial Fauna Impact Assessment (**Appendix E**).

5.2.2.4 Invertebrate Fauna

There were 23 potential SRE species recorded in the Study Area, including one identified during database searches as previously collected in the area. All SRE species recorded within the Study Area have the potential to be impacted by the Project to some extent, as they were collected from habitats that are common within the development envelopes. However, the SRE status of these species may not represent a restricted distribution but rather a lack of taxonomic resolution or lack of regional records.

The Claypan habitat was the only restricted habitat identified within the Study Area. No SRE species were found to occur within the Claypan habitat. All the SRE species were found to occur within habitats that are considered to be widespread in the Study Area and surrounding landscape. Given that no SRE species have collection records within the Project development envelope and considering that no SRE species were found to occur within restricted habitats that will be impacted by the Project, it appears unlikely that the Project will have a significant impact to SRE species.

5.2.2.5 Potential Impact to the GVDNR

The assessment of impact to the GVDNR is as discussed in **Section 5.1.2**.

5.2.3 Management Measures

A Fauna Management Plan has been prepared with the objective of minimising impacts to local fauna populations from the implementation of the Project and is included in **Appendix C**. Some of the management measures within the Fauna Management Plan that may help to mitigate impacts on fauna species from the development and operation of the Project are given here. Most of the measures relate to all fauna species, although specific measures are given for particular species:

- plan and complete clearing activities to limit clearing of vegetation in general, and clearing of significant habitats such as Dune Fields and dune crests in particular. Where possible, schedule clearing outside of breeding times of species of conservation significance and complete clearing progressively to allow fauna time to disperse;
- create a fauna awareness programme for staff and contractors detailing how impacts to fauna of conservation significance can be minimised during site operations; this program should:
  - educate staff and contractors about fauna of conservation significance and how to recognise them;
  - educate staff and contractors on where this fauna is likely to be found onsite; and
  - include a reporting system that identifies the location of any fauna of conservation significance (sightings, nesting/burrowing sites/road kill), and allows environmental staff to then on-report these to the DPaW.
- if evidence of a resident population of conservation significant species is detected, develop a Significant Species Management Plan for the species to supplement the Project's fauna management plan;
- implement an Introduced Fauna Management Plan that includes reporting sightings, minimising ingress of introduced fauna to the Project, and controlling numbers of existing introduced fauna in the Project areas;
- implement a Traffic Management Plan that enforces speed limits in areas that are known to contain fauna that may be susceptible to vehicle strikes;

- implement a Fire Management Plan (in conjunction with DPaW and the Pila Nguru) to ensure that altered fire regimes do not compromise the quality of foraging and breeding habitats in the vicinity of the Project area;
- consider noise, artificial light and dust impacts to fauna during design, construction and operation and implement engineering controls to mitigation impacts where ever possible; and .
- plan for closure within the Project design phase, and in each subsequent phase, by identifying final land uses, rehabilitation challenges, locations of rehabilitation resources such as topsoil and planning for progressive rehabilitation throughout the life of the operation.

Princess Parrot

- if Princess Parrots are observed breeding in the vicinity of the Project, the area will be demarcated and reported to DPaW, and a buffer zone to protect against disturbance will be applied; and .
- in areas where the clearing of mature Marble Gums is unavoidable, conduct pre-clearance surveys to ensure any tree hollows present are clear of nesting or roosting Princess Parrots and other vertebrate fauna.

Malleefowl

- if Malleefowl mounds are observed in the vicinity of the Project, the mounds will be demarcated and reported to DPaW, and buffer zones to protect against disturbance will be established; and
- in areas where the clearing of potential breeding habitat is unavoidable, conduct pre-clearance surveys to ensure these areas are free of Malleefowl mounds.

Sandhill Dunnart

- breeding times of this species are thought to be from September to January, suggesting that avoiding clearing in Dune Field and Mallee over Spinifex habitats during this time may lessen Project impacts (if a population is present).

Grey Falcon and Peregrine Falcon

- minimise destruction of potential breeding habitats, particularly tall trees or trees with hollows (or potential to develop hollows).

Woma and Death Adder

- if encountered, authorised snake handlers should relocate individuals to nearby habitat.

Bush Stone-curlew

- where possible, avoid clearing in drainage depressions – the vegetation in these depressions is likely to be of importance to the Bush Stone-curlew.

Nullarbor Quail-thrush

- where possible, avoid clearing in drainage depressions in Treeless Plain and Treeless Stony Plain habitats – the vegetation in these depressions is likely to be of importance to the Nullarbor Quail-thrush and other species in these habitat types.

5.2.4 Predicted Outcome

Given the widespread representation of all habitat types both within and outside the Project, and the identification of all conservation significant species in other regional assessments, the impacts of the Project on terrestrial fauna are considered not significant on a local or regional scale. However, given the status of the GVDNR, potential impacts to fauna within the GVDNR through the short term loss of 306 ha of habitat may be considered significant and therefore require offsets. It is expected that the EPA's objective to 'maintain representation, diversity, viability and ecological function at the species, population and assemblage level' will be satisfied, subject to the implementation of suitable offsets.

5.3 Subterranean Fauna

The EPA's objective for subterranean fauna is:

> *'to maintain representation, diversity, viability and ecological function at the species, population and assemblage level'.*

5.3.1 Key Statutory Requirements, Environmental Policy and Guidance

Subterranean fauna are protected under state and federal legislation, governed by three Acts:

- Wildlife Conservation Act (WA) (WC Act);
- Environmental Protection Act 1986 (WA) (EP Act); and
- Environmental Protection and Biodiversity Conservation Act 1999 (Cwlth) (EPBC Act).

To complement this legislation, the EPA have also developed the following guidelines to outline the considerations and sampling methods for subterranean fauna in WA. The subterranean fauna assessment discussed in this section was designed in accordance with both of these guidelines:

- Environmental Assessment Guideline 12*: Consideration of Subterranean Fauna in Environmental Impact Assessment in Western Australia*; and
- EPA Guidance Statement 54a: *Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia*.

5.3.2 Assessment of Potential Impact

The information in this section of the PER is based on the 'Subterranean Fauna Desktop Assessment' completed by Outback Ecology/MWH in April, 2014 (**Appendix F**). The desktop include a literature review of the wider Project area to identify the presence of any subterranean fauna. Federal and state databases were also accessed, and a reconnaissance survey carried out for the mining area, the preliminary borefield and the test bore valley.

This proposed Project involves several activities that may impact subterranean fauna including the mining of pits, the operation of a borefield and the construction of haul roads and access corridors.

Potential direct impacts on subterranean fauna associated with the development of the Project are:

- removal of habitat through excavation of the ore reserve within the proposed mining area; and
- changes in infiltration and aquifer recharge related to compaction and increase in sediment load in run-off that could reduce surface-subsurface water exchange during flow periods (e.g., lessen input of resources) and alter groundwater quality, which may exceed species tolerance limits (Marmonier, 1991; and Outback Ecology/MWH 2014); and
- reduced nutrient input as a result of vegetation clearing.

The subterranean habitats present within the proposed mining area and preliminary borefield were not considered to be prospective for supporting stygofauna and troglofauna (**Appendix F**). Therefore, it is considered unlikely that any subterranean fauna species will be impacted by the activities proposed by the Project.

The subterranean habitats present within the proposed southern sector of the haul road are considered to be prospective for supporting stygofauna and troglofauna. However, the level of impact of the proposed development is considered low. In addition, the geology present appears to be relatively uniform and widespread indicating continuity of potential habitat beyond the proposed haul road. Therefore, it is unlikely that there is a risk to the long term conservation of any subterranean fauna species that may be present in the area.

5.3.3 Management Measures

No further investigation of stygofauna or troglofauna values are considered necessary for the Project. If the degree of development activities were increased in the southern sector of the haul road to include relatively extensive excavation or groundwater abstraction then further investigation of subterranean fauna values may be required.

5.3.4 Predicted Outcomes

The overall findings of this subterranean fauna assessment indicate that the proposed development of the mining area, preliminary borefield and haul road will meet the EPA objectives in that the proposal does not pose a threat to maintaining subterranean fauna representation, diversity, viability and ecological function at the species, population and assemblage level.

5.4 Hydrological Processes

The EPA's objective for Hydrological Processes is:

> *'to maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected'.*

5.4.1 Key Statutory Requirements, Environmental Policy and Guidance

Groundwater and surface water is protected by the following WA legislation:

- *Rights in Water and Irrigation Act (1914); and*
- *Environmental Protection Act (1986).*

In addition, the following documents provide guidance for protection of groundwater and surface water:

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000)
- State Water Quality Management Strategy Document No. 6 (Government of WA, 2004)
- Western Australian Water in Mining Guideline (DoW, 2013)
- Operational Policy no. 5.12 – *Hydrogeological Reporting associated with a Groundwater Well Licence* (DoW, 2009)
- Water Quality Protection Guidelines No. 11 - *Mining and Mineral Processing, Mine dewatering* (DoW, 2000)

5.4.2 Groundwater

The assessment of potential impact and proposed management measures is sourced from the Hydrogeological Report prepared for the Project by Graham Ride. Further information on drilling and construction of the Cyclone #1 (recorded as Cyclone #1) is provided in the Bore Completion Report (**Appendix G**).

A pump-test of the Cyclone #1 and additional bores has not been undertaken, hence a conceptual model of the groundwater system has not been developed and hydrogeological modelling to determine potential impacts from abstraction has not been undertaken. The assessment of potential impact is based on:

- the inferred significant groundwater storage within the confined aquifers observed in the deep investigation production bore, which are considered to be part of a large regional basin groundwater system;
- shallow aquifer characteristics acquired from site exploration and bore drilling; and
- data on regional shallow aquifers sourced from various publications.

Pump-testing of bores will be undertaken prior to submission of the Mining Proposal in order to confirm water supply, develop a groundwater conceptual model and undertake hydrogeological modelling.

5.4.2.1 Assessment of Potential Impacts

Deep Aquifers

Abstraction of groundwater from the deep aquifer identified within the Project area may potentially impact local and regional deep aquifer groundwater resources. The Officer Basin aquifer intersected by the Cyclone #1 is considered to be part of an extensive major saline aquifer system. This assessment is based on:

- Western Australian and Commonwealth Government geological and hydrogeological interpretation;
- other limited deep drilling; and
- comparison of this sector of the Officer and Gunbarrel Basins (Waigen area and Birksgate Sub-basin) and the aquifers intersected by Cyclone #1 to other similar large Australian sedimentary basins.

The stratigraphic sequences and the thick (over 250 m) high yielding aquifers intersected in the production bore, together with distant deep stratigraphic bores and oil and gas exploration wells in the Waigen area and Birksgate Sub-basin, indicate that these aquifers are similar to other extensive high yielding aquifer systems in other large Australian sedimentary basins, including the Amadeus and Georgina Basins. In these comparative basins these types of aquifers have been mapped to be continuous over hundreds of kilometres. The distant oil and gas exploration wells such as Mulyawara #1 and Birksgate #1 and the stratigraphic bore Vines #1 intersected thick sequences of porous sandstones, limestones and dolomites, which were high yielding when being drilled using air-circulation; these bores are between 80 and 200 km distant from the Cyclone #1 drilled at Cyclone (see **Figure 4-7**).

The extraction of groundwater from the deep aquifer at the identified volumes and rates required for the mine operation over the projected life of the mine will not have a significant impact on the deep groundwater resources either locally or regionally, based upon above interpretation and comparison with extraction of groundwater at a rate of 12 GL/year from a 300 m thick sandstone aquifer in the Amadeus Basin.

There are no other current users of this large saline water resource within the Waigen area or Birksgate Sub basin, consequently there will be no adverse impact on other users from extracting groundwater from this saline aquifer.

Shallow Aquifers

Three shallow drilling water supply bores were constructed by Lost Sands in the Project area, each yielding less than 1 L/sec of saline water. These bores together with extensive exploration drilling indicate that within the Project area there exists occasional, intermittent, localised, low yielding, saline, shallow aquifers. In addition there are numerous regional shallow aquifers present.

Potential impacts to local and regional shallow aquifers include:

- drawdown through abstraction of groundwater from the deep aquifer;
- seepage from water storage facilities;
- development of recharge mounds; and
- hydrocarbon and chemical contamination from mining activities and loading facilities.

Due to the confined nature of the deep aquifer, it is highly unlikely that there is any connectivity to shallow aquifers, and therefore unlikely that abstraction from the deep aquifer will impact the shallow aquifers. There are also not any groundwater dependent ecosystems or habitat that is prospective for subterranean fauna within or surrounding the area of the proposed borefield.

In the remote instance that groundwater drawdown does impact the shallow aquifers, any shallow aquifers that are used within the region are located distant from the Project area as described here. Shallow aquifers occur in the region associated with paleochannels, playas, alluvial and other sedimentary deposits. Those intersected to date in shallow drilling for water and mineral exploration, pastoral and community supplies have been limited localised aquifers and the majority have been saline.

Based on regional studies by the WA Government and studies by oil and gas exploration companies the primary paleochannels in the GVD are below regional surface water drainage lines. These paleochannels are distant from the Project area. Shallow saline and brine aquifers associated with the GVD bioregion salt lakes and playas are up gradient and or distant from the Project area and no impacts from mine site groundwater use are envisaged.

Extraction of groundwater from the deep aquifer for the Project mine supply will not have any impacts on the aquifers used for the water supply for Tjuntjuntjara Aboriginal community 170 km west-southwest of the mine site and Ilkurlka Roadhouse 130 km to the northwest or other distant communities within the GVD bioregion in SA. Extraction of groundwater from the deep aquifer for the Project mine supply will not have impacts on known Aboriginal soaks which are local, shallow up-gradient groundwater resources. The known soaks are distant from the proposed mine and bore-field.

Groundwater abstracted from the deep aquifer will be stored in water storage facilities within the Project area. Potential seepage and development of recharge mounds may occur from these water storage facilities as well as the TSFs. This can be managed through installation of monitoring bores and implementation of a monitoring program.

Hydrocarbon and chemical contamination of shallow aquifers may occur through construction and operation of the mine and loading facility however this can be mitigated through standard mine site

environmental management techniques that are detailed within the Water Management Plan. The concentrate will be containerised at the mine site before being trucked to the loading facility, thereby minimising the risk of contamination along the route and at the loading facility.

5.4.2.2 Management Measures

To meet the mine water demand for the mine, a borefield consisting of a series of up to 16 deep production and up to 20 shallow monitoring bores will be required. The production bores will be spread out within the mining area development envelop to minimise pumping interference (**see Figure 2-5**). Water levels and drawdown in the production bores will be monitored using down-hole transducers; bore head works will be equipped with flow metres and non-return flow valves.

The production and monitoring bores will be constructed to a high standard in compliance with the DoW - Water Bore Construction Regulations and Australian Water Bore Construction Standards. The deep bores will be pressure cemented within and above the confining layer with high quality cement grout and cased with high quality materials to cope with the saline corrosive conditions. Following closure of the mine and subject to agreement with the key stakeholders, the deep bores will be plugged opposite the confining beds and near the surface.

Shallow monitoring bores will also be required to monitor and facilitate management of shallow groundwater within the mine site that may occur within potential recharge mounds, as well as monitor quality of the shallow groundwater. Standard groundwater management techniques will be used to retain the recharge water within the mining lease.

A minimum of 20 shallow monitoring bores will be required, half to the weathered rock interface and the other half to 40 m depth. These will be located within the mining area development envelope; including a line of bores near the western boundary of the development area. Based on the results of previous shallow exploration drilling in this area these bores may not intersect shallow aquifers but will still be required to monitor any development of recharge mounds. Any monitoring bore encountering a shallow aquifer will need to be cased with a minimum of 100 mm PVC casing to enable periodic sampling for field and laboratory chemical analysis.

A Water Management Plan has been prepared to manage and monitor the bore field, shallow aquifers within the mine area and possible recharge mounds (**Appendix C**). The Water Management plan includes regular monitoring and annual assessment of bore and bore field abstraction, chemical and trace metal water quality monitoring and groundwater level monitoring including monitoring variations in potentiometric surfaces (sub artesian aquifer pressure surfaces).

5.4.2.3 Predicted Outcomes

Due to the predicted extensive aquifer system available as a groundwater source for abstraction, the amount of water required for the operation of the mine is not likely to have a significant impact on local or regional deep groundwater resources. Due to the confined nature and depth of the proposed groundwater source, contamination of the deep aquifer from mining operations will not occur. In addition, there are no additional users of the preferred groundwater supply.

Potential impacts to the shallow aquifers from mining operations will be managed through implementation of the Water Management Plan and monitoring program such that they are not likely to be significant. The confined nature of the proposed groundwater source means that it is highly unlikely that there is any connectivity to the shallow aquifers; hence it is unlikely that abstraction from the deep aquifer will impact the shallow aquifers. In addition, in the remote instance that drawdown of the shallow aquifers does occur, all surrounding users of the regional shallow aquifers are situated at a suitable distance from the Project such that impacts will not occur. There are also not any groundwater dependent ecosystems or habitat prospective for subterranean fauna within or surrounding the proposed borefield.

Given the above, it is predicted that the EPA objective for groundwater will be met and that potential impacts to groundwater will be low.

5.4.3 Surface Water

A desktop assessment of surface water was undertaken by MWH in March 2014 and is included in **Appendix H** (MWH, 2015). Information for this section is sourced from this report. A conceptual surface water management scheme to protect the mine and infrastructure from flooding was designed based on the desktop study.

5.4.3.1 Assessment of Potential Impact

Potential impacts to surface water are described in detail in **Appendix H** (MWH, 2015).

Potential impacts of the Project on surface water regimes relate to the placement of the proposed mine, infrastructure and roads and include:

- modification or interruption of natural drainage channels and/or flows;
- drainage shadows down gradient of the mine site, airstrip and roads;
- ponding up gradient of the mine site and roads;
- increased sediment runoff and scour; and
- possible hydrocarbon and chemical contamination.

The proposed project area is located within the Warburton Basin. The percentage disturbance within the regional catchment is small (see **Figure 4-8**), which implies any alteration to the surface water regime may be noticed at a local level, but will be insignificant within the regional catchments.

It should be noted that a preliminary design of the haul road is all that is available at this stage and hence a roadway drainage design has not been undertaken; as such this assessment is made in terms of the typical surface water impacts of haul roads of this general type. The assessment cannot therefore provide details of impacts and mitigation measures for specific elements of the haul road. These will be provided at the Mining Proposal stage.

5.4.3.1.1 Modification or interruption of natural drainage channels and/or flows

The pit areas will interrupt the flow of the natural drainage line across the inter-dunal catchments. The pit catchment is representative of approximately 3% of the total regional catchment area and is located near to the catchment divide within the local catchments, therefore the impact of the pit on the drainage lines is localised to within the pit footprint. Given the low rainfall, high evaporation, small catchment area associated with the inter-dunal catchments and the pit's proximity high in the catchment, the potential for significant volumes of runoff are low. Therefore the placement of the pit is not likely to have a significant impact on surface water flows.

Infrastructure platforms and TSFs interrupt the flow of eight natural inter-dunal drainage lines. The upstream reach of these drainage lines will be very short and runoff volumes very low due to the presence of the pit void upstream of the infrastructure areas. Runoff will likely infiltrate or flow as sheet flow around the raised platforms and tailings facilities. The existence of the mine camp in its current position west of the airstrip will provide minimal disruption to the overflow path as long as the infrastructure at the camp is constructed on piles with 3 steps up to the floor level. This will allow the overflow path to pass under and around the structures at shallow depth. Natural drainage lines will suffer minimal disruption from the airstrip as it is orientated parallel with the flow pathways and a proposed swale and bund will serve to divert flows around the airstrip.

The haul road will interrupt surface water flows however these will be diverted through culverts and over floodways. This will have the effect of altering surface water flows at a local catchment level. This effect will dissipate as the flows move downstream and join the sheet flows and channel flows that are contributing to the river system from the larger catchment area. Typically flows at high flow catchment crossings will pass directly over the haul road by means of a floodway having the same longitudinal profile level as the river or creek bed. Such a floodway would be expected to have minimal effects on the natural surface flows. Any slowing or restriction of natural flows caused by the floodway will decrease proportionally as the size of the runoff event increases. For low and medium flow crossings culverts

and floodways will be used. Alteration of natural flows at low and medium catchment crossings by culverts may result in upstream ponding and downstream drainage shadows. However, the impact of the haul road is likely to be insignificant, given that watercourses generally flow infrequently and for short periods as a result of the ephemeral nature of creeks in the area, combined with low, irregular rainfall and high evaporative and infiltration losses.

5.4.3.1.2 Drainage shadows and ponding

As runoff will be intercepted and stored within the pit footprint, or diverted around the pit by the diversion channel, there will be a drainage shadow created downstream of the pit. It is anticipated that the shadow will extend from the northern and southern ends of the western pit boundary out to the east in a triangular shape out to approximately 1 km from the pit boundary. The volume lost from the drainage lines will be largely equal to the direct rainfall volume over the pit footprint. Given the low rainfall and high evaporation, this will not be significant within the local and regional catchment. The lateral extent of the shadow will be maximised to the area immediately west of the infrastructure. Where direct rainfall lands out of the pit area, to the west, any runoff generated will follow the existing natural drainage lines. Ponding is not likely to be a significant problem in the Mine area.

Potential hydrological risks to vegetation, flora and fauna resulting from drainage shadows and ponding during the operational phase of the haul road include:

- ecohydrological impacts of altering surface water flow to vegetation health, in particular sensitive and significant habitats;
- surface water flow impacts on soil water retention – saturation levels;
- inundation – flooding/ponding impacts on vegetation;
- water shadow effects of culverts, for example, ponding upstream increasing periods of inundation in select areas; and downstream effects i.e. scouring and shadow;
- deterioration or destruction of habitat suitable for fauna species.

Maintaining sheet flow while reducing ponding and shadow effects are essential practices to minimise the impact on vegetation, flora and fauna. Where surface water dependent vegetation associations are located, environmental culverts will be used to re-distribute flows downstream of the road alignment and re-instate sheet flows.

Given the irregular rainfall, high losses and ephemeral surface water system, flow may occur for only a short period. Any potential impacts to surface water flows from drainage shadows are therefore expected to be insignificant or short-lived.

5.4.3.1.3 Increased sediment runoff and scour

Increased sediment runoff and scour may occur during clearing and through the installation of culverts and floodways, if not correctly constructed. Concentrating flow and energy through culverts or over floodways can lead to erosion and scouring of both the upstream side of the culvert/floodway and of the downstream environment. Erosion and scouring can cause:

- loss of top soil;
- undercutting and slumping of riverbanks;
- increased suspended solids and turbidity of downstream water quality;
- deposition of sediment downstream;
- realignment of the river or watercourse; and
- reduced vegetation growth in areas of concentrated and increased water flow.

Culverts and floodways will be installed in accordance with the approved engineered design. Given the low flow volumes, low rainfall and high evaporation, any sediment runoff and scour is likely to be localised and managed through standard environmental management practices.

5.4.3.1.4 Potential hydrocarbon and chemical contamination

The following may potentially result in contaminants being washed into local surface water flows:

- hydrocarbon or chemical spillage during transport;
- use of chemicals including paints, solvents and pesticides for service maintenance; and/or
- wash-off of hydrocarbons from road surfaces during rainfall events.

Impacts upon permanent water sources will be more significant during periods of limited or no rainfall when discharge and contaminants will accumulate and any flushing of the natural system is at a minimum. This impact will only be significant in the unlikely event of a large accidental hydrocarbon or chemical spillage along the haul road alignment. This risk is low given the general lack of flowing water or permanent pools along the proposed haul road alignment.

5.4.3.2 Management Measures

A Water Management Plan has been prepared (**Appendix C**), with the objective of protecting surface water. The management and monitoring proposed in the Water Management Plan is based on the desktop Hydrology Assessment, and will be refined based on site specific survey data and ground conditions. The Hydrology assessment identified major and minor drainage crossings along the haul road development envelope that are likely to require installation of floodways and culverts, as shown in **Figure 5-4**. Management and monitoring of surface water that will be undertaken in accordance with the Water Management Plan will include, but not be limited to:

- minimising the clearing footprint within the development envelopes to minimise potential erosion;

- minimise vegetation clearance associated with watercourses;
- implementing soil erosion control techniques to prevent erosion and an increase in surface water turbidity.
- monitoring of the drainage shadow from the pit on an annual basis;
- opportunistic monitoring of surface water during rainfall events; and
- monitoring of diversion channels, outfalls, swales, bunds and floodway channels.

A Project conceptual surface water management plan for the purposes of managing stormwater and protecting Project infrastructure has also been developed and is shown in **Figure 5-5**. For the purposes of construction, this will be further refined based on site specific survey data and ground conditions.

5.4.3.3 Predicted Outcome

The Project will have insignificant impacts on regional hydrology. Some local impacts may occur but will also not be significant. Any potential impacts can be minimised through the application of the Water Management Plan. Therefore the EPA objective will be met for surface water.

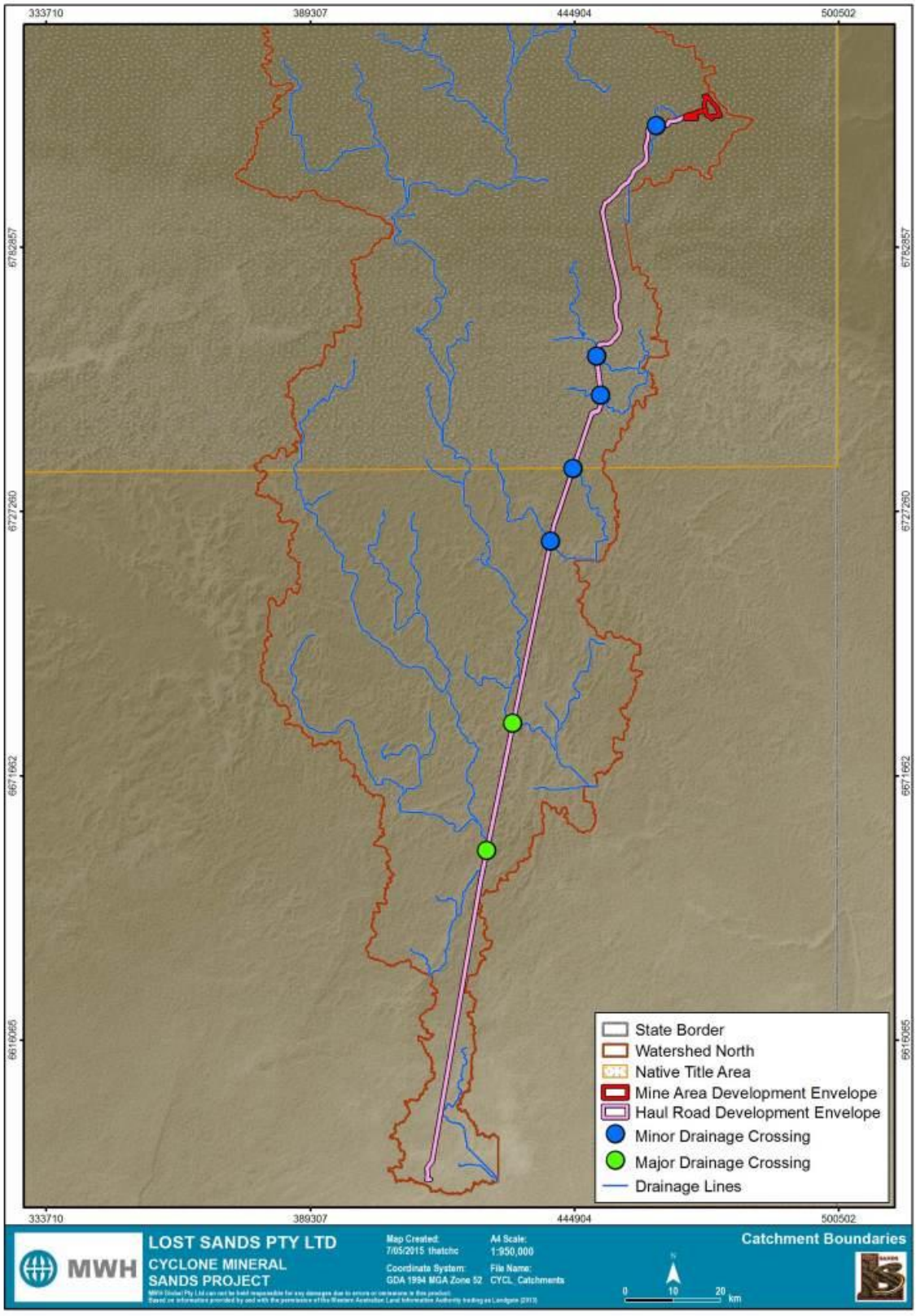

Figure 5-4: Proposed Drainage Crossings along the Haul Road

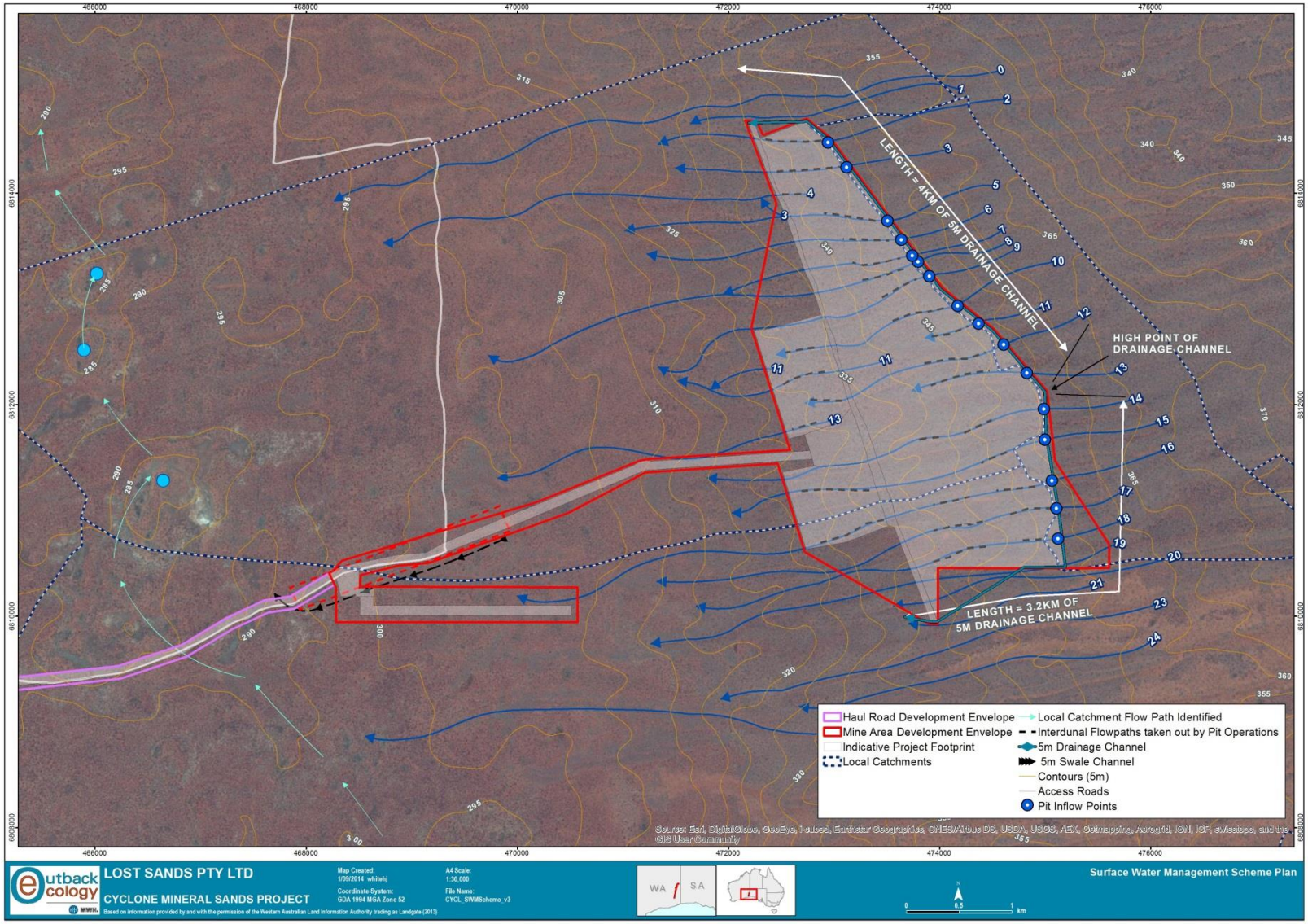

Figure 5-5: Conceptual Surface Water Management Strategy

5.5 Heritage

The EPA's objective for heritage is:

' to ensure that historical and cultural associations are not adversely affected'

5.5.1 Key Statutory Requirements, Environmental Policy and Guidance

Aboriginal Heritage is protected by the *Aboriginal Heritage Act 1972*. In addition the following documents provide guidance on assessing and managing impacts to Aboriginal Heritage:

EPA guidance statement 41: Assessment of Aboriginal Heritage; and

- Aboriginal Heritage Due Diligence Guidelines (April 2013). Department of Aboriginal Affairs (DAA).

On 15th November 2014, a signing ceremony took place on site at the community of Tjuntjuntjara, after which Lost Sands executed the Cyclone Zircon Project Native Title and Mining Agreement (and ancillary documentation) with the Pila Nguru (Aboriginal Corporation)(RNTBC) representing the Spinifex People, the traditional owners of the land containing the Project. The agreement provides for compensation payments, contracting opportunities, direct employment, an educational trust fund and cultural initiatives.

5.5.2 Assessment of Potential Impacts

5.5.2.1 Mine Area Development Envelope

No sites of significance have been recorded within the mine area development envelope, although the possibility exists that occasional archaeological finds (manuports, or manually transported objects left on the plains in the past) may be located within the development envelope (Cane 2014) (**Appendix I**).

5.5.2.2 Haul Road Development Envelope

The existing haul road alignment does not impact the cultural heritage significance of the surrounding area and has been cleared for use (Cane 2014) (**Appendix I**). However, the development of the haul road may result in increased access to sensitive sites and traditional hunting areas. For this reason the haul road use will be restricted to Project related vehicles, DPaW personnel and the Pila Nguru. It is considered that signage will be effective in preventing unauthorised use of the road as the amount of traffic likely to encounter the road is very minimal. A system will be implemented for monitoring and controlling unauthorised usage of the road and truck drivers will be responsible for reporting sightings of any vehicles that are not regular authorised users.

5.5.3 Management Measures

A Cultural Heritage Management Plan has been prepared for the Project (**Appendix C**), with the purpose being to preserve the cultural heritage of Lost Sands' Cyclone Mineral Sands Project mining

leases and the haul road, from any impacts relating to construction or mining activities, and to continue to foster a working relationship between Lost Sands and the Pila Nguru community. The plan presents management measures that will be implemented in order to prevent impacts to Aboriginal Heritage sites and to further document Aboriginal Heritage in the area, including, but not limited to:

- an archaeological survey will be undertaken over the mine area development envelope prior to disturbance;
- should any items of significance be located during the archaeological surveys, DAA will be consulted prior any salvage of these objects occurring, and the traditional owners will re-locate them prior to disturbance;
- should any archaeological items be located during Project construction or operation, DAA and the traditional owners will be advised and consulted as to the appropriate way to re-locate them in accordance with the requirements of the *Aboriginal Heritage Act 1972*;
- documentation of geographic and cultural associations of people born near and descended from people born near the Project will be undertaken;
- documentation of significant living areas and related religious narratives and key locations adjacent to the Project will be undertaken ; and
- cultural awareness training will be provided for all personnel involved in construction and operation of the Project.

In addition, Lost Sands will contribute to the community and broader education for the Spinifex people, and will describe the social benefit and capacity building and how that can be continued/enhanced, including but not limited to:

- traineeships and on the job training in a range of mine site skills for the life of the operation;
- financial contribution to the Pila Nguru education; and
- a long term site employee target for members of the Pila Nguru community has been established.

5.5.4 Predicted Outcomes

The development impacts on Aboriginal culture and heritage arising from the Project are likely to be low, therefore the EPA's objective *to ensure that historical and cultural associations are not adversely affected* will be met.

5.6 Amenity

The EPA 's objective in relation to amenity is:

'to ensure that impacts to amenity are reduced as low as reasonably practicable.'

The areas that may potentially impact amenity have been defined as dust and noise, with the transport and storage of product at the Forrest Railway Siding potentially impacting residences in the vicinity.

Light was not identified within the ESD as an environmental factor that is required to be addressed within this PER. The environmental impacts associated with light are mainly related to fauna and are outlined in **Section 4.7**. The potential impacts from light are not considered to be significant and readily managed through other regulatory processes, hence are not required to be addressed in detail within the PER.

5.6.1 Dust

The potential impacts of dust generation during the transport of ore were assessed for the Project due to the location of sensitive receptors at the Forrest Railway Siding. The Forrest Railway Siding contains six residential dwellings, which are all affiliated with the airport business. There is no permanent resident at Forrest; the airport manager normally stays for one year on contract.

An ARTC worker's rest house is located south of the railway line, opposite the proposed container storage area; this is temporary accommodation that is only used once a week. Activities at the rail siding will consist of:

- haulage of concentrate via two (2) truck movements (a return trip from Cyclone to Forrest), in any four hour period, or 12 truck movements in any 24 hour period; this incorporates both haul trucks and water-truck movements. This entails a total of 12 journeys along the road per day;
- stacking of up to 130 enclosed containers at the container handling area on a compacted gravel hardstand; and
- loading of a train approximately every ten days, which is estimated to take up to ten hours to complete and may occur during the day or night.

5.6.1.1 Key Statutory Requirements, Environmental Policy and Guidance

The key legislation relating to managing dust impacts in Western Australia includes:

- *Environmental Protection Act 1986*

In addition, the following guidance has been considered in undertaking the assessment of potential impacts:

- A Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and Other Related Activities. Department of Environment and Conservation March 2011;
- EPA Guidance Statement No.3 Separation Distances between Industrial and Sensitive Land Uses EPA (2005); and
- Implementation Guidelines for State Planning Policy 5.4.

5.6.1.2 Assessment of Potential Impact

The dust assessment considered the sensitive receptors at the rail siding and was completed by Metreo Consulting in January, 2014 (**Appendix J**). It should be noted that there has been only minor activity at the rail siding for many years and hence there have not been any previous dust issues. The following activities will occur to facilitate the development and decommissioning of the Project, and may potentially generate dust:

- road construction - for road from site to rail siding. The construction activities have potential to generate dust, although only for a singular and relatively short period of time;
- road haulage - The road is located some 700 m west of the cluster of six residences and at least 350 m away from the ARTC rest house. Settleable and suspended dust generated through vehicle movements down the roads is a potential impact. The most likely impact is one of visual disturbance caused by visible dust plumes along the haul road; and
- container handling - container handling will be undertaken on four occasions each day and this is not expected to represent a significant source of dust since the container handler will be operating at relatively low speeds (Metreo, 2014).

In addition to the sensitive receptors at Forrest, increased dust generation can also have adverse impacts on both flora and fauna, as discussed in **Section 5.1** and **Section 5.2** respectively.

5.6.1.3 Management Measures

A Dust Management Plan has been prepared for the Project (**Appendix C**) with the objective to avoid or minimise potential impacts of dust on vegetation, flora, fauna and human health of mine personnel and sensitive receptors at the Forest Rail Siding. The plan includes but is not limited to the following management strategies:

Dust Control - Road Construction

- minimise clearing and land disturbance to the absolute minimum required to construct the haul road;
- any topsoil/surface/vegetative material should be pushed back from the proposed road formation to form parallel windrows on either side of the proposed road formation no more than 2 m high;

- control vehicle speeds at the construction site;
- use existing roads and avoid construction of any unnecessary new tracks;
- water road surfaces prior to working and ensure ongoing road watering to minimise visible dust; and
- on completion of construction re-spread windrows onto road batter as quickly as possible.

Dust Control - Road Haulage

- limit haul road speed to 40 km/hr for the last 2 km into Forrest; and
- ensure that any grading of the road only occurs following rainfall or with sufficient watering to avoid dust lift-off.

Dust Control – Container Handling

- the compacted gravel hardstand will be sprayed with a binder as required to limit dust generation during loader operations.

Dust Monitoring

- excessive visible dust will be the trigger for an initial response; and
- dust monitoring including settled dust and automated dust sampling may be implemented if valid complaints are received or observations indicate that it is warranted.

Public Consultation and Complaints

- information of the proposed works will be circulated to properties within Forrest;
- signage will be posted around the boundary of the work site to provide contact details for queries and complaints; and
- complaints will be responded to by first confirming that meteorological conditions indicate that Lost Sands' activities might have been a source of dust and then addressing the specific activity leading to the dust generation.

5.6.1.4 Predicted Outcome

Potential sensitive receptors to the generation of dust from construction, operation and decommissioning of the Project are located within the vicinity of the rail siding and southern portion of the haul road. Due to the location of roads from the residences, settleable dust is unlikely to be a nuisance problem, whilst suspended dust will have dispersed before reaching these locations. Therefore the most likely impact is one of visual disturbance caused by visible dust plumes along the haul road, which will be controlled by the management actions discussed above. The relatively slow speed attained by a mobile container handler indicates that dust generation will be minor and that when dust is generated it will not be lifted very high by the vehicle. The limited degree of the impacts and the proposed management actions will ensure that the EPA's objectives of reducing impacts to amenity as low as reasonably practicable will be met.

5.6.2 Noise

The key areas of consideration for meeting the EPA's objectives in relation to noise were:

- the Project accommodation village (as there are no noise sensitive premises within the vicinity of the mine); and
- the container handling at the railway siding and truck haulage on a private haul road to determine compliance with the Environmental Protection (Noise) Regulations 1997. Trucks operating on public roads are exempt.

An environmental noise assessment was completed for the Project by Lloyd George Acoustics in January, 2014 (**Appendix K**). Assessments were completed using computer modelling to predict noise levels from the proposed mining operations with the following inputs:

- meteorological information;
- topographical data;
- ground absorption; and
- source sound power levels.

5.6.2.1 Key Statutory Requirements, Environmental Policy and Guidance

The key legislation relating to noise is:

- Environmental Protection Act 1986; and
- Environmental Protection (Noise) Regulations 1997;

In addition, the following guidance has been considered in assessing potential impacts of noise from the Project:

- Draft Guidance Statement No.8 *Environmental Noise* May 2007;
- State Planning Policy 5.4 *Road and Rail Transport Noise and Freight Considerations in Landuse Planning* (Western Australian Planning Commission 2009); and
- Implementation Guidelines for State Planning Policy 5.4.

5.6.2.2 Assessment of Potential Impact

Noise is expected to be generated at the Project through the operation of earth moving equipment, processing, ore transport and power generation. This may potentially impact the amenity of personnel at the camp and potential sensitive receptors located in the vicinity of the rail siding and proposed loading facility. The noise assessment took into account meteorological information, topographical data, ground absorption and sound source power levels. The predicted levels at the mine and the Forrest Railway Siding are shown in **Figure 5-6** and **Figure 5-7** respectively.

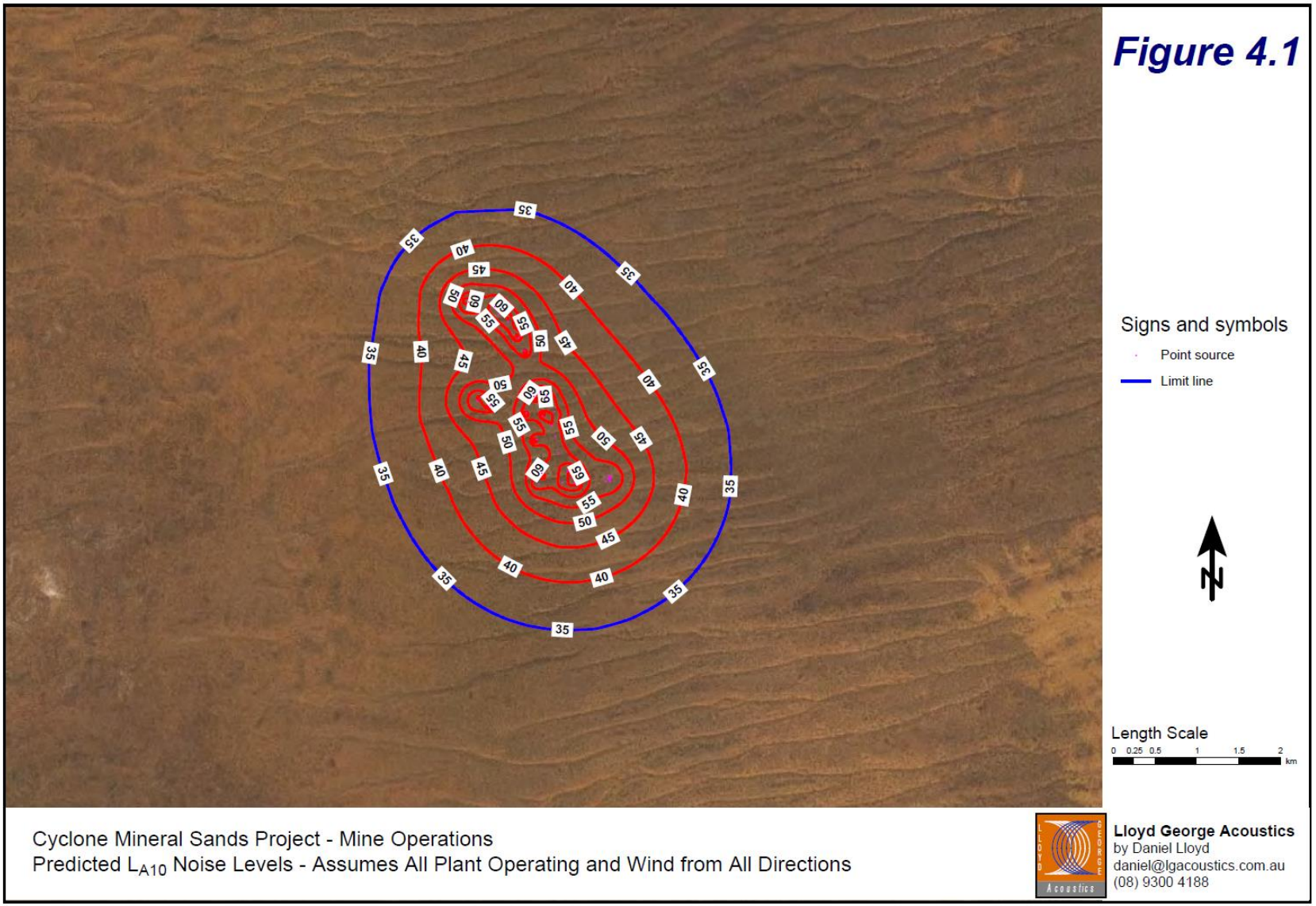

Figure 5-6: Potential noise impacts at the mine

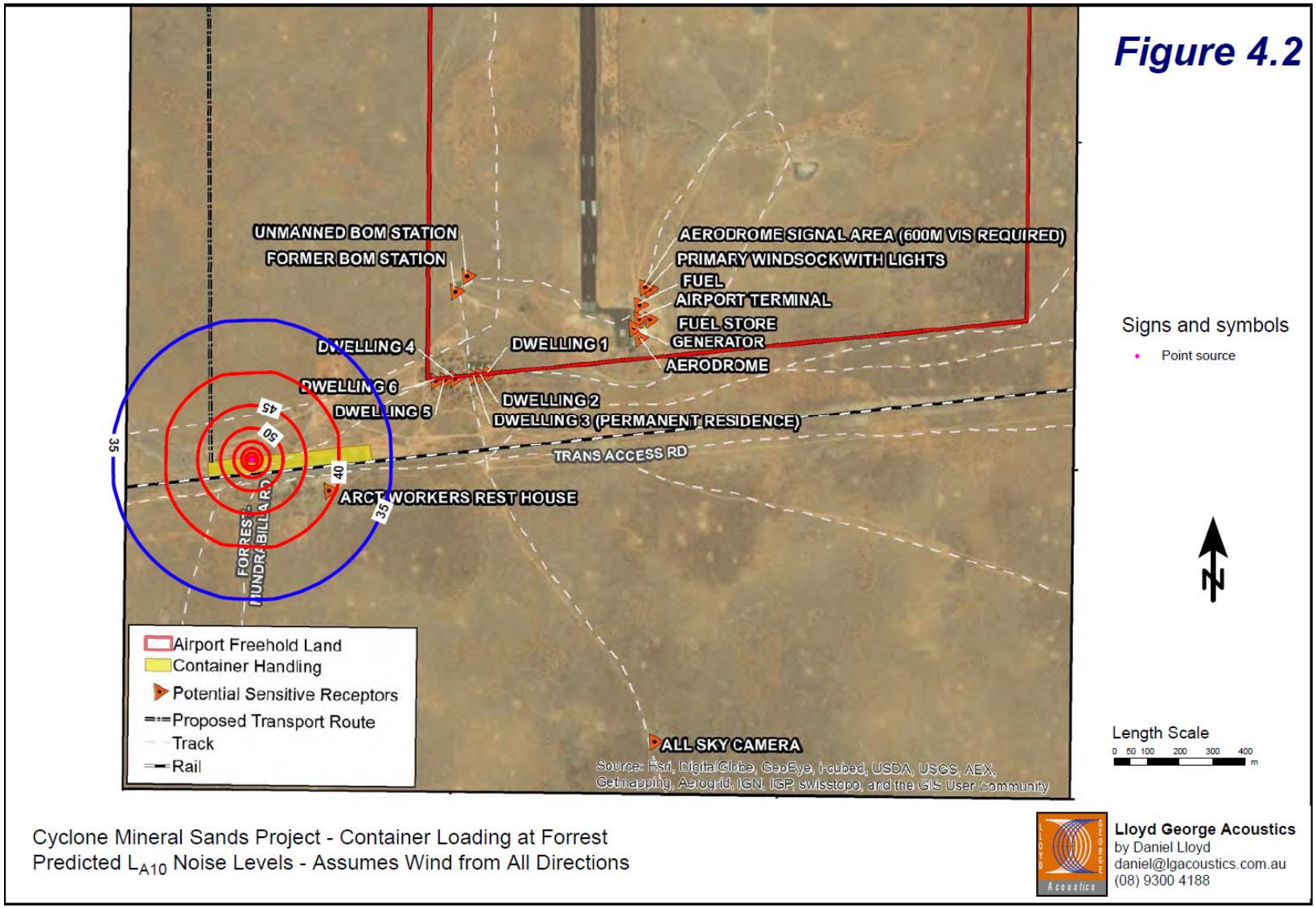

Figure 5-7: Potential noise impacts at the Forrest Rail Siding

The assessment found that due to the absence of noise sensitive premises, the mine will be compliant with the regulations. Noise from the rail siding is predicted to comply with the regulations at all times at the permanent residences, however, it is predicted to exceed the regulations by 5 decibels (dB) at the ARTC Workers Rest Home. The use of this accommodation is sporadic, and the noise inside the dwelling with windows shut is not expected to be significant, but this will still require ongoing consultation and management.

The assessment also found that any haul roads should be 150 m from any noise sensitive receptors to ensure compliance with the regulations, although this is only applicable to private roads.

5.6.2.3 Management Measures

The following key management actions have been proposed to address any potential impacts that may come about as a result of noise:

- mine site - place camp at least 2 km from mining operations;
- mine site - power generation plant should be placed behind an earth bund to reduce noise to the camp;
- Forrest Railway Siding - use of the ARTC Workers Rest Home is once a week. Noise impacts should be managed in consultation with person staying there; and
- truck noise - any haul road should be at least 150 m from any noise sensitive receptor.

5.6.2.4 Predicted Outcome

The results of the noise assessment show that noise associated with the Project is predicted to comply with the assigned levels under the Regulations at all times at the mine and during road haulage operations. There would potentially be an impact at the temporary ARTC accommodation on limited occasions, but this could be managed by consultation with any temporary residents. In line with the above recommendations, the mine camp is located at least 2km from the mining operations and the haul road is at least 150m from any noise sensitive receptor. The location of the mine, infrastructure and roads and the results of the noise assessment as described above mean that the EPA's objectives relating to amenity will be satisfied.

5.7 Rehabilitation and Closure

The EPA's objective for rehabilitation and closure is: '*To ensure that premises are closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed outcomes and land uses, and without unacceptable liability to the State*.'

5.7.1 Key Statutory Requirements, Environmental Policy and Guidance

This section has been prepared in consideration of:

- the Environmental Scoping Document (ESD);
- the Guidelines for Preparing Mine Closure Plans (DMP and EPA, 2011);
- the Principles of the Strategic Framework for Mine Closure (ANZMEC and MCA 2000);
- the Mine Closure and Completion Handbook (Department of Industry, Tourism and Resources 2006);
- Mine Safety and Inspection Regulations 1995;
- Radiation Safety Act 1975; and
- the Radiation Protection Series Publication No. 9 - Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005).

5.7.2 Assessment Of Impact

A preliminary mine closure plan has been prepared by MWH and is included as **Appendix L.**

Planning for mine closure and rehabilitation needs to be undertaken in an effective and progressive manner in order to prevent and minimise adverse long term environmental, social and economic impacts. Effective and progressive mine closure planning is a prerequisite for the creation of stable, safe and non-polluting landforms suitable for the agreed post mining land use. Planning for mine closure needs to be incorporated into the Project's design and construction and be conducted as a life-of-mine (LoM) process. Mine closure works aim to:

- minimise the footprint of operations upon closure;
- determine the optimum strategies for effective closure and rehabilitation of the mine site;
- progressively rehabilitate disturbed areas during the mine life; and
- monitor the site during operations and upon completion of rehabilitation activities to demonstrate compliance with closure objectives.

The preliminary mine closure plan comprises the following core components:

- domains and features;
- environmental data

- analysis of data (detailing knowledge gaps and associated risks for each domain or feature);
- stakeholder identification;
- post mining land use;
- identification of closure risks;
- development of completion criteria; and
- closure implementation.

The preparation of the preliminary mine closure plan at this stage will ensure that potential impacts resulting from poor rehabilitation and closure practices will be negated.

5.7.3 Management Measures

Management measures required for rehabilitation and closure of each of the domains and features are given within the Preliminary Mine Closure Plan (Appendix L). The Preliminary MCP augments this PER, and is not a standalone MCP, as some information that is normally presented within an MCP is presented within the PER, and is not repeated within the MCP.

The proposed management measures will be further developed through preparation of a detailed Mine Closure Plan (MCP) following EPA approval, to augment a Mining Proposal for DMP approval. The MCP will be developed in accordance with the revised joint DMP and EPA *Guidelines for Preparing Mine Closure Plans (2015)*.

5.7.4 Predicted Outcome

The preliminary mine closure plan indicates that the EPA's objective for rehabilitation and closure will be met, ie premises are closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed outcomes and land uses, and without unacceptable liability to the State.

5.8 Environmental Offsets

The EPA's objective for offsets is: '*To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets*.'

5.8.1 Key Statutory Requirements, Environmental Policy and Guidance

This section has been prepared in consideration of:

- WA Environmental Offsets Guidelines (Government of WA, 2014)
- Environmental Protection Bulletin No. 1 – Environmental Offsets (EPA, 2014)

The Tjuntjuntjara community was established in the GVDNR for the Pila Nguru in the 1980's. DPaW is pursuing the development of a formal memorandum of understanding with the Pila Nguru to formally progress joint management of the GVDNR. Any future activities relating to management of the GVDNR (including any offsets from this proposal) will involve the engagement and participation (including employment) of the Pila Nguru.

5.8.2 Potential impact

The Project includes construction and operation of a haul road through the Class A GVDNR which will result in clearing of 306 hectares (0.012% of the GVDNR) and may result in the following potential indirect impacts:

- modification of surface and groundwater flows;
- introduction and spread of weeds;
- generation of dust from mining activities and haul road;
- use of saline water and binding agent along the haul road;
- alteration of fire regime; and
- increased access to the GVDNR including additional tracks being created.

5.8.3 Mitigation Hierarchy

The mitigation hierarchy has been applied to the potential impacts to the GVDNR as follows:

Avoid

Potential impacts to the haul road during construction and operation will be avoided through:

- Modification of the haul road route to avoid conservation significant flora, claypans, sand dune crests and significant fauna habitats; and
- Maintaining clearing and land disturbance to the absolute minimum required to construct the haul road.

Minimise

Potential indirect impacts to the haul road during construction and operation as described above will be minimised through implementation of the following management plans (**Appendix C**):

- Overarching Environmental Management Plan
- Vegetation and Flora Management Plan
- Fauna Management Plan
- Haul Road Management Plan
- Weed Management Plan
- Dust Management Plan
- Fire Minimisation Plan
- Water Management Plan
- Cultural Heritage Management Plan

Rehabilitate

Rehabilitation of the haul road will be undertaken through implementation of the Mine Closure Plan which aims to return the environmental values of the haul road within five years of rehabilitating the road.

Offset

Through application of the mitigation hierarchy above it is determined that the residual impact to the GVDNR is the short-term loss of 306 ha of vegetation within the GVDNR for 12 years of operation plus 5 years of rehabilitation. Lost Sands has therefore proposed an offset for this short-term loss of vegetation within GVDNR, as detailed in the offsets reporting form below (**Table 5-6**), which has been prepared in accordance with the WA Environmental Offsets Guidelines (Government of WA, 2014). The offset plan and associated funding will be finalised within one year of commencement of operations.

Table 5-6: Offsets reporting form

Existing Environment / Impact	Mitigation			Significant residual impact	Offset calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Time Scale / Lag	Likely offset success	Offset quantification
Clearing of 306 hectares (ha) within the GVDNR	Haul road route modified to avoid conservation significant flora, claypans, sand dune crests and significant fauna habitats. Minimise clearing and land disturbance to the absolute minimum required to construct the haul road. A Ground Disturbance Procedure will be developed including pre-clearance surveys. For example, Conservation significant flora and fauna habitat will be demarcated and avoided wherever possible Pre-clearance surveys will ensure any tree hollows present are clear of nesting or roosting Princess Parrots and other vertebrate fauna. The Weed Management Plan that focuses on the prevention of weeds being introduced into the GVDNR will be implemented, and includes: Ongoing weed monitoring and management along the haul route Weed hygiene measures Eradication techniques if required A Conservation Significant Flora and Weed Identification Guide will be developed, which will be	A specific Ground Disturbance Procedure will be developed for the Haul Road to ensure: Any topsoil/vegetative material is pushed back from the proposed road formation to form parallel windrows on either side of the proposed road formation no more than 2 m high An inventory of available topsoil is maintained and cover material available for use in the rehabilitation of the road Any Priority Flora species impacted will be noted as keystone species; with seeds collected from known distribution areas during construction and operation Seed collected will be appropriately cleaned, stored and utilised during rehabilitation of the haul road A seed list is compiled of taxa associated with each vegetation community along the length of the haul road within the GVD NR The site specific Mine Closure Plan will be implemented to ensure:	<u>Can the environmental values be rehabilitated</u> Very little rehabilitation of this vegetation has been undertaken as the mines present within this region are recent and have not yet completed rehabilitation. However, given the soil types present, extent of surrounding native vegetation, lack of introduced species, proposed rehabilitation trials, known rehabilitation methodologies and linear nature of the road that will increase the potential for re-colonisation, there is no reason to believe that rehabilitation of the haul road will not be successful. Success will be based upon adherence to a detailed Rehabilitation Plan and Mine Closure Plan. Trials will be undertaken during	The residual impact is the short-term loss of 306 ha of vegetation within the GVDNR for 17 years (Secondary impacts such as potential increases in dust, feral animals and weeds will be mitigated as part of Lost Sands operational EMPs) <u>Extent</u> Clearing of 306 ha of vegetation within the GVDNR. (That is, 0.012% of the total GVDNR area of 2,494,504 ha) <u>Quality</u> Vegetation condition recorded across the majority of the Study Area was generally considered to be 'Excellent' within the GVD regions and 'Very Good' to 'Good' within the Nullarbor Plain. Some areas could be considered 'Degraded'; however, it is also possible that poor conditions	**Direct Offset:** **On ground management** The objective of proposed on-ground management actions is the tangible and measureable improvement to the conservation values of the GVDNR. Stakeholder consultation to date has identified the following key factors that will influence the Offset Package: Key identified threats to the conservation values of the GVDNR are; inappropriate fire regimes and feral herbivores (particularly camels) Traditional Owner involvement in land management activities is a key objective for the legislative Land Manager (DPaW) As the responsible land manager proposed offset actions will be developed in conjunction with DPaW, and delivered via an MOU between Lost Sands and DPaW subsequent to the approval of the Project. All proposed land management activities will include potential synergies and co-	<u>Offset Plan Implementation</u> The risk of offset implementation failure is Low. Management will be undertaken in consultation with DPaW and other experts and delivered via an agreed Offset Plan and MOU that includes all agreed 3rd party contracts. <u>Contingency Strategy / Research</u> The risk of the contingency strategy failure is considered Low. Funds will be allocated to an appropriate organisation to undertake the research. The GVD Biodiversity Trust is an established local entity able to appropriately	<u>Residual Impact:</u> The life of the Offset Actions will continue whilst the haul road is being utilised by the proponent. The residual impact of the road through the GVDNR is likely to be 17 years. <u>Offsets Plan:</u> A Final Offsets Plan including funding and KPIs will be produced within 1 year of commencement of operations. The content of the plan will be determined in consultation with Pila Nguru and DPaW and may include: *1) An MOU with DPaW that includes all 3rd party contracts* *2) A strategy for Wildfire Threat Analysis* *3) A Camel Control Plan* *4) A Monitoring and Evaluation Plan*	<u>Can the values be defined and measured</u>? 1) Rehabilitation of the Haul Rd will be defined and measured by: Rehabilitation completion criteria stipulated within the Mine Closure Plan. 2) The final Offset Plan will include KPIs that define success. KPIs will inform a monitoring program that will assess performance based upon measurements of the: a)Threat itself: eg. Number of control programs/year; Number of Camels culled/year; Frequency/Intensity/Seasonality/Magnitude of fires). b) Response to threat mitigation: eg. Measurements of particular 'indicator species' or specific habitat parameters.	The residual impact of the proposal is the short-term loss of 306ha from the GVDNR for 17 years. No TECs, DRF or priority flora are impacted, nor threatened fauna or significant habitat. Offset measures need to relate back to the relevant impact (that is, to the values of the GVDNR), and therefore the objective of the offsets proposed is to improve the conservation values of the GVDNR. The proposed draft offset package therefore relates to currently recognised threats to the values of the GVDNR. In particular, inappropriate fire and feral herbivores (particularly camels). The threats that are considered priorities for the GVDNR will be agreed upon through consultation with Pila Nguru and DPaW. Calculator tools such as the EPBC Act environmental offsets assessment guide are not applicable in this scenario as they focus on impacts to

Existing Environment / Impact	Mitigation			Significant residual impact	Offset calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Time Scale / Lag	Likely offset success	Offset quantification
	made available to all personnel that are managing clearing activities. The Fauna Management Plan will be implemented which will assist to maintain the abundance, diversity, geographic distribution and productivity of fauna, species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge, this will include but not be limited to avoidance of mature Marble Gums, wherever possible. This will include management of feral fauna where possible. The Fire Minimisation Plan will be further developed in collaboration with DPaW and the Pila Nguru to ensure that altered fire regimes do not compromise the quality of foraging and breeding habitats. The Dust Management Plan will be implemented to reduce adverse dust impacts to flora and fauna in the surrounding environment, this includes but is not limited to application of a dust suppressant on the road. Traffic Management Strategies are included in the Fauna Management	Rehabilitation complies with agreed completion criteria. Strategies will be continually reviewed and research and investigation trials undertaken. For example: Trials will be undertaken on the viability and germination of the seed; Topsoil stockpiles and seed banks will be assessed throughout the life of the mine: The depth of material within the haul road that has been impacted by the application of a dust suppressant and saline water will be ascertained. Natural surface hydrology and drainage lines will be re-instate as far as practicable within the haul road envelope Stripped topsoil and vegetative material will be re-applied to disturbed areas Compacted areas will be ripped to maximise rainfall infiltration, and root exploration Locally-provenance seed will be used in accordance with allied vegetation associations Monitoring against specific completion criteria developed in conjunction with	the operation of the mine to inform, monitor and reassess rehabilitation methodologies to facilitate a successful outcome. <u>What is the type of vegetation being rehabilitated</u> The haul road passes through the Maralinga, Carlisle and Nullarbor Plain subregions, which have vegetation as follows: <u>Maralinga</u>: Tree steppe *of Eucalyptus gongylocarpa, Mulga and E. youngiana over hummock grassland; Triodia basedowii* dominating the aeolian sands; Acacia dominating the colluvial soils with *Eremophila* and *Santalum* spp, and Halophytes confined to edges of salt lakes and saline drainage systems. <u>Carlisle</u>: a tree steppe of *Eucalyptus gongylocarpa*, Mulga and *E. youngiana* over	encountered on the Nullarbor Plain are the result of normal climatic conditions. Completely degraded areas were limited to clearing around rail and airstrip infrastructure around Forrest at the southern end of the haul road development envelope and some isolated access tracks. Grazing from camels and rabbits was evident, particularly in the Nullarbor Plain where vegetation structures had been altered at a number of sites. <u>Conservation Significance</u> The GVD NR is a Class A Nature Reserve established under the *Lands Administration Act 1997.* <u>Land Tenure</u> Class A Nature Reserve <u>Time Scale</u>	operative engagement with the South Australian Department of Environment, Water and Natural Resources and Traditional Owners in SA managing the adjacent Mamungari Conservation Park Biosphere Reserve. Lost Sands propose the following possible on-ground management activities as Direct Offsets, which may be subject to change pending consultation with DPaW and Pila Nguru: 1) Undertake a Wildfire Threat Analysis for the GVDNR. This vital information will be used to support a Fire Management / Response Plan in collaboration with DPaW and the Pila Nguru to re-establish fire regimes sympathetic with conservation values (but also considering property and life). 2) Develop and implement a Feral Camel Control Plan to minimise the impact to the native ecosystems being impacted by excessive grazing. The Plan will be developed using the expertise of the Pila Nguru, DAFWA, DPaW with synergies investigated with the South Australian Department of Environment, Water and Natural Resources.	deliver any re-directed funds. Lost Sands will work with DPaW and the GVD Biodiversity Trust to ensure that any research undertaken relates and is relevant to the impacted environmental values.	Timing of the implementation of the offsets plan will be dependent upon stakeholder engagement and outcomes of the planning process. It is proposed that an audit and review of key actions will occur annually.		threatened species and communities, hence such tools cannot be utilised in this case. Lost Sands has therefore presented a regional landscape-scale approach to the development of offsets consistent with the WA EPA Environmental Offset Guidelines whereby the entire GVDNR benefits from the short-term loss of less than 0.012% of its area. Funds required for development and implementation of the agreed offset plan will be contributed by Lost Sands over the period of 17 years (12 years operations and 5 years rehabilitation). The actual timing of relinquishment of funds on an annual basis will be articulated within the Final Offset Plan and associated MOU developed with DPaW. Stakeholder engagement to date has agreed that this is an appropriate approach. A contingency strategy will be presented whereby the equivalent

Existing Environment / Impact	Mitigation			Significant residual impact	Offset calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Time Scale / Lag	Likely offset success	Offset quantification
	Plan and include enforcing speed limits in areas that are known to contain fauna that may be susceptible to vehicle strikes. The design and construction of the Haul Rd will ensure: Surface water flows will be maintained wherever possible Transport of material from road building activities into shallow depressions and other low lying areas will be avoided .	stakeholders will be undertaken. Operational Procedures will ensure: Water sprays on the vehicles used for dust suppression will be regularly checked to ensure that the spray does not impact on the topsoil/surface/ and vegetative material stockpiles Any contamination that occurs on the road during operations is removed to a designated area outside of the GVD NR	hummock grassland; woodlands of *Acacia papyrocarpa* (Western Myall) over *Maireana sedifolia* (Bluebush). <u>Nullarbor:</u> bluebush-saltbush steppe with some woodlands of *Acacia papyrocarpa* over *Maireana sedifolia* in peripheral areas <u>Time lag</u> It is anticipated that the haul road will be rehabilitated and a large percentage of the environmental values returned within five years of rehabilitating the road.	The Project has a ten year mine life. The haul road will be the first feature to be developed and the last feature to be rehabilitated; hence will remain 'cleared' for approximately 12 years. It is anticipated that within a five year period Lost Sands will be able to demonstrate that the rehabilitation is successfully trending towards achievement of the completion criteria. Therefore the total time scale of impact is predicted to be 17 years.	3) Develop and implement a Monitoring and Evaluation Plan to establish long-term monitoring sites and assess changes to ecosystems **Contingency Planning:** **Indirect Offsets:** If knowledge gaps prevent the development or implementation of particular components of the Offset Plan, or if there are funds remaining once all elements of the plan have been completed, funds may be re-directed to research that focusses on strategies that improve landscape scale management within the region. The GVD Biodiversity Trust will be investigated as a vehicle to deliver these re-directed funds.				funding (or proportionate funding) is re-directed to an appropriate Trust if knowledge gaps prevent the development or implementation of particular components of the Plan, or if there are funds remaining once all elements of the plan have been completed. If operations proceed after the anticipated 12 years of operations funds will continue to be released at an equivalent annual rate.

6 Community And Stakeholder Consultation

Lost Sands has proactively consulted with the local community, the Pila Nguru, on a regular basin since the establishment of the Project. Lost Sands engaged stakeholders early in the planning for this proposal, primarily in the interests of achieving a collaborative approach and to ensure that local knowledge is considered in the design and management of the proposal.

Stakeholder consultation for the proposal commenced in November and December 2005 when the proposal was introduced to the Pila Nguru people. The Pila Nguru people continued to be consulted through the exploration phase of the Project until the Project development stage in 2013/2014.

In 2012 Lost Sands extended its stakeholder consultation process to include regulatory bodies such as:

- DoW;
- DMP;
- Department of Environment and Conversation (DEC) now known as DPaW and DER;
- EPA; and
- OEPA.

Additional stakeholders also consulted during the Project development stage included the Forrest airport and ARTC.

To date consultation has included:

- written and verbal communications with the traditional custodians, the Pila Nguru, including notification of the scope and purpose of the technical studies, landholder access arrangements for exploration, environmental investigations and eventual mining operations and notification of Lost Sand's *Environmental Protection Act 1986* referral and the consequent EPA determination of the requirement for a PER assessment of the proposal;
- individual Project briefings and meetings with the Pila Nguru; and
- written and verbal communication with key State Government agencies including the DoW, DER, DPaW and OEPA.

The broad outcomes of the stakeholder consultation activities associated with the proposal to date have included:

- increased government and community awareness and understanding of the Project;
- involvement of regulatory authorities in shaping Project activities;
- identification of areas of concern to local residents, the wider community and other stakeholders;
- provision of information by local stakeholders for use by Lost Sands in planning and investigations;

- identification of potential business/employment opportunities for local stakeholders; and
- opportunities for members of the traditional custodian and local community to voice opinions and concerns.

6.1 Stakeholder Comments and Proponent Responses

Table 6-1 summarises the stakeholder consultation that has occurred to date including specific topics of discussion, primary issues raised and responses. This table excludes:

- any communications which refer to financial arrangements;
- discussions with traditional custodians and other stakeholders which are not relevant to the PER process

Table 6-1: Proposal specific consultation, topics of discussion, comments or issues raised and outcomes

Stakeholder Consultation Register					
Date	**Stakeholder(s)**	**Description of Consultation**	**Topic of Consultation**	**Stakeholder Comment / Issue**	**Proponent Response and / or Resolution**
19/05/15	DPaW OEPA	Meeting	Offsets	MWH (Kim Bennett and Sarah Perry) and Lost Sands (Phil McMurtrie) met with Nick Woolfrey, Sandra Thomas (Kensington Office) and Julie Futter, John Lizamore (Kalgoorlie Office) from DPaW, and Luke Jacenko, Richard Sutherland from the OEPA. The purpose of the meeting was to discuss the revised offsets reporting form. DPaW advised that the offsets form should incorporate more flexibility in the types of the offset proposed, so that they can be modified if necessary based on what are considered to be the priority threats to the GVDNR.	The offsets reporting form was revised to introduce flexibility into the types of offsets, so that there is an option for them to be changed dependent on the outcomes of ongoing consultation with DPaW and Pila Nguru.
01/05/2015	OEPA	Meeting	Comments on Draft PER Version 2	MWH (Kim Bennett and Sarah Perry) and Lost Sands (Phil McMurtrie) met with Luke Jacenko, Richard Sutherland and Kaylene Carter from the OEPA. The purpose of the meeting was to discuss comments on the draft PER Version 2 and the revised offsets reporting form. OEPA advised that they believed the offsets reporting form was acceptable, however they would need to get advice from DPaW as to whether they consider it adequate for inclusion in the PER.	A meeting was arranged with DPaW to discuss the adequacy of the draft offsets reporting form for the PER to be released for public comment.
15/11/2014	Pila Nguru	Meeting	Mining agreement	On 15th November 2014, a signing ceremony took place on site at Tjuntjuntjara, after which Lost Sands executed the Cyclone Zircon Project Native Title and Mining Agreement (and ancillary documentation) with the Pila Nguru (Aboriginal Corporation)(RNTBC) representing the Spinifex People, the traditional owners of the land containing the Project. The agreement provides for compensation payments, contracting opportunities, direct employment, an educational trust fund and cultural initiatives.	
24/09/2014	DPaW/OEPA	Meeting	Offsets	MWH (Kim Bennett and Sarah Cohen) and Lost Sands (Phil McMurtrie and Neil McIntyre) met with Nick Woolfrey, Sandra Thomas (Kensington Office) and Ian Keeley, Julie Futter (Kalgoorlie Office) from DPaW, and Luke Jacenko from the OEPA. The purpose of the meeting was to discuss DPaW's interest in the road through the GVDNR being retained post closure; the discussion also covered how this would be presented within the PER, and how this would impact on the quantification of the proposed offset.	MWH on behalf of Lost Sands stated that the default position of rehabilitating the road would be presented in the PER, and the offset proposed was considered only for the duration of time that the road was utilised by Lost Sands.
02/09/2014	OEPA	Meeting	Offsets	MWH (Kim Bennett and Sarah Perry) and Lost Sands (Phil McMurtrie and Neil McIntyre) met with Luke Jacenko from OEPA. Luke advised of the new WA Offsets Guidelines and the requirements for the Cyclone Project. MWH advised Luke that DPaW would like the option of retaining the haul road assessed within the PER	MWH on behalf of Lost Sands incorporated requirements of Offsets Guidelines into the PER.
15/08/2014	OEPA / DPaW	Meeting	Biodiversity Offsets	MWH (Kim Bennett and Sarah Cohen) and Lost Sands (Phil McMurtrie) met with Daniel Coffey, Nick Woolfrey, Sandra Thomas (Kensington Office) and Ian Keeley, Julie Futter (Kalgoorlie Office) from DPaW. The purposed of the meeting was to discuss the proposed offsets required for the Cyclone Project. DPaW advised that they would like the option of retaining the haul road within the PER	MWH on behalf of Lost Sands to arrange meeting with OEPA to discuss how to address option of retaining road within PER, and proposed offsets.
22/05/2014	OEPA	Email	Cyclone PER	Kaylene Carter from OEPA provided MWH on behalf of Lost Sands with examples of good PERs to refer to in terms of layout and how factors tables were addressed. Guidance was also provided in relation the application of EAG-9.	MWH on behalf of Lost Sands to consider examples and guidance provided from OEPA while developing the PER document.

Stakeholder Consultation Register					
Date	**Stakeholder(s)**	**Description of Consultation**	**Topic of Consultation**	**Stakeholder Comment / Issue**	**Proponent Response and / or Resolution**
8/05/2014	OEPA	Meeting	PER Content and Format	MWH (Kim Bennett, Sarah Perry and Sarah Cohen) on behalf of Lost Sands met with Mark Jefferies, Kaylene Carter from OEPA. Kaylene Carter was assigned as the OEPA assessment officer for the Project. Noise, Weeds, Mine Closure and Offsets were discussed in relation to how they would be addressed within the PER. EPBC approvals were discussed. Lost Sands confirmed that the Mine Closure Plan would be incorporated as a component within the PER and not as a stand-alone Mine Closure Plan.	MWH on behalf of Lost Sands took advice provided by OEPA into consideration when preparing the PER.
17/04/2014	Pila Nguru	Meeting	Negotiation Protocol	Pila Nguru provides amended structure for negotiation meetings to attempt to reach agreement with Lost Sands in August 2014.	Lost Sands advises Pila Nguru that it would like to target August 14 for completion of the negotiation meetings and finalising the mining agreement.
14/04/2014	DoW	Email	Deep bore	Receipt of report confirmed and no issue.	Completion report for deep bore in E69/1920 submitted to DoW.
9/04/2014	DMP	Discussion	Section 19 areas	Section 19 is an area set aside by DMP for its geological investigations. The Section 19 area north of Forrest is likely to be modified so as not to affect the road alignment following completion of a report by the Geological Survey. Don Flint advised that the areas would stay until the Section 19 report and could then look at options for reducing the area.	Send proposed road alignment to Don Flint at the Geological Survey. If Section 19 areas are long term then road would have to be diverted.
7/04/2014	DPaW	Meeting	Biodiversity Offsets	MWH (Kim Bennett, Sarah Perry and Sarah Cohen) on behalf of Lost Sands met with Daniel Coffey, Nick Woolfrey (Kensington Office) and Ian Keeley, Julie Futter (Kalgoorlie Office) from DPaW. The purposed of the meeting was to discuss possible options for offsets required for the Cyclone Project. DPaW raised concern in relation to the haul road remaining within the GVDNR post mine closure. A number of possible offset possibilities were discussed for both Lost Sands and DPaW to consider. Agreed to meet again once a better idea of potential impacts to flora and fauna has been gained, to discuss offsets in more detail.	MWH on behalf of Lost Sands considered advice from DPaW in relation to not retaining a haul road through the GVDNR post mine closure. In response to DPaW's concerns, Lost Sands agreed to remove the haul road and rehabilitate the haul road footprint post mine closure.
31/03/2014	DMP	Discussion	Section 19 areas	Neil Spencer advised of Section 19 areas north of Forrest which could affect the proposed road alignment and provided a contact in the Geological Survey who could provide more details	Send proposed road alignment to Neil Spencer to check if the Section 19 areas were an issue.
24/03/2014	DPaW	Email	Cyclone flora/fauna surveys: Phase 2 methods summaries	DPaW informed MWH (on behalf of Lost Sands) of the proposed supplementary surveys for flora and fauna scheduled for autumn 2014 were in-line with OEPA guidance and are endorsed to proceed by DPaW.	MWH on behalf of Lost Sands to undertake fauna surveys using survey methods endorsed by DPaW.
10/03/2014	DPaW	Email	Cyclone flora/fauna surveys: Phase 2 methods summaries	MWH provided an email to Claire Stevenson and Daniel Coffey (DPaW) providing a summary of the intended flora and fauna survey methods for the Phase 2 survey methods for the Cyclone Project planned for March/April 2014. These were provided for DPaW to provide a written endorsement of these methods prior to undertaken field surveys.	MWH on behalf of Lost Sands submitted survey summaries to DPaW.

Stakeholder Consultation Register					
Date	**Stakeholder(s)**	**Description of Consultation**	**Topic of Consultation**	**Stakeholder Comment / Issue**	**Proponent Response and / or Resolution**
27/03/2014	Pila Nguru	Meeting	Public Environmental Report		Lost Sands provides Pila Nguru with updated timing for the Autumn season Level 2 environmental surveys.
17/02/2014	ARTC	Email	Plans for Forrest	Information received and no issues raised.	Send email with plans to ARTC Property Manager with Forrest activity area and relevant Project information.
17/02/2014	ARTC	Email	Forrest siding	Confirmed receipt of information and no issues. Will discuss the proposal in detail when the Project siding location is finalised.	Discussion with ARTC property manager regarding possible use of the rail siding at Forrest. Send a plan of the Forrest siding showing the area required for train loading.
13/02/2014	OEPA and DPaW	Meeting	Phase 2 Level 2 Fauna and Flora Surveys	Lost Sands (Phil McMurtrie) and MWH (Tristan Derham, Dr Michael Young, Jeni Alford, Chad Hughes and Morné van Zyl) met with Claire Stevenson, John Dell and Kelly Freeman from OEPA and Sandra Thomas and Daniel Coffey from DPaW. During the meeting all discussed the current status of the Flora and Fauna investigation to delineate further survey requirements and obtain approval of methodology. It was noted that In order to get final approval of the survey methodology for the Phase 2 Level 2 effort the survey methodology needs to be circulated to the OEPA and DPaW for sign-off. Queries were raised as to the haul route construction methodology through the GVDNR, especially regarding borrow pit areas. Lost Sands explained that a detailed methodology will be developed once the road alignment had been refined and a detail design of the road had been completed.	MWH on behalf of Lost Sands was to prepare a fauna survey methodology for review.
11/02/2014	ARTC	Phone call	Plans for Forrest	No obvious issues. Needs to see a plan of our preferred siding area and details of activities. Will contact Lost Sands after reviewing plans if any issues arise.	Phone Property Manager at ARTC. Provide an update on the project and siding requirements. Lost Sands will email a plan and relevant project information.
6/02/2014	Forrest airport	Phone call	Plans for Forrest	Sounds like it would benefit his business. Will send us plans of his freehold and leasehold areas relative to the rail line. Provided contact details for the Property Manager at ARTC and suggested we talk to him about the siding.	Phone call from the Forrest airport owner. Discussed the plans for the road and siding and all planned activities at Forrest. Lost Sands will contact ARTC after plans received from Andrew
30/01/2014	Forrest airport	Discussion	Forrest update	Manager will forward plans and our contact details to owner. Expects the information to be appreciated and well received.	Contact Forrest airport manager as the airport owner has not contacted us and we will send plans showing proposed road and siding location.
30/01/2014	Forrest airport	Email	Plans for Forrest	Airport manager receives plans.	Plans showing locations of proposed activities at Forrest sent to the airport manager.
30/01/2014	Forrest airport	Email	Forrest siding	Confirmed receipt of information and will forward it to the owner of the airport.	Discuss the project and proposed use of Forrest rail siding with the Forrest airport manager. Send map showing proposed road from Cyclone and the area required for train loading.
27/11/2013	Forrest airport	Phone call	Plans for Forrest	Interested in ensuring airport safety and understanding activities in train loading area. No issues, Airport manager will ask the owner to contact us.	Phone call with Forrest airport manager to update on project progress. Road will be well clear of the airport and mineral will be transported in closed containers.
13/11/2013	OEPA	Letter	Cyclone Mineral Sands Project – Fauna Survey Design	Anthony Sutton – Director of OEPA's Assessment and Compliance Division provide advice to Lost Sands and MWH in relation to the fauna survey requirements for the Cyclone Mineral Sands Project.	MWH on behalf of Lost Sands to incorporate DPaW comments into fauna survey design for Phase 1 of Level 2 fauna investigations.

Stakeholder Consultation Register					
Date	**Stakeholder(s)**	**Description of Consultation**	**Topic of Consultation**	**Stakeholder Comment / Issue**	**Proponent Response and / or Resolution**
13/11/2013	Pila Nguru	Report	Environmental studies		Lost Sands provides Pila Nguru with a report on field results for the northern Level 2 environmental surveys.
8/11/2013	DPaW	Email	Fauna surveys	Sandra Thomas from DPAW provided comments on the scope for the Phase 1 of the Level 2 fauna investigations in the Great Victoria Desert Nature Reserve (class A). DPaW provided comments on: Survey intensity Survey timing Targeted Surveys Traditional Owners Options; and Conservation Commission of Western Australia briefing.	MWH on behalf of Lost Sands to incorporate DPaW comments into fauna survey design for Phase 1 of Level 2 fauna investigations.
17/10/2014	OEPA and DPaW	Meeting	Supplemental Fauna Survey	Lost Sands (Phil McMurtrie) and MWH (Tristan Derham, Dr Michael Young, Chad Hughes and Morné van Zyl) met with OEPA and Sandra Thomas, Mark Cowen, Karl Brennan, Julie Futter, Neville Hague, John Dell, Claire Stevenson and Chris Bishop from DPaW. MWH presented preliminary fauna and flora results of the recently undertaken surveys at the Cyclone Zircon Project Study Area. The main purpose of the discussions was to obtain regulator input (consensus) into the methodology intended for the supplemental fauna survey so that it adequately addressed all ESD requirements for a Spring Survey. A primary concern of DPaW was that there was not sufficient data, nor had there been sufficient consultation to choose the central haul route over the eastern one. DPaW regarded the previous work undertaken by Bamford as inadequate. Of particular concern was the lack of reference to nearby surveys. DPaW were happy to share results of nearby surveys with MWH. DPaW's primary concern was survey adequacy in the GVD Nature Reserve. Secondary to that was species protected under the Wildlife Conservation Act 1950. DPaW noted that management procedures for the final road alignment would be appropriate conditions on the approval rather than being undertaken prior to the PER submission	MWH to undertaken the following actions on behalf of Lost Sands - to provide preliminary flora and fauna data to OEPA and DPaW and to provide preliminary survey pan to DPaW for comment on adequacy for use within the PER.
8/10/2013	Pila Nguru	Discussion	Public Environmental Report	Pila Nguru confirms that the rangers will be available to be involved on those dates.	Lost Sands provides Pila Nguru with dates for the planned Level 2 environmental surveys in the southern section of the study area.
2/10/2013	Pila Nguru	Discussion	Exploration	Pila Nguru responds to Lost Sands with the preferred route for traffic past Tjuntjuntjarra for the deep bore drilling.	Lost Sands provides Pila Nguru with details of proposed truck movements past Tjuntjuntjarra for the deep bore drilling.
1/10/2013	Pila Nguru	Discussion	Environmental studies	Pila Nguru requests information on the Level 2 environmental studies for the PER.	Lost Sands provides Pila Nguru with information on the proposed Level 2 environmental studies.
16/09/2014	OEPA	Email	Cyclone Mineral Sands Project - Rehabilitation criteria and closure planning	Vanessa Angus from OEPA provide guidance in relation addressing Mine Closure Plan requirements within the PER. *"The EPA expect mine closure plans to demonstrate, based on reliable science-based and appropriate site-specific information, that ecologically sustainable closure can be achieved".* Vanessa also made reference in this email to page 25 of the Guidelines: *"Development of completion criteria and associated performance indicators must commence up-front in the project approval stage for new projects or as early as possible for existing operations, and be reviewed and refined throughout the development and operation*	MWH on behalf of Lost Sands to considered advice and guidance when addressing mine closure requirements when development the PER document. MWH will incorporate indicative completion criteria into the closure section of the PER.

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				of the project to respond to monitoring, research and trial information and any other information or change as appropriate. Indicative completion criteria, based on a conservative estimate of closure performance, may be acceptable at the project approval stage, provided that they are capable of objective verification and based on the best available data at the time. As more information becomes available, more comprehensive and detailed completion criteria can be progressively determined." Vanessa confirmed that the use of indicative completion criteria would be acceptable for use in the closure section of the PER.	
12/09/2013	OEPA	Meeting	Discuss the finalised Environmental Scoping Document	Vanessa Angus (EPA Assessing officer), Richard Sutherland, Kelly Freeman (Terrestrial Ecosystems – Botanist), Bridget Hyder (Terrestrial Ecosystems), John Dell (Terrestrial Ecosystems), Clare Stevenson, Luke (offsets), Mel Bolton, Mike Young, Tristan, David Hall, Morne Van Zyl In terms of the finalised Environmental Scoping Document, determine the acceptability of the proposed MWH methodology to undertake a Public Environmental Review for the Cyclone Zircon Project (The MWH methodology was developed based on the draft Environmental Scoping Document). OEPA suggested that the current survey methodology as well as refinements based on this clarification meeting be discussed with officials from the DPaW. The OEPA indicated that at the level of the PER they require a demonstration that the hierarchy of impacts have been considered, i.e. certain levels of impact require offsets whilst others do not. The fact that the proposed haul road alignment transgresses a Nature Reserve will require an off set. This will likely include the implementation of certain management measures within the GVD The OEPA need to amend the timeline in the finalised ESD to reflect the correct submission and assessment dates. The OEPA agreed to correct the ESD. OEPA would prefer the PER document to be brief and to the point. Mine Closure has been identified as an integrating factor. MWH proposed to develop qualitative completion criteria for incorporation into the PER, with the view that these would be quantitative over time, one the final landform designs have been developed, and there is a greater understanding of the soil properties available on the outer surfaces and the vegetation these soils are likely to support. OEPA indicated they would provide further advice on the completion criteria. The OEPA indicated that a closure section within the PER is acceptable, and that a stand along Mine Closure Plan would not be required.	MWH on behalf of Lost Sands to liaise with DPaW in relation to survey methodology. MWH on behalf of Lost Sands to address OEPA comments / queries sufficiently within the PER. MWH will develop a closure section on behalf of Lost Sands for incorporation into the PER.
11/09/2013	Pila Nguru	Discussion	Exploration	Pila Nguru agrees to meet with Lost Sands at Tjuntjuntjarra and jointly visit Cyclone to inspect recent water bore activities.	Lost Sands advises Pila Nguru of plans for a visit to Cyclone on 25 September and suggested that Pila Nguru could participate to inspect current site activities.
2/09/2013	DoW	Email	Test bores	Receipt of reports confirmed. No issues.	Completion reports for 3 bores on L69/18 submitted to DoW.
30/08/2013	Pila Nguru	Meeting	PER	Pila Nguru confirms receipt and advises that this information will be included for discussion at the next meeting of Pila Nguru Directors.	Lost Sands provides Pila Nguru with information on the PER for the Cyclone Project and suggestions for Pila Nguru involvement in the environmental studies.
23/08/2013	OEPA	Email	PER	The final ESD is provided to Lost Sands by the EPA.	Lost Sands receives the final ESD from the EPA.

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23/08/2013	Pila Nguru	Discussion	Negotiation Protocol	Pila Nguru requests a meeting with Lost Sands to finalise the agreement for the Miscellaneous Licences and discuss the timing for restarting Negotiation Meetings.	Lost Sands responds to Pila Nguru request explaining the forecast timing for planned activities and the engagement of KHC to assist Lost Sands with the Mining Agreement negotiations.
13/08/2013	DoW	Email	Deep bore	Confirmation that application received and bore can be test pumped using the construction licence.	Lost Sands submits an application to construct a deep bore at Cyclone in E69/1920. Requested information about pump testing the bore.
18/07/2013	EPA	Presentation	PER	The EPA Board discussed the Project following the presentation by Lost Sands.	Lost Sands provides a presentation to the EPA Board Meeting and answers questions from the Board.
20/06/2013	DoW	Discussion	Test bores	DoW requested information on the use of water from the 3 test bores.	Lost Sands advised that an application to take water from the bores would be submitted following test pumping.
7/06/2013	DoW	Submission	Test bores	Applications are complete and no more information required.	Lost Sands submits applications for 3 test bores for Miscellaneous Licence L69/18.
4/6/13 10/6/13	OEPA	Email	PER	EPA provides a draft ESD to Lost Sands for review and comment.	Lost Sands sends comments on the draft ESD to OEPA.
25/03/2013	OEPA	Meeting	EPA referral	OEPA advises that the level of assessment is a PER with a 5 week public review period and the EPA will prepare the ESD.	The Cyclone Project including the proposed road through the GVDNR is referred to the EPA following the standard process.
31/01/2013	Pila Nguru	Discussion	Negotiation Protocol	Pila Nguru advises Lost Sands that the contaminated soil issue has not been resolved and requests a meeting to decide actions to resolve.	
16/01/2013	OEPA	Meeting	EPA referral	OEPA advised Lost Sands to refer the project to the EPA under Section 38 of the EP Act.	Lost Sands presented and discussed project information at a meeting with representatives of OEPA, DEC, and DMP.
14/01/2013	DMP	Meeting	OEPA meeting	Mike Freeman forwarded details to OEPA.	Provide details of Lost Sands participants for the meeting with OEPA.
21/11/2012	DMP	Discussion	Referral to EPA	Mike Freeman discussed the project with the EPA and we should meet with OEPA early 2013.	Discussion with DMP for advice on how to approach EPA regarding the Project.
21/11/2012	DMP	Discussion	EPA referral	DMP advised that Lost Sands should provide a briefing to OEPA and DEC.	Lost Sands will commence preparing for the joint OEPA and DEC meeting.
19/11/2012	OEPA	Discussion	EPA referral	DEC asked Lost Sands about its intentions for referring the Project to the EPA.	Lost Sands commenced discussions and planning for approaching EPA regarding Project referral.
1/11/2012	DMP	Email	Road in GVDNR	Mike Freeman clarified the approval process for a Miscellaneous Licence for a road in the GVDNR.	A copy of the Level 1 Road Options Report was sent to Mike Freeman at DMP.
1/11/2012	DMP	Discussion	EPA referral	Mike Freeman will contact the EPA chairman and OEPA officers to facilitate the process.	DEC has advised that Lost Sands should consider referring the project to the EPA and request assistance from DMP.
31/10/2012	DMP	Discussion	Road options studies	DMP made comments but had no issues with the report.	A copy of the road options report was sent to DMP.
11/10/2012	DEC	Email	Road options studies	DEC receives the Road Options Report.	The Road Options Report based on Level 1 environmental studies was sent to DEC.

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Date	**Stakeholder(s)**	**Description of Consultation**	**Topic of Consultation**	**Stakeholder Comment / Issue**	**Proponent Response and / or Resolution**
17/09/2012	Pila Nguru	Information provided	Cultural Clearance	Pila Nguru request information from Lost Sands regarding the location of the test pit and the drill lines referred to in Scott Canes report.	Lost Sands provides information to Pila Nguru regarding the location of the test pit and the drill lines referred to in Scott Canes report.
17/09/2012	Pila Nguru	Discussion	Cultural Clearance	Pila Nguru advises Lost Sands that additional heritage clearance will be required for the bore sites.	
Aug - Sep 2012	DEC	Discussion	Road options studies	Pila Nguru representatives and technical experts review the Road Options Report and provide comments and edits for the report.	Discuss and respond to Pila Nguru comments for finalising the Road Options Report for DEC.
31/08/2012	DMP	Discussion	Project approval process	DMP to continue discussions with DEC to facilitate a joint meeting.	Discussion with DMP regarding a meeting that should be arranged with DEC and include DMP.
20/08/2012	Pila Nguru	Discussion	Cultural Clearance	Pila Nguru request information on the location of the planned bores and will also discuss the clearance requirements with Scott Cane.	Lost Sands advises Pila Nguru of discussions with Scott Cane regarding heritage clearance for planned bores beside the road.
30/07/2012	Pila Nguru	Discussion	Road options studies	Discussion with Lost Sands regarding process for review of Level 1 report.	Discussion with Pila Nguru regarding process for review of Level 1 report.
26/07/2012	Pila Nguru	Discussion	Negotiation Protocol	Pila Nguru discusses with Lost Sands future plans for recommencing activities when funding is obtained.	Lost Sands advises Pila Nguru that most Cyclone Project activities are being deferred until additional funding is obtained.
17/07/2012	Pila Nguru	Discussion	Miscellaneous licence peg	The datum peg can be installed as discussed at the previous meeting.	Lost Sands requested confirmation from Pila Nguru that a datum peg for a miscellaneous licence for water could be installed beside the road to Cyclone.
26-27/6/12	Pila Nguru	Discussion	Road options studies	Preliminary timing for commencing the Level 2 studies is a concern due to the delay in completion of the Level 1 studies. Pila Nguru want to see the completed report before discussing details of the Level 2 studies.	Lost Sands agrees that the Level 2 studies will not start until Pila Nguru reviews the Level 1 report and agrees to the methodology and process for the Level 2 studies.
16/07/2012	Pila Nguru	Discussion	Miscellaneous Licence	Pila Nguru approves Lost Sands request for placement of datum peg for water exploration application.	Lost Sands request permission from Pila Nguru to place a Miscellaneous Licence datum peg for an application for water exploration.
16/07/2012	Pila Nguru	Discussion	Exploration	Pila Nguru confirms with Lost Sands the exploration tracks should be left open and not rehabilitated	Lost Sands and Pila Nguru discuss planned exploration track closures and tracks that Pila Nguru prefers to be left open. The tracks left open are approved by DMP as part of the tenement relinquishment.
13/07/2012	DoW	Discussion	Test bores	Revised timing acknowledged.	Lost Sands advises DoW that the tenement approval for 69/16 & 69/17 could be another 8 weeks.
11/07/2012	DoW	Discussion	Test bores	Bore applications have been received but the tenements (69/16 & 69/17) have not been granted.	Tenement approval is subject to an infrastructure agreement with Pila Nguru. Will keep DoW informed of progress.
9/07/2012	Pila Nguru	Meeting	Negotiation Protocol	Pila Nguru confirms receipt and will include these items in the agenda for discussion at the next negotiation meeting.	Lost Sands provides Pila Nguru with information for the next negotiation meeting including copies of the Miscellaneous Licence application, radioactivity measurements from metallurgical testwork, and possible employment opportunities at Cyclone.
6/07/2012	Pila Nguru	Information provided	Road options studies	The report will be distributed within Pila Nguru and their advisers for review.	Lost Sands provided a copy of the draft Road Options Report to Pila Nguru for review and comment.

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Date	**Stakeholder(s)**	**Description of Consultation**	**Topic of Consultation**	**Stakeholder Comment / Issue**	**Proponent Response and / or Resolution**
7/06/2012	Pila Nguru	Information provided	Heritage agreement	Pila Nguru advised that the site visit will be for general familiarisation for the Pila Nguru and would not include any heritage clearance work.	Send information on proposed activity areas at Cyclone and GPS coordinates for site visit by Pila Nguru including area requiring clearance for deep bore.
7/06/2012	Pila Nguru	Discussion	Heritage agreement	Pila Nguru is working on the heritage agreement document which should be presented at the next negotiation meeting.	Lost Sands would like to make progress with the heritage agreement for test bores on the miscellaneous licences.
6/06/2012	Pila Nguru	Information provided	Road options studies	Pila Nguru responded proposing communication arrangements for comment and agreement on the Level 2 methodology.	Draft methodology for Level 2 environmental studies sent to Pila Nguru for review and comment.
31/05/2012	Pila Nguru	Discussion	Road options studies	Pila Nguru are preparing for their environmental survey program and need the Level 1 reports and Level 2 methodology for alignment with studies by Lost Sands.	Provide Pila Nguru with timing for the draft Road Options Report and will then provide a draft of the Level 2 studies methodology.
29/05/2012	DEC	Discussion	Road options studies	Acknowledged and requested the scope of work provided by DEC.	Complete Level 1 flora report sent to Pila Nguru for review
21/05/2012	Pila Nguru	Discussion	Exploration	Pila Nguru will review and respond.	Lost Sands provides Pila Nguru with information on proposed exploration track closures seeking Pila Nguru comments on tracks it may want left open.
9/05/2012	Pila Nguru	Discussion	Negotiation Protocol	Pila Nguru met with Lost Sands at Tjuntjuntjarra to discuss activities and progress the negotiation meeting program.	Lost Sands and Pila Nguru met at Tjuntjuntjarra to discuss all current and planned activities to keep Pila Nguru informed of progress.
9/05/2012	Pila Nguru	Discussion and Information provided	Negotiation Protocol	Pila Nguru and Lost Sands ongoing communications regarding site activities including, exploration, pegs for applications, environmental studies, water search and project plans.	Lost Sands and Pila Nguru ongoing communications regarding site activities including, exploration, pegs for applications, environmental studies, water search and project plans.
3/05/2012	DMP	Discussion	Deep bore	DMP advised that the deep bore should be completed under a program of works with a cover letter explaining additional details not included on the standard application.	Request information from DMP regarding drilling a deep bore at Cyclone on E69/1920.
3/05/2012	DMP	Discussion	Deep bore	DMP advised the process to follow to retain the deep bore.	Request information regarding retaining the deep bore if it is successful.
23/04/2012	Pila Nguru	Discussion and Information provided	Environmental studies	Pila Nguru requests information on guidelines used for planning the Level 2 environmental studies.	Lost Sands provides Pila Nguru with information on guidelines for the planned environmental studies.
29/03/2012	Pila Nguru	Discussion	Cultural Clearance	Pila Nguru confirms receipt of the letter and will review it and comment.	Lost Sands provides Pila Nguru with a letter explaining the planned project development activities.
19/03/2012	Pila Nguru	Discussion and Information provided	Negotiation Protocol	Pila Nguru approves release of the PFS results to the ASX.	Lost Sands provides Pila Nguru with a draft of the Cyclone Project PFS release of results to the ASX.
16/03/2012	Pila Nguru	Discussion	Environmental studies	Pila Nguru provides Lost Sands with detailed protocol and instructions regarding activities for the Level 1 environmental studies for the 3 road options. Pila Nguru will provide approval for areas that can be surveyed and photographed.	Lost Sands agrees to comply with Pila Nguru protocol and instructions during the Level 1 environmental studies.
15/03/2012	Pila Nguru	Discussion	Environmental studies	Pila Nguru requests from Lost Sands a vehicle suitable for use by Pila Nguru in the Level 1 environmental surveys.	Lost Sands request details from Pila Nguru regarding the number of people that will be involved in the Level 1 environmental surveys.

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Date	**Stakeholder(s)**	**Description of Consultation**	**Topic of Consultation**	**Stakeholder Comment / Issue**	**Proponent Response and / or Resolution**
14/03/2012	DEC	Information provided	Road options studies	Information received by DEC Kalgoorlie.	A technical note and scope for environmental studies for 3 road options was sent to DEC Kalgoorlie office as background for a meeting to plan the field work.
14/03/2012	Pila Nguru	Discussion	Negotiation Protocol	Pila Nguru provides approval for the negotiation protocol comments in the ASX release.	Lost Sands request permission from Pila Nguru for comments about the negotiation protocol in an ASX release.
Mar-12	Pila Nguru	Discussion	Road options studies	Pila Nguru provided representatives to advice on culturally sensitive areas.	Environmental surveys of the 3 road options using 2 helicopters with fauna and flora professionals and Pila Nguru representatives.
8/02/2012	Pila Nguru	Discussion	Environmental studies	Pila Nguru confirms receipt of the proposal and advises the date for the meeting to finalise the Negotiation Protocol is 7/8 March 2012.	Lost Sands provides Pila Nguru with a draft proposal for the Level 1 environmental studies including Pila Nguru involvement for assessing 3 road options.
19/01/2012	Pila Nguru	Discussion	Negotiation Protocol	Pila Nguru agreed that the ASX release was acceptable.	Lost Sands provides Pila Nguru with a draft ASX release for comment and approval regarding Pila Nguru matters.
17/01/2012	Pila Nguru	Discussion	Negotiation Protocol	Pila Nguru provides Lost Sands with a revised draft of the NP document and confirms the next workshop date.	Lost Sands confirms receipt of revised NP document and informs of progress removing the contaminated soil.
21/12/2011	DEC	Information provided	Road options studies	Information received by DEC.	A technical note and scope for environmental studies for 3 road options was sent to DEC for review and comment.
1/11/11 15/12/11	DEC	Discussion	Road options studies	DEC reviewed the study scope and provided comments to ensure the objective was to identify the option with the least environmental impact.	Send strategy for evaluating road options to DEC and confirm that Pila Nguru will be involved.
1/11/2011	DEC	Information provided	Road in GVDNR	DEC responded with comments for consideration in the road options study.	Send proposal for evaluation of road options to Sandra Thomas following meeting outcome with Norm Caporn (DEC).
19/10/2011	Pila Nguru	Information provided	Negotiation Protocol	Pila Nguru confirms receipt.	Lost Sands provides Pila Nguru with a plan for development of the Cyclone Project.
14/09/2011	DEC	Meeting	Meeting with DEC	DEC requires Lost Sands to complete an analysis of the 3 road options presented at the meeting using Level 1 environmental studies to determine the option with the least impact.	Lost Sands met with DEC and DMP to provide an introduction to the project and introduce the concept of a road through the GVDNR
14/09/2011	DEC and DMP	Meeting	Road options studies	DEC advised that a study of road options would be required to determine the route of least environmental impact before considering a road in the GVDNR.	Lost Sands attended a meeting with DEC and DMP to present the Project with a focus on the possible road through the GVDNR.
9/09/2011	Pila Nguru	Discussion	Negotiation Protocol	Pila Nguru request details of the Lost Sands consultant and employee at Cyclone and the purpose of the work.	Lost Sands explained that they were doing some preliminary reconnaissance for environmental studies and would be only using existing cleared tracks.
31/08/2011	DMP	Meeting	DEC meeting	Mike Freeman (DMP) will discuss the Project with Norm Caporn at DEC to arrange a meeting.	Discussion with Mike Freeman who is facilitating a meeting between Lost Sands and DEC to introduce the Project to DEC.
19/08/2011	Forrest airport	Discussion	Forrest siding	Airport owner is happy to answer any questions regarding use of the facilities at Forrest. Provided contact details for the rail service contractor based at Forrest.	Will contact again when more details are available on the proposal for the siding.
17/08/2011	Pila Nguru	Discussion and Information provided	Negotiation Protocol	Pila Nguru provides Lost Sands with a request for maps, photos, sand mining information, project timeframe and any other information that would be useful for the Negotiation Protocol workshop.	Lost Sands provides Pila Nguru with information requested for the Negotiation Protocol workshop.

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5/08/2011	Forrest airport	Discussion	Forrest siding	The airport manager recommended Lost Sands talks to the airport owner and provided contact details for the owner.	Lost Sands discussed the project with the Forrest airport manager and notified that use of the Forrest rail siding is being considered for the project.
4/08/2011	Pila Nguru	Discussion	Negotiation Protocol	Pila Nguru confirms receipt of the documents and comments on the need for Heritage assessments for the road options.	Lost Sands sends Pila Nguru a copy of the mining lease application documents.
4/08/2011	Pila Nguru	Discussion	Negotiation Protocol	Pila Nguru advises Lost Sands that it will not attend the meeting and will wait until after the Negotiation Protocol workshop before discussing the road in detail.	Lost Sands invites Pila Nguru to a meeting with DEC and DMP to provide information on the Project and discuss the options for road access.
2/08/2011	Pila Nguru	Discussion	Negotiation Protocol		Lost Sands advises Pila Nguru that a mining lease application over the Cyclone deposit will be submitted to the DMP.
15/07/2011	Pila Nguru	Information provided	Negotiation Protocol	Pila Nguru acknowledges receipt of the video.	Lost Sands provides Pila Nguru with information and video regarding aboriginal employment at Iluka's Jacinth mine.
6/07/2011	Pila Nguru	Information provided	Road options studies	Reports received by Pila Nguru.	Send copies of the Level 1 flora and fauna reports to Pila Nguru for review and comment.
6/07/2011	Pila Nguru	Discussion	Negotiation Protocol	Pila Nguru is in general agreement about these aspects of the Negotiation Protocol.	Communications with Pila Nguru regarding preparation of Negotiation Protocol including team size, costs, timing and cooperation.
14/06/2011	Pila Nguru	Discussion	Negotiation Protocol	Pila Nguru letter to Lost Sands following 10/5/11 meeting at Tjuntjuntjarra advising that Pila Nguru would like to hold a workshop in August 2011 to develop a formal Negotiation Protocol for Mining Agreement negotiations between Pila Nguru and Lost Sands.	Lost Sands agrees to support Pila Nguru in being fully informed in the negotiation process and will fund the workshop.
12/04/2011	DMP	Discussion	DMP approvals	Confirm the meeting date for 19 May 2011.	Arrange a meeting between Lost Sands and the DMP to introduce the Project and get guidance.
16/03/2011	DMP	Discussion	DMP approval process	Nick Galton-Fenzie recommended that Lost Sands contacts Graham Cobby at DMP.	Questions for Nick Galton Fenzie regarding DMP approvals and fees.
16/3/11 21/3/11	DMP	Discussion	Project approval process	DMP provided the information and other relevant information available on the DMP website.	Lost Sands requested information from DMP regarding miscellaneous licence fees.
3/03/2011	DEC	Discussion	Project approval process	DEC appreciates the invitation and will send a representative depending on who is available that day.	Contact DEC to advise that Lost Sands will be meeting with DMP in Kalgoorlie to present information on the project and invite DEC to attend.
1/03/2011	DMP	Email	Project approval process	Because of the proximity to the GVDNR and the proposed road we should contact DEC.	Email to David Pickles (DEC Kalgoorlie) regarding the environmental approval process for the Cyclone Project.
4/05/2010	DoW	Letter	Water supply	DoW advised that there are no licensed groundwater users within 300 km of the project area.	Lost Sands sent a request to DoW for water bore information in the Cyclone region.

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Sep08 to Dec13	Pila Nguru	Discussion	Exploration	Pila Nguru communications with Lost Sands as agreed for exploration and feasibility work 10 days before site work commenced, 2 days before site work commenced, and when Lost Sands travelled through Tjuntjuntjarra on the way to and from site.	Lost Sands communications with Pila Nguru as agreed for exploration and feasibility work. Notifications occur when exploration program is confirmed, 10 days before site work commences, 2 days before site work commences, and at Tjuntjuntjarra on the way to and from site. Dates for exploration work were May-Nov 07, Sep 08, Mar-Jul 09, Nov-Dec 10, Mar-May 11, Aug 11, Feb 12, Mar 12, Apr-Jun 12, Oct 13, Nov-Dec 13, Mar-Apr 14.
23/01/2008	Pila Nguru	Discussion	Exploration	Discussion with Lost Sands regarding hire of Pila Nguru's bulldozer for exploration on Pila Nguru's land.	Lost Sands contacted Pila Nguru to discuss hire of Pila Nguru's bulldozer for exploration on Pila Nguru's land.
26/10/2007	Pila Nguru	Discussion	Exploration	Meetings with Lost Sands at Tjuntjuntjarra and Ilkulka for detailed discussions on exploration logistics.	Lost Sands met with Pila Nguru at Tjuntjuntjarra and Ilkulka for detailed discussions on exploration logistics.
27/08/2007	Pila Nguru	Discussion	Exploration	Pila Nguru contacted Lost Sands to discuss exploration program and logistics for future work.	Pila Nguru contacted Lost Sands to discuss exploration program and logistics for future work.
13/08/2007	Pila Nguru	Phone call	Heritage	Discussion on heritage clearances.	Lost Sands phone call to Pila Nguru to discuss heritage clearances.
20&21/5/07	Pila Nguru	Discussion	Heritage clearance	Resolve cultural heritage clearance process for exploration.	Lost Sands discussions with Pila Nguru to resolve cultural heritage clearance for exploration.
4/05/2007	Pila Nguru	Discussion	Heritage clearance	At exploration tenements undertaking cultural heritage clearances	Lost Sands and Pila Nguru at the exploration tenements undertaking cultural heritage clearances.
May-Nov 2007	Pila Nguru	Discussion	Exploration	Communications regarding exploration activities.	Lost Sands communications with Pila Nguru during initial exploration in the Wanna Lakes region, including the Hurricane and Cyclone prospects.
18 &19/5/06	Pila Nguru	Discussion	Site access	Discuss cultural heritage clearance for exploration.	Meeting at Tjuntjuntjarra with Pila Nguru to discuss cultural heritage clearance for exploration.
24/04/2006	Pila Nguru	Discussion	Site access	Discussion on access notification and entry permits.	Lost Sands contacted Pila Nguru to discuss notification required for access and permission for entry.
21/04/2006	Pila Nguru	Discussion	Site access	Discussion on access to exploration areas.	Lost Sands contacted Pila Nguru to discuss access to the exploration areas.
20/04/2006	Pila Nguru	Discussion	Heritage	Meeting agreed for 19 May 2006	Arrange meeting to discuss cultural heritage clearance for exploration work.
19/04/2006	Pila Nguru	Discussion	Heritage	Discussion of cultural heritage clearance process.	Lost Sands contacted Pila Nguru and discussed the cultural heritage clearance process.
13&14/12/05	Pila Nguru	Discussion	Meeting	Discussed proposed activities with Pila Nguru.	Lost Sands met with Pila Nguru at Tjuntjuntjarra present Lost Sands information and discuss proposed activities.
15/11/2005	Pila Nguru	Phone call	Introduction	Pila Nguru agreed to a meeting to discuss proposed activities.	Lost Sands first contact with Pila Nguru by phone to discuss the exploration tenements on Pila Nguru land and arrange a meeting to discuss proposed exploration activities and heritage clearances.

6.2 Ongoing Stakeholder Consultation

Consultation with stakeholders, including regulatory authorities, is ongoing and will continue throughout the approvals process and (subject to approval), the construction and operations phase of the Project.

Key stakeholders to be consulted in the future by Lost Sands include:

- The Pila Nguru;
- DPaW;
- EPA;
- DER;
- DMP;
- DoW;
- Forrest Airport;
- ARTC;
- Shire of Laverton;
- Shire of Menzies;
- City of Kalgoorlie Boulder; and
- Shire of Dundas.

A summary of the timings and types of consultation to be undertaken by Lost Sands are provided in **Table 6-2**.

Table 6-2: Proposed Ongoing Consultation

Stakeholder	Timing of Consultation	Type of Consultation
Pila Nguru	Quarterly updates on Project activities during construction, operation and closure of the mine and infrastructure on Pila Nguru land. Immediately advise Pila Nguru of any matters of potential heritage importance that may not have been identified during heritage surveys.	Lost Sands will provide a Quarterly Activities Report and will respond to comments on the report or requests for additional information. Invite Pila Nguru to inspect and comment on potential heritage matters. Pila Nguru will also be advised of planned activities which are non-routine.
DPaW	Report as necessary on Project activities during construction, operation and closure of the road through the GVDNR.	Lost Sands will communicate regularly with DPaW as required to ensure DPaW has sufficient information regarding activities in the GVDNR and to demonstrate that activities are in compliance with licence conditions.
EPA	Reports on Project activities during construction, operation and closure of the mine and infrastructure as	Lost Sands will report on Project activities during construction, operation and closure of the mine and infrastructure as required by licence conditions and on any

Stakeholder	Timing of Consultation	Type of Consultation
	required by licence conditions and legislation.	event or incident that EPA should be informed.
DMP	Regular reporting as required during construction, operation and closure as required by licence conditions and legislation.	Lost Sands will report to DMP on all Project activities within DMP administered tenements in accordance with licence conditions and legislation and will respond to requests for information as necessary.
DoW	Regular reporting as required during construction, operation and closure of the water supply system as required by licence conditions and legislation.	Lost Sands will report to DoW on water supply activities in accordance with licence conditions and legislation and will respond to requests for information as necessary.
Conservation Commission	Report as necessary on Project activities during construction, operation and closure of the road through the GVDNR, through DPaW	Lost Sands will communicate regularly with DPaW as required to ensure DPaW has sufficient information regarding activities in the GVDNR and to demonstrate that activities are in compliance with licence conditions.
Forrest Airport	Regular updates on Project activities planned for the Forrest area during construction, operation and closure.	Lost Sands will advise Forrest Airport of all activities in the Forrest area including road, rail siding, and rail services. Lost Sands will respond to all comments and take corrective action if required to maintain a good relationship.
ARTC	Communicate as required regarding all storage and transport activities on land leased from ARTC.	Lost Sands will keep ARTC informed of all current and planned activities at the rail siding and respond to comments or requests in a timely manner.
Shire of Laverton	Communicate as required regarding activities on land within the Shire of Laverton.	Lost Sands will inform the Shire of Laverton of plans for all construction and closure activities within the shire including the mine and infrastructure.
Shire of Menzies	Communicate as required regarding activities on land within the Shire of Menzies.	Lost Sands will consult with the Shire of Menzies regarding plans for road construction within the Shire.
City of Kalgoorlie Boulder	Communicate as required regarding activities on City of Kalgoorlie Boulder land.	Lost Sands will consult with the City of Kalgoorlie Boulder regarding plans for construction and closure of the relevant section of mine haul road and the rail siding facilities at Forrest.
Shire of Dundas	Communicate as required regarding activities on land within the Shire of Dundas.	Lost Sands will consult with the Shire of Dundas regarding plans for use of the Shire roads for access to the Project area and contribute to maintenance of the roads by agreement with Shire.

7 Proposed Environmental And Social Commitments

In order to avoid and mitigate potential environmental impacts associated with the Project as discussed within this document, Lost Sands has proposed a series of social and environmental commitments as outlined in **Table 7-1** below. These commitments will be refined in consultation with stakeholders throughout the assessment of this Project.

Table 7-1: Proposed Social and Environmental Commitments

No.	Topic	Objective	Commitment	Timing	Advice
1	Environmental Management System (EMS)	Further develop the EMS	Further develop the EMS based on the AS/NZ ISO 14001:2004 Environmental Management System Standards	Mining Proposal and Works Approval Stage and prior to Construction	DER DMP DPaW
2	Flora and Vegetation	Lost Sands Environmental Protection Objective: Minimise impacts on flora and vegetation in particular minimise the impacts to the GVDNR. EPA Objective: *To maintain representation, diversity, viability and ecological function at the species, population and community level.*	Environmental management commitments in relation to flora and vegetation include: Minimising clearing wherever possible; Developing a guide for personnel for the identification of conservation significant fauna, flora and weeds; Monitoring of vegetation, flora and priority flora in appropriate locations along haul road and surrounding the mine site; Avoiding transport of material from road building activities into shallow depressions and other low lying areas Design and implementation of a vehicle washdown station at the southern end of the haul road at the rail siding. This will ensure that all vehicles travelling into the Project do not carry in any new introduced weeds species. This would be especially relevant for earth moving equipment during construction. This action would need to be implemented in conjunction with separate actions to limit the spread of weeds already within the Project area, such as weed mapping Progressive rehabilitation techniques and trials to determine the best means to restore vegetation as close as possible to pre-mining state.	Life of Mine	DPaW DMP DER
3	Terrestrial Fauna	Lost Sands Environmental Protection Objective:	Environmental management commitments in relation fauna include:	Life of Mine	DPaW DMP

No.	Topic	Objective	Commitment	Timing	Advice
		Avoid, minimised and reduce the impacts on native terrestrial fauna. EPA Objective: *To maintain representation, diversity, viability and ecological function at the species, population and assemblage level*	Implement a Traffic Management Plan that enforces speed limits in areas that are known to contain fauna that may be susceptible to vehicle strikes. Implement the Fire Minimisation Plan to ensure that altered fire regimes do not compromise the quality of foraging and breeding habitats in the vicinity of the Project area. Implement the Fauna Management Plan that includes; reporting sightings; reporting and management procedures for fauna species of conservation significance including Princess Parrot and Malleefowl; minimising ingress of introduced fauna to the Project; and controlling numbers of existing introduced fauna in the Project areas.		
4	Subterranean Fauna	Lost Sands Environmental Protection Objective: Avoid, minimise and reduce the impact on subterranean fauna values. EPA Objective: *To maintain representation, diversity, viability and ecological function at the species, population and assemblage level*	If the degree of development activities were increased in the southern sector of the haul road to include relatively extensive excavation or groundwater abstraction then further investigation of subterranean fauna values may be required.	In the event of extensive excavation or groundwater abstraction along the southern sector of the haul road.	DPaW

No.	Topic	Objective	Commitment	Timing	Advice
5	Hydrological Processes	Lost Sands Environmental Protection Objective: Avoid, reduce and minimise impacts upon groundwater and surface water values. EPA Objective: *To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance are protected.*	Environmental management commitments in relation the management of water resources include: Pump testing of production bores will be undertaken post PER process during the DFS stage; Hydrogeological modelling of groundwater systems will be completed after pump test has been undertaken at conclusion of PER process during the DFS stage; Installation of a minimum of 20 shallow monitoring bores, half to the weathered rock interface and the other half to 40 m depth Production and monitoring bores will be constructed to a high standard in compliance with the Department of Water - Water Bore Construction Regulations and Australian Water Bore Construction Standards; Shallow monitoring bores encountering a shallow aquifer will be cased with a minimum of 100 mm PVC casing to enable periodic sampling for field and laboratory chemical analysis; Maintaining surface water flow where possible; Monitoring of the drainage shadow from the pit on an annual basis; Opportunistic monitoring of surface water during rainfall events; Monitoring of diversion channels, outfalls, swales, bunds and floodway channels; Minimising the clearing footprint within the development envelopes to minimise potential erosion; and Implementing soil erosion control techniques to prevent erosion and an increase in surface water turbidity. Implement the water management plan that includes: Manage and monitor the bore field, shallow aquifers within the mine area and possible recharge mounds.	Life of Mine	DMP DER DoW

No.	Topic	Objective	Commitment	Timing	Advice
			Development of a groundwater monitoring procedure that refers to relevant guidelines and standards for groundwater monitoring and quality control and assurance techniques; Monitoring of deep production regular monitoring and annual assessment of bore and bore field abstraction, Monitoring of shallow monitoring bores including water levels, drawdown and water quality. Chemical and trace metal water quality monitoring and groundwater level monitoring including monitoring variations in potentiometric surfaces (sub artesian aquifer pressure surfaces).		
6	Aboriginal Heritage	Lost Sands Environmental Protection Objective: Avoid or reduce impacts upon aboriginal artefacts and maintain cultural heritage values of the Project area. EPA Objective: *To ensure that historical and cultural associations are not adversely affected*	Environmental management commitments in relation to heritage include: an archaeological survey will be undertaken over the mine area development envelope prior to disturbance; should any items of significance be located during the archaeological surveys, the traditional owners will re-locate them prior to disturbance; should any archaeological items be located during Project construction or operation, the traditional owners will be advised and consulted as to the appropriate way to re-locate them in accordance with the requirements of the *Aboriginal Heritage Act 1972*; documentation of geographic and cultural associations of people born near and descended from people born near the Project will be undertaken; documentation of significant living areas and related religious narratives and key locations adjacent to the Project will be undertaken ; and cultural awareness training will be provided for all personnel involved in construction and operation of the Project.	Life of mine	OEPA Department of Aboriginal Affairs Pila Nguru People

No.	Topic	Objective	Commitment	Timing	Advice
			In addition, Lost Sands will contribute to the community and broader education for the Spinifex people, and will describe the social benefit and capacity building and how that can be continued/enhanced, including but not limited to: traineeships and on the job training in a range of mine site skills; financial contribution to the Pila Nguru education; and a long term site employee target for members of the Pila Nguru community will be established Traineeships for Pila Nguru will be maintained for the life of the operation		
7	Amenity	Lost Sands Environmental Protection Objective: Avoid or reduce the impact on amenity values from dust and noise. EPA Objective: *To ensure that impacts to amenity are reduced as low as reasonably practicable*	Environmental management commitments in relation to dust and noise include: incorporating a binding agent into the construction of the haul road implementing regular dust suppression along the haul road and internal mine roads; implement engineering controls to mitigate impacts where ever possible for noise, artificial light and dust during design, construction and operation	Post approval of PER and prior to submission of Mining Proposal and Works Approval.	OEPA DPaW DMP
8	Rehabilitation and Closure	Lost Sands Environmental Protection Objective: Ensure that the Project is sufficiently decommissioned and rehabilitation in a manner that is acceptable with the	Environmental management commitments in relation to rehabilitation and closure include: Upon completion of the Definitive Feasibility Study (DFS), a stand-alone Mine Closure Plan (MCP) will be developed in accordance with the joint Department of Mines and Petroleum (DMP) and Environmental Protection Authority (EPA) Guidelines for Preparing Mine Closure Plans (2015) to augment the Mining Proposal.	Life of Mine	OEPA DMP

No.	Topic	Objective	Commitment	Timing	Advice
		proposed end land use, EPA Objective: *To ensure that a planning process is in place so that the mine can be closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed post-mining outcomes and land-uses, and without unacceptable liability to the State*	Further quantification of the characteristics and volumes of the potential mine waste materials will be undertaken as the Project develops, to ensure the appropriate management of the waste materials through protocols for soil profile reconstruction and rehabilitation. The final depth of the cover material and the suitability of the overburden material relative to tailings characteristics will be verified through trials on the TSF, within the first year of operation. The outcomes of the trials will be incorporated into the rehabilitation prescriptions (such as cover thickness), to facilitate the optimal rehabilitation outcomes. Trials will be conducted during the first two years of the operation to confirm that the proposed reconstructed soil profile will support plant growth. Develop adequate financial provisions for closure utilising third party rates, upon completion of the DFS and update annually throughout operations. The physical and chemical characteristics of waste materials and the placement within landforms will be utilised as the basis for selecting appropriate target ecosystems (analogues). Install target ecosystems (analogues) in undisturbed vegetation which are representative of post closure Project landforms. Closure specific stakeholder consultation with key stakeholders will be undertaken to define the post mining land use and any infrastructure to remain post closure.		
9	Offsets	Lost Sands Environmental Protection Objective: To offset residual environmental impacts upon the	Lost Sands will contribute funding towards an agreed offsets plan over a period of 17 years (12 years operation and 5 years rehabilitation). A Final Offsets Plan including funding and KPIs will be produced within 1 year of commencement of operations. The content of the plan will be determined in	For a period of 17 years from construction through to closure.	DPaW OEPA Conservation Commission

No.	Topic	Objective	Commitment	Timing	Advice
		GVDNR from the Project. EPA Objective: *Provide a contribution to regional conservation that will offset clearing within the GVDNR.*	consultation with Pila Nguru and DPaW and may include: *An MOU with DPaW that includes all 3rd party contracts* *A strategy for Wildfire Threat Analysis* *A Camel Control Plan* *A Monitoring and Evaluation Plan* Funds required for development and implementation of the agreed offset plan will be contributed by Lost Sands over the period of 17 years. The actual timing of relinquishment of funds on an annual basis will be articulated within the Final Offset Plan and associated MOU developed with DPaW. A contingency strategy will be presented whereby the equivalent funding (or proportionate funding) is re-directed to an appropriate Trust if knowledge gaps prevent the development or implementation of particular components of the Plan, or if there are funds remaining once all elements of the plan have been completed. If operations proceed after the anticipated 12 years of operations funds will continue to be released at an equivalent annual rate. Timing of the implementation of the offsets plan will be dependent upon stakeholder engagement and outcomes of the planning process. It is proposed that an audit and review of key actions will occur annually.		Pila Nguru People

8 Study Team

The following consultants have contributed to the preparation of the PER and its supporting investigations:

- Australasian Groundwater and Environmental Consultants
- Bamford Consulting Ecologists
- Groundwater Technologies
- Lloyd George Acoustics
- MWH (formerly Outback Ecology)
- Metreo Consulting
- Ride Consulting
- Scott Cane
- Sustainability Pty Ltd
- Woodman Environmental Consulting

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