SUSTAINABILITY
FUTURE GROWTH

TRANSPORT CORRIDOR OPTIONS ASSESSMENT

THE CYCLONE MINERAL ZIRCON PROJECT
GREAT VICTORIA DESERT, WESTERN AUSTRALIA

September 2012

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ABBREVIATIONS

BCE	Bamford Consulting Ecologists
Central Desert	Central Desert Native Title Services Limited
C	Central
CS	Conservation Significant
D	Disturbed
DEC	Department of Environment and Conservation
DMA	Decision Making Authority
DMP	Department of Mining and Petroleum
DSEWPC	Department of Sustainability, Environment, Water, Populations and Communities
DFS	Detailed Feasibility Study
DIA	Department of Indigenous Affairs
Diatreme	Diatreme Resources Limited
E	East
EIA	Environmental Impact Assessment
EN	Endangered
EPA	Environmental Protection Authority
GIS	Geographical Information System
GVD	Great Victoria Desert
GVD1	Great Victoria Desert Subregion 1
GVD2	Great Victoria Desert Subregion 2
GVD3	Great Victoria Desert Subregion 3
GVDNR	Great Victoria Desert Nature Reserve
ILUA	Indigenous Land Use Agreement
IUCN	International Union for the Conservation of Nature
JORC	Australasian Joint Ore Reserves
km	Kilometre
LGA	Local Government Areas
LSPL	Lost Sands Pty Ltd
m	Metre
MCP	Mamungari Conservation Park
Mig	Migratory
MOU	Memorandum of Understanding
Mt	Million tonne
NS	Not Surveyed

NUL1	Nullarbor Subregion 1
NUL2	Nullarbor Subregion 2
P	Priority
PEC	Priority Ecological Community
PFS	Pre-feasibility Study
PTAC	Paupiyala Tjarutja Aboriginal Corporation
S	South
SA	South Australia
SRE	Short Range Endemic
Sustainability	Sustainability Pty Ltd
T	Threatened
the Project	Cyclone Zircon Mineral Sands Deposit
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VSA	Vegetation Substrate Association
VT	Vegetation Type
W	West
WA	Western Australia
WA Herbarium	Western Australia Herbarium Specimen Database
Woodman	Woodman Environmental Consulting Pty Ltd

EXECUTIVE SUMMARY

BACKGROUND

Lost Sands Pty Ltd (LSPL) is a wholly owned subsidiary of Diatreme Resources Limited (Diatreme). LPSL is proposing to develop the Cyclone Zircon Mineral Sands Deposit (the Project) located in the northern Eucla basin in Western Australia (WA). The Project involves developing a mineral sands deposit that contains zircon, rutile and other titanium minerals.

During LSPL's initial Pre-Feasibility Study (PFS) eight transport corridor options were reviewed and, of these, three corridor options were subsequently selected for further assessment. These three options are:

1. Deakin: the most easterly of the three corridors, situated close to the border between WA and SA and linking with the Trans-Australian Railway line at Deakin (a distance of 230km);
2. Forrest: the central option linking with the Trans-Australian Railway line at the rail siding of Forrest (a distance of approximately 240km); and
3. Loongana: the most westerly option skirting the western boundary of the Great Victoria Desert Nature Reserve (GVDNR) and linking with the Trans-Australian Railway line at Loongana (a minimum distance of 405km).

This report presents an assessment by Sustainability Pty Ltd (Sustainability) of the flora, fauna and some socio-environmental characteristics of the three options to determine which are feasible and warrant further detailed evaluation.

VEGETATION AND FLORA

The proposed mine site, associated facilities and northern section of the transport corridors are located within the eastern subregion of the Great Victoria Desert bioregion, GVD3. This subregion is characterized by extensive sandplains of deep Quaternary aeolian sands, which support primarily a tree steppe of *Eucalyptus gongylocarpa, E. youngiana* and *Acacia aneura* (Mulga) over hummock grassland dominated by *Triodia basedowii*. *Acacia* dominates colluvial soils with *Eremophila* and *Santalum* spp., with halophytes confined to the edges of salt lakes and saline drainage systems.

Immediately to the south of GVD bioregion is the Nullarbor bioregion, of which two subregions are recognised. The proposed transport corridors traverse through both the northern Nullarbor subregion, NUL1, and the southern Nullarbor subregion, NUL2. In the northern section of NUL1, sandplains, colluvial areas, salt lakes and saline drainage systems occur, with the vegetation identical to that of the sandplains of GVD3 (Barton & Cowan 2001b). In the central and southern areas, low woodlands of *Acacia papyrocarpa* (Western Myall) over *Maireana sedifolia* (Pearl Bluebush) are present, along with *Myoporum platycarpum* and *Eucalyptus oleosa* in the east and west, and woodlands dominated by *Acacia aneura* (Mulga).

The transport corridor options all extend into the northern part of subregion NUL2. NUL2 is dominated by the Nullarbor Plain; a vast, flat, treeless plain determined by the combination of aridity and calcareous soils. The vegetation is comprised of Bluebush – Saltbush steppe in central areas, with low woodlands of *Acacia papyrocarpa* over bluebush present in peripheral areas, along with *Myoporum platycarpum* and *Eucalyptus oleosa* in the east and west.

A "Level 1" reconnaissance survey was conducted across the area of the Project (including the three transport options) by Woodman Environmental Pty Ltd (Woodman) from 22–27 March 2012, in accordance with EPA Guidance Statement No. 51 (EPA 2004). Most of the survey was undertaken by helicopter due to both the size of the survey and the lack of vehicular access to the majority of the Project area. Personnel were landed at selected sites to survey the flora.

The flora were surveyed in detail at 96 sites across the three transport corridor options which, combined, cover a total distance of approximately 700km. The majority of sites were established in the northern half of the Project area, corresponding to areas of more complex vegetation types associated with sand dunes, sand plains and loamy plains. Fewer sites were established in the southern half of each transport corridor option, as the southern half corresponded with the relatively homogenous Nullarbor Plain, where large areas of similar vegetation types occurred. Portions of western and eastern alignments were unable to be surveyed because of their occurrence in culturally sensitive areas.

Sixteen vegetation types were defined using a combination of landforms, and the habit and foliage cover of dominant species within each discernible height stratum. None of the vegetation types recorded on the three transport corridor options represented the Department of Conservation and Environment (DEC) Priority Ecological Community (PEC), *Yellow sandplain communities of the Great Victoria Desert*. No vegetation types likely to be of regional conservation significance were found on along the Central and Eastern transport corridor options. The vegetation type "Low Shrubland of *Eremophila* ? *attenuata* and Low Open Chenopod Shrubland of *Atriplex nummularia* subsp. *nummularia* in claypans of light clay" was only found on the Western transport corridor option and is potentially of conservation significance at the regional level.

A total of 175 discrete vascular flora taxa and 1 known hybrid were recorded within the transport corridor survey area (i.e. within 50m either side of the centre line of the provisional corridor alignment). No listed threatened flora species were recorded on any of the transport corridor options. A total of two confirmed and two potential conservation significant flora taxa were recorded in the Project area: *Acacia* eremophila numerous-nerved variant (A.S. George 11924) (P3), *Dampiera ?eriantha* (P1), *Eremophila ?attenuata* (P1) and *Eucalyptus pimpiniana* (P3).

FAUNA

Bamford Consulting Ecologists (BCE) was commissioned to conduct a "Level 1" reconnaissance fauna study of the Project area, including the three transport corridor options. A desktop study identified 267 vertebrate fauna species as potentially occurring in the project area. The presence of 72 of the expected vertebrate species was confirmed during the field survey.

The vertebrate fauna assemblage was found to vary considerably along the length of the three transport corridor options, with higher diversity in the north compared to that recorded in the Central Nullarbor, at the southern end of the routes. Although quite depauperate, the Nullarbor supports a unique fauna assemblage due to its unique Vegetation/Substrate Associations (VSAs). The transport corridor options cover largely undisturbed environments.

The three transport corridor options for the Project traverse a range of land systems, soils and vegetation but despite this, much of the routes pass through similar VSAs that are extensive and broadly similar, with only a few locations with distinctive VSAs.

Six VSAs that provide habitat for fauna were identified during the site reconnaissance. Of these, Mallee Eucalypt woodlands on red sand dunes and Sheoak woodlands on calcareous soils were widespread across the northern parts of the project area, covering much of the Great Victoria Desert (GVD) subregions. Gypsum salt lakes are scattered throughout the GVD, with several larger lake systems in the north-west and north-east. An extensive band of Myall/Mulga woodland runs through the middle of the study area, forming a northern edge to the Nullarbor Plain. The Nullarbor Plain is dominated by a mosaic of low shrublands and grasslands, with dongas scattered throughout.

Of the 30 fauna species of conservation significance that may be present in the transport corridors, the initial survey recorded only seven. The most significant was the Southern Marsupial Mole *(Notoryctes typhlops)* which is listed as Endangered and is protected by *the EPBC Act.*

CULTURALLY SIGNIFICANT AREAS

As a result of consultations with the Pila Nguru, Native Title Holders of the Pila Nguru lands Determination Area (WC95/51), it became apparent that both the Western (Loongana) and Eastern (Deakin) transport corridor options could potentially impact on areas of great cultural significance. This was particularly pertinent for the Western option. The Pila Nguru expressed considerable concern about this option as the route passes through an area where there are a number of significant cultural sites.

CONSERVATION ESTATE

The Central (Forrest) and Eastern (Deakin) transport corridor options both pass through the Great Victoria Desert Nature Reserve (GVDNR). With respect to the Eastern option, it also follows the WA/SA border, with some potential impacts also to the Mamungari Conservation Park (SA) which has been classified as a UNESCO World Biosphere Reserve.

LANDFORMS AND LOCAL HYDROLOGY

Hydrological impacts are expected to be localised as the Project area has limited surface drainage, much of it terminating in either Gypsum salt lakes (in the GVDNR) or Dongas (on the Nullarbor). Both of these VSAs are uncommon within the landscape and therefore are considered to be conservation significant. Large chains of lakes are present in the Western and Eastern haul road alignment corridor options, with smaller claypans present in all haul road alignment corridor options. The gypsum salt lake VSA is least represented within the Central corridor option. All other VSAs have similar representation relative to other corridor options. The local hydrology of the Central option will therefore be least affected by the construction of a transport corridor as it only contains small claypans and dongas, whilst the Western transport corridor option contains an intricate chain of small lakes. All three haul road corridor options contain landforms prone to erosion (dune fields).

INFRASTRUCTURE

Neither Loogana (Western option) nor Deakin (Eastern option) have a rail siding or support infrastructure which will be needed for the transport of product to port. As such, LSPL would be required to seek permission from the WA EPA for the construction of new sidings at either of these sites as well as the current operators for the rail line. The station at Forrest provides the advantage of an existing siding as well as accommodation and support infrastructure in the form of the Forrest airport and lodgings.

LEGISLATIVE FRAMEWORK

The main differences between the three transport corridor options in regards to legislation are:

- The Western (Loongana) option does not cross DEC managed land and therefore the *Conservation and Land Management Act 1984* is not relevant.

- The Central (Forrest) and Eastern (Deakin) transport corridor options would require a Miscellaneous Licence over areas within DEC managed lands. This approval would require consent from both houses of State parliament.
- The Western (Loongana) and the Eastern (Deakin) transport options would require approval from the WA EPA for the construction of new sidings at either of these sites, as well as from current operators for the rail line.
- A Native Vegetation Clearing Permit application for the Deakin option would require the least area of disturbance as it is the shortest route.

CONCLUSIONS AND RECOMMENDATION

The primary consideration with respect to potential impact on vegetation, flora and fauna would be to select the option(s) with the least overall disturbance footprint, thereby minimising overall impact. In this regard, the Western corridor represents the least favourable option due to its length and therefore footprint. The Western option is also unfavourable due to its proximity to the Carlisle and Jubilee Lake systems and several culturally sensitive sites. Therefore, in relation to minimising impacts on vegetation, flora and fauna the Central and Eastern corridor options would be preferable to the Western option.

The Central and Eastern options represent a significantly lower impact on vegetation, flora and fauna due to their reduced length and therefore footprint. However, the Eastern corridor is the less favourable of the two shorter corridors as its alignment takes it through the Forrest Lakes system and close to the Mamungari Conservation Park. Although the Central option traverses the GVDNR, the vegetation types and fauna habitats of this option were found to be widespread and similar to those of the Western and Eastern options. Given that no cultural issues associated with the Central option were identified, the Central option is thought to have the least potential impact to vegetation, flora, fauna and cultural values of the region.

Strategies to minimise potential impacts upon flora and fauna assemblages are:

- minimise the transport corridor disturbance footprint;
- ensure that the final route avoids unique or isolated habitats;
- ensure that the final route minimise changes in the topography of fauna and surface drainage corridors;and
- conduct a "Level 2" flora and fauna survey of the preferred transport corridor option to support the detailed planning of the alignment to avoid significant vegetation, flora and fauna.

1. INTRODUCTION

1.1 BACKGROUND

Lost Sands Pty Ltd (LSPL) is a wholly owned subsidiary of Diatreme Resources Limited (Diatreme). LPSL is proposing to develop the Cyclone Zircon Mineral Sands Deposit (the Project) located in the northern Eucla basin in Western Australia (WA).

The Project involves developing a mineral sands deposit that contains zircon, rutile and other titanium minerals. Evaluations of the deposit have demonstrated an Australasian Joint Ore Reserves Committee (JORC) compliant resource of 132Mt of mineral sands with an average heavy mineral content of 2.3%.

Following an initial Pre-Feasibility Study (PFS), LSPL is preparing a Detailed Feasibility Study (DFS) for the Project. This study will assess the potential quantity and quality of heavy mineral products that can be produced from the deposit and the capital and operating costs involved. During the PFS, eight transport corridor options were reviewed and, of these, three corridor options were subsequently selected for further assessment. This report presents an assessment by Sustainability Pty Ltd (Sustainability) of the three options based on flora, fauna and some socio-environmental characteristics.

1.2 SCOPE AND OBJECTIVES

The objective of this study was to provide a comparative assessment of the flora, fauna and some socio-environmental characteristics of the three transport route options available to the Project to determine which option(s) is feasible and warrants further detailed evaluation during the DFS.

The scope of the assessment included:

- Identification of the flora and fauna aspects, and potential environmental impacts, of each of the three transport route corridor options;
- Determination of the transport corridor option(s) that is considered best in terms of potential environmental and some socioeconomic impacts, and that warrants further detailed assessment; and
- Provision of a description of the legislative framework applicable to the transport corridor option selection process.

1.3 PRE-SURVEY CONSULTATION

LSPL met with the Environmental Management Branch (EMB) of the Department of Environment and Conservation (DEC) on the 14th September 2011 to discuss the project and, in particular, its preferred transport corridor, which traverses the Great Victoria Desert Nature Reserve. The DEC advised that:

- An environmental assessment should be undertaken of the preferred transport corridor and alternative options, such that DEC can provide its recommendations as to the significance of environmental impacts of each option; and
- DEC should be consulted regarding the design of field study programmes to ensure that they satisfy Environmental Protection Authority's (EPA) survey guidelines and DEC's information requirements.

Subsequently, a methodology for a Level 1 flora and fauna survey of three transport corridor options was developed by Sustainability, Woodman and BCE on behalf of LSPL (refer to Appendix D). DEC provided comment on the proposed methodology (Appendix E), which was duly incorporated into the final survey methodology.

LSPL have been holding regular consultative meetings with the Paupiyala Tjarutja Aboriginal Corporation, the Native Title representative for the Pila Nguru People and the Central Desert Native Title Services since before exploration tenancies over the Eucla Basin Heavy Minerals project area were granted. Specific negotiation meetings were begun with the parties regarding access and potential transport routes (amongst other matters) to mining lease 69/141 in December 2011. During the December 2011 meeting, representatives from the community reviewed the plans, negotiated with LSPL the three (3) proposed routes and agreed that their own anthropological consultants, Scott & Annie Cane, should accompany community elders in a reconnaissance helicopter survey along each of the proposed routes to ensure that the routes were checked for community and heritage sites in anticipation of the physical Level 1 field survey. Scott Cane is the author of the authoritative work "Pila Nguru – The Spinifex People" first published in 2002 and has worked with Pila Nugu for 20 years.

In May 2012, Sustainability attended a regular LSPL negotiation meeting with Pila Nguru in which the proposed transport routes were again discussed for the purpose of responding to any community questions. During the meeting no material concerns were raised with regards to the implementation of the proposed field work and survey teams.

2. PROJECT DESCRIPTION

2.1 LOCATION

The Project is located within the Eucla Basin of WA, approximately 220 kilometres north of Forrest (on the Trans-Australian Rail line) and 25 kilometres west of the South Australian border (Figure 2.1). Current access to the deposit is by unsealed road with a full day of travel time from the LSPL exploration base at Ceduna in South Australia (SA).

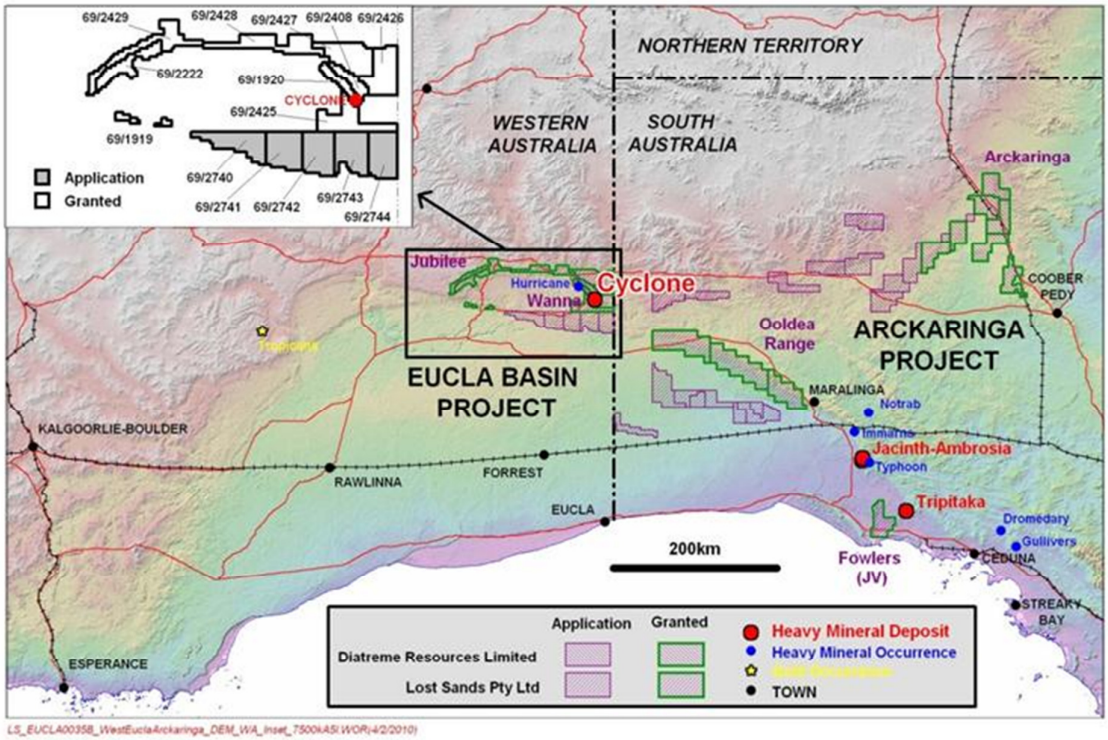


Figure 2.1 Cyclone Zircon Mineral Sands Deposit and Lease Location Plan

2.2 OVERVIEW OF TRANSPORT OPERATIONS

The transport corridor will be a private road for the Project use only and will be capable of handling multi-trailer road trains with a load carrying capacity of up to 120 tonnes (Figure 2.2). There will be approximately eight truck movements per day i.e. a loaded road train departing from the Project for the selected rail siding and returning unloaded to the Deposit is considered as two movements. Up to 150,000 tonnes of product is expected to be transported annually.

The trucks will offload the concentrate into stockpiles at the siding and a front end loader will be used to load a train on the siding. The train will haul the concentrate to port. Several ports are being considered, including Port Adelaide in SA and the ports of Esperance and Kwinana in WA.

Figure 2.2 Typical Product Transport Road Train (photograph courtesy of Diatreme)

2.3 TRANSPORT CORRIDOR OPTIONS AND CONSIDERATIONS

Following the initial discovery of the resource, the prefeasibility study considered eight transport corridor options (Figure 2.3). A summary of the preliminary assessment of the location, cost estimate and the affected Native Land Title holdings for each of the eight corridors is provided in Figure 2.3 and Table 2.1.

After an initial assessment of costing, Native Title and regulatory approvals, including consultative meetings with key stakeholders by LSPL, it was determined that each of the northerly, easterly and westerly corridors involved significantly greater distances than those to the south and traversed tracts of undisturbed land that are recognised as having Native Title ownership or were in the process of being registered as such. Subsequently, it was concluded that the southerly transport corridor options to Loongana, Forrest and Deakin were considered more socially, environmentally and economically viable and worthy of further detailed assessment.

These three options were:

1. Deakin: the most easterly of the three corridors, situated close to the border between WA and SA and linking with the Trans-Australian Railway line at Deakin (a distance of 230km);
2. Forrest: the Central option linking with the Trans-Australian Railway line at the rail siding of Forrest (a distance of approximately 240km); and
3. Loongana: the most westerly option skirting the western boundary of the Great Victoria Desert Nature Reserve (GVDNR) and linking with the Trans-Australian Railway line at Loongana (a minimum distance of 405km) (Figure 2.3).

Table 2.2 summarises the length and area of the three options.

Table 2.1 Comparison of Preliminary Transport Corridor Options

Road-to-Rail Link Options	Distance (km)	Estimated Cost (≈$130,000AUD/km)	Key Issues
Deakin*	230	$29,900,000	• Route crosses the Great Victoria Desert Nature Reserve • Route is adjacent to interstate boundary and is in the vicinity of surface water bodies (Forest Lakes) • Significant rail line siding works required • Route crosses Native Title land (single title holder)
Forrest*	240	$31,200,000	• Route crosses the Great Victoria Desert Nature Reserve • Route crosses Native Title land (single title holder)
Loongana*	405	$52,650,000	• Route crosses Native Title land (single Title Holder) • Route passes close to registered cultural heritage sites • Route is in the vicinity of surface water bodies (Jubilee and Carlisle Lakes)
Coober Pedy	560	$72,800,000	• Destination in SA requiring interstate approvals • Route crosses Native Title land (multiple titles)
Leonora	670	$87,100,000	• Route crosses Native Title land (multiple titles) s
Kalgoorlie	730	$94,900,000	• Route crosses Native Title land (multiple titles)
Alice Springs	730	$94,900,000	• Destination in Northern Territory requiring interstate approvals • Route crosses Native Title land (multiple titles)
Newman	950	$123,500,000	• Route crosses Native Title land (multiple titles) • The length of the transport corridor make this option cost prohibitive

*Three options selected for further assessment

Table 2.2 Length and area per subregion of each proposed transport corridor option

Option	Length (km)	Total Area (ha)	Subregion	Area within each Subregion (ha)	Area within GVDNR (ha)
Western (Loongana)	405	810	GVD3 GVD2 NUL1 NUL2	145 152.5 342.5 170	Nil
Central (Forrest)	250	500	GVD3 NUL1 NUL2	170 190 145	315 (158km)
Eastern (Deakin)	230	460	GVD3 NUL1 NUL2	145 220 100	288 (144km)

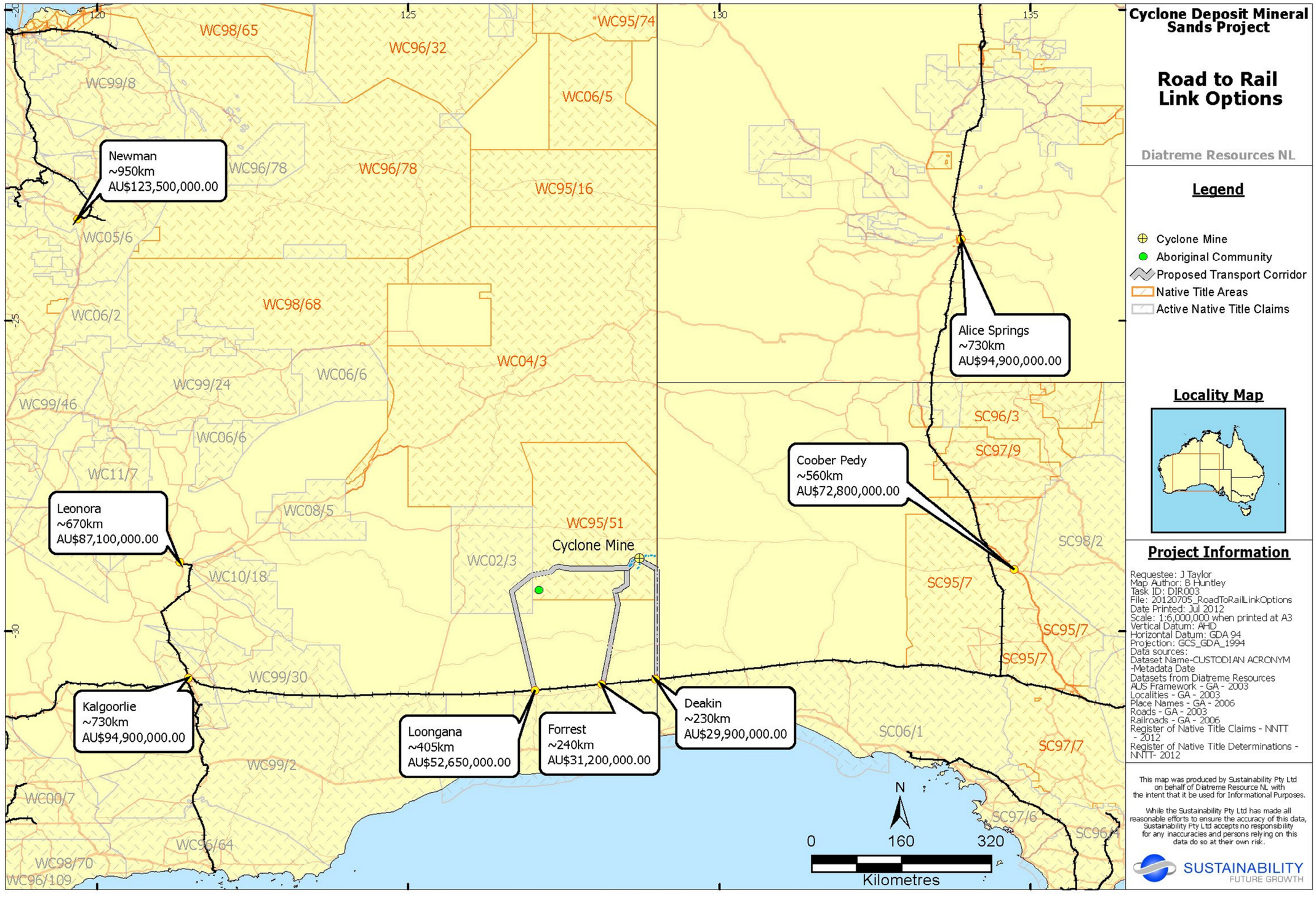


Figure 2.3 Initial Transport Corridor Options with Distance from the Project to Rail Siding and Estimate of Construction Cost

2.4 LAND TENURE

All three transport corridor options traverse both the GVD and Nullarbor bioregions (Figure 2.4). The majority of the GVD bioregion consists of Crown land, conservation reserves and Aboriginal land (ANRA 2002). The Nullarbor bioregion is comprised of pastoral leases, conservation reserves, Aboriginal land and part of the Woomera Prohibited Area (ANRA 2002). The GVD itself overlies both of these bioregions in WA and SA. The deposit is located within Paupiyala Tjarutja Aboriginal Corporation (PTAC) tribal lands where the Pila Nguru (Spinifex) People are the custodians.

The GVD is home to members of the Paupiyala Tjarutja Aboriginal Corporation, which is the Native Title representative for the Pila Nguru people. The mine and northern section of the transport corridor options is located within the Pila Nguru lands Determination Area (WC95/51) (Figure 2.5), which is listed on the National Native Title Register and protected under the Commonwealth *Native Title Act 1993* (NNTT 2011). The western Loongana transport corridor option traverses through both the Pila Nguru Native Title Determination Area and the Pilki People Native Title Application Area (WC02/3) (Figure 2.5). Current land use in the Project area is solely traditional Aboriginal activity.

The Central Forrest transport corridor option traverses the GVDNR. The Deakin transport corridor option traverses the eastern boundary of the GVDNR and the western boundary of the Mamungari Conservation Park in SA (Figure 2.6).

2.5 POPULATION CENTRES

The Project is located in the Shire of Laverton, with the town of Laverton over 600km to the east. There are no established communities within an approximate 100km radius of the Project location.

The nearest occupied residence is located approximately 125km north-northwest from the deposit at the Ilkurlka roadhouse (Figure 2.7). This roadhouse is located on the Anne Beadell Highway and is situated near an airstrip and a camp ground. Both the airstrip and Anne Beadell Highway are unpaved. The airstrip is approximately 1.5km in length and is not controlled. The permanent settlement of Tjuntjunjarra, located within the GVDNR (ANRA 2002), is 170km south-southwest of the Project area (Figure 2.7).

All proposed transport corridor options pass through the three following WA Local Government Areas (LGAs):

- Shire of Laverton;
- Shire of Menzies; and
- The City of Kalgoorlie/Boulder.

Aside from the residences and communities listed above, there are no nearby community centres or residences within the vicinity of the proposed haul roads within any of these LGAs.

2.6 INFRASTRUCTURE

There are no major roads through the Great Victoria Desert bioregion. The Trans-Australian Railway extends from Port Augusta in SA to Kalgoorlie in WA, passing through the Nullarbor bioregion. It forms an important freight route between WA and the eastern states. An unpaved road, the Trans Access Road, provides access to the Trans-Australian Railway.

2.7 INDIGENOUS HERITAGE

A search on the Department of Indigenous Affairs' (DIA) Register of Aboriginal Sites database (DIA 2011) indicated the presence of some registered Aboriginal heritage sites in the region that are protected under the *Aboriginal Heritage Act 1972*. (Table 2.3, Figure 2.8).

Table 2.3 Registered Indigenous Heritage Sites in the Vicinity of the Project

Site ID	Distance from Project	Description
2628: Tjatju	Approx. 12km north of the Serpentine Lakes borefield option	Water source
2627: Wipuwara	Approx. 2km north of the Serpentine Lakes borefield option	Water source
3061: Boo-Yoo-Noo Rock Hole	Approx. 10km east of the Forrest haul road option and 10km SW of Deakin option	Ceremonial, Mythological, Man-Made Structure, Quarry
2626: Mirin	Approx. 6km south of Deakin haul road option	No description provided
2625: Kapara-Tjara	Approx. 10km south of Deakin haul road option	Water source
2624: Wati Kutjara (Sandhill)	Approx. 12km west of Deakin haul road option	Mythological
2623: Malupiti/ Forrest Lakes	Approx. 10km west of Deakin haul road option	No description provided

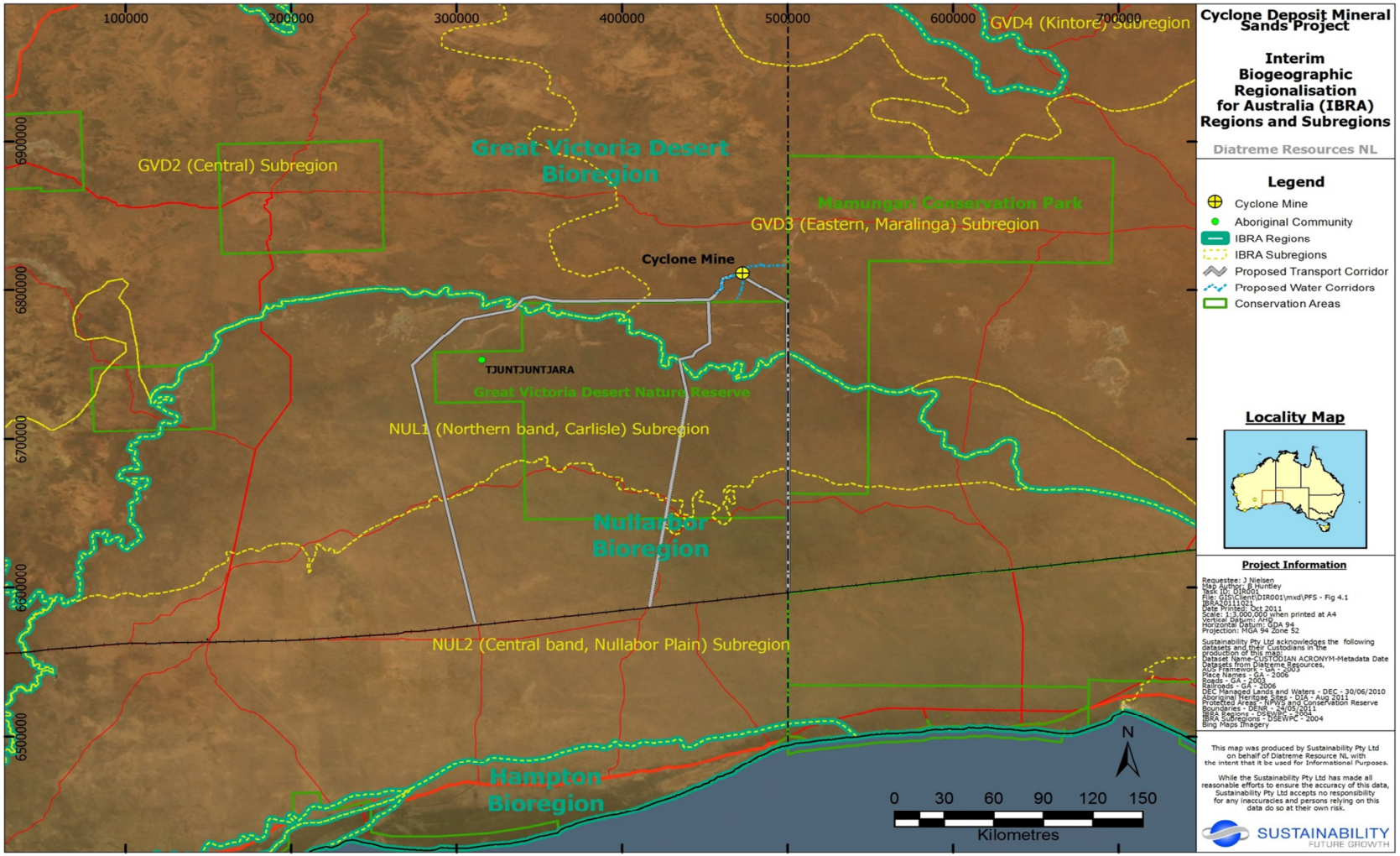


Figure 2.4 Locations of the Minesite Transport Corridors Options and IBRA Bioregions

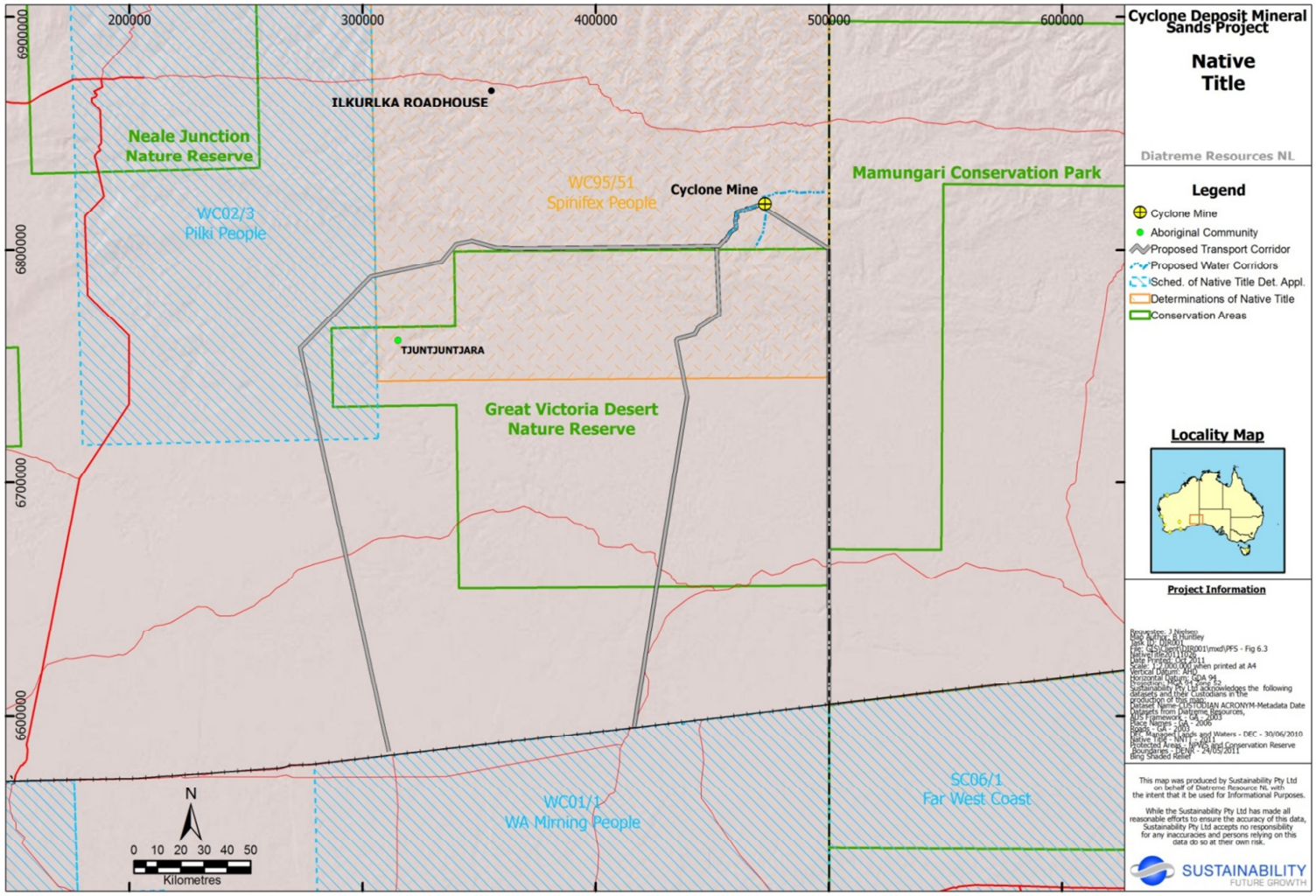


Figure 2.5 Native Title Determination and Application Areas

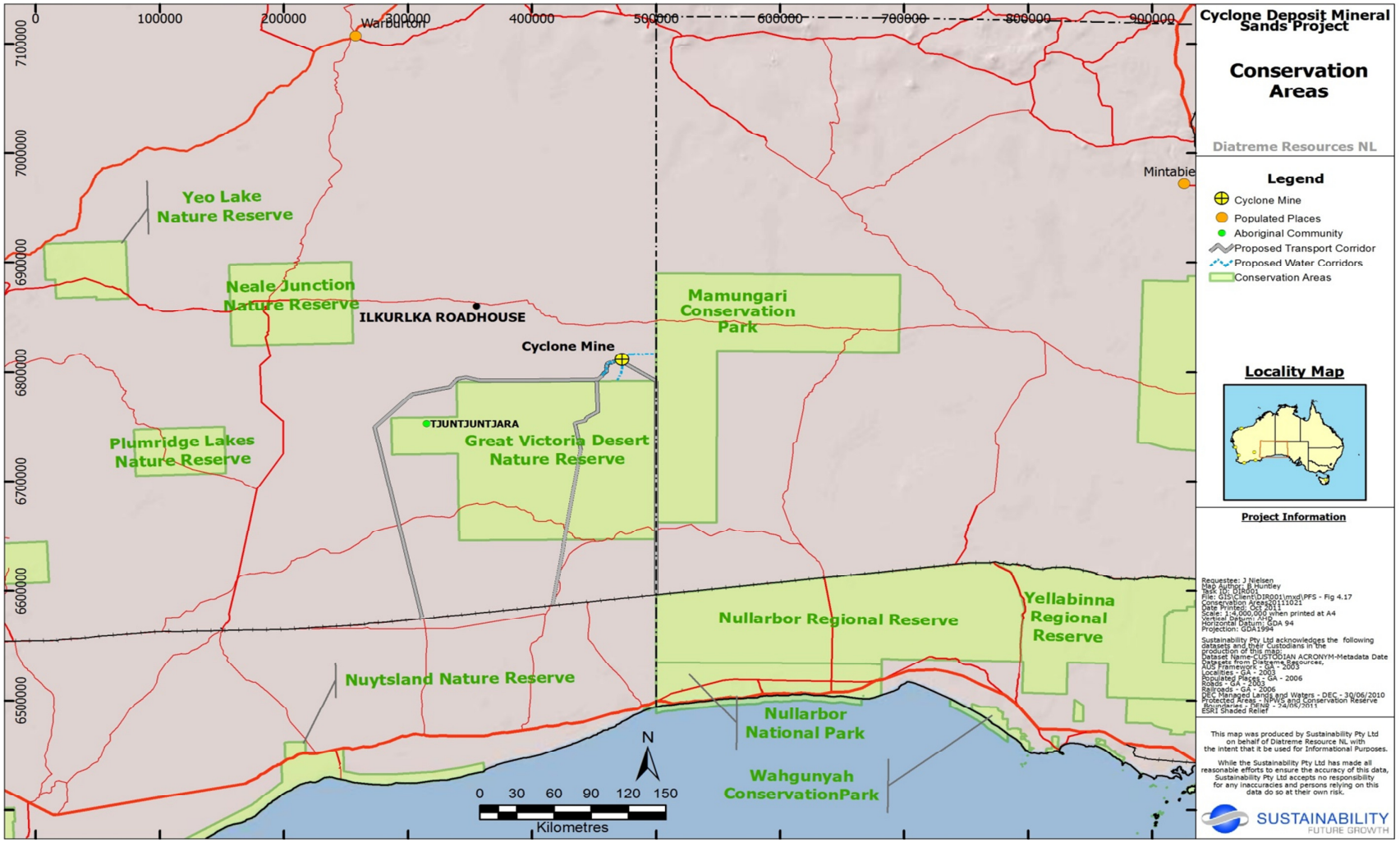


Figure 2.6 Conservation Areas and the Project Area

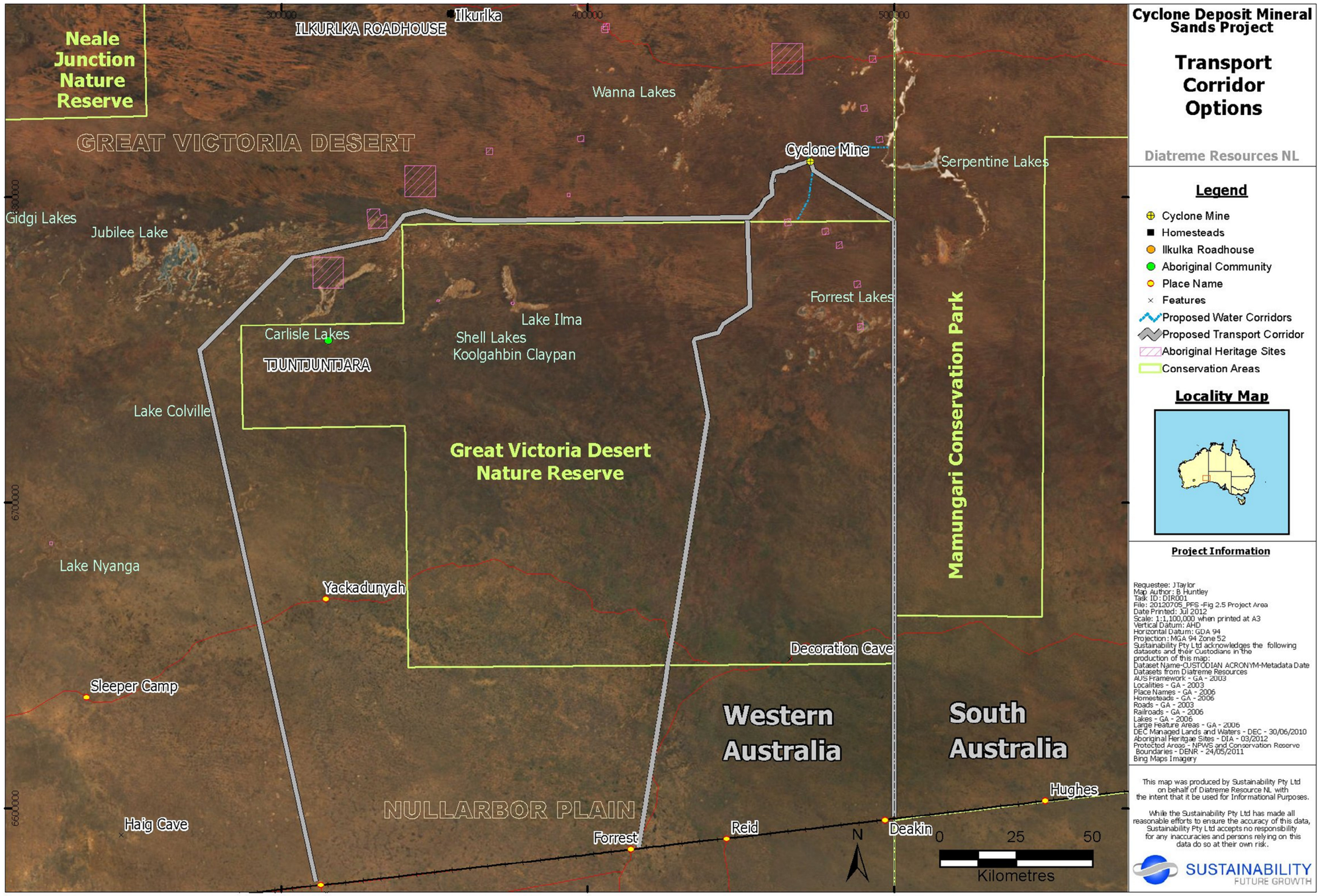


Figure 2.7 Project Location and Transport Corridor Options in Relation to Population Centres, Lake Systems and Conservation Parks

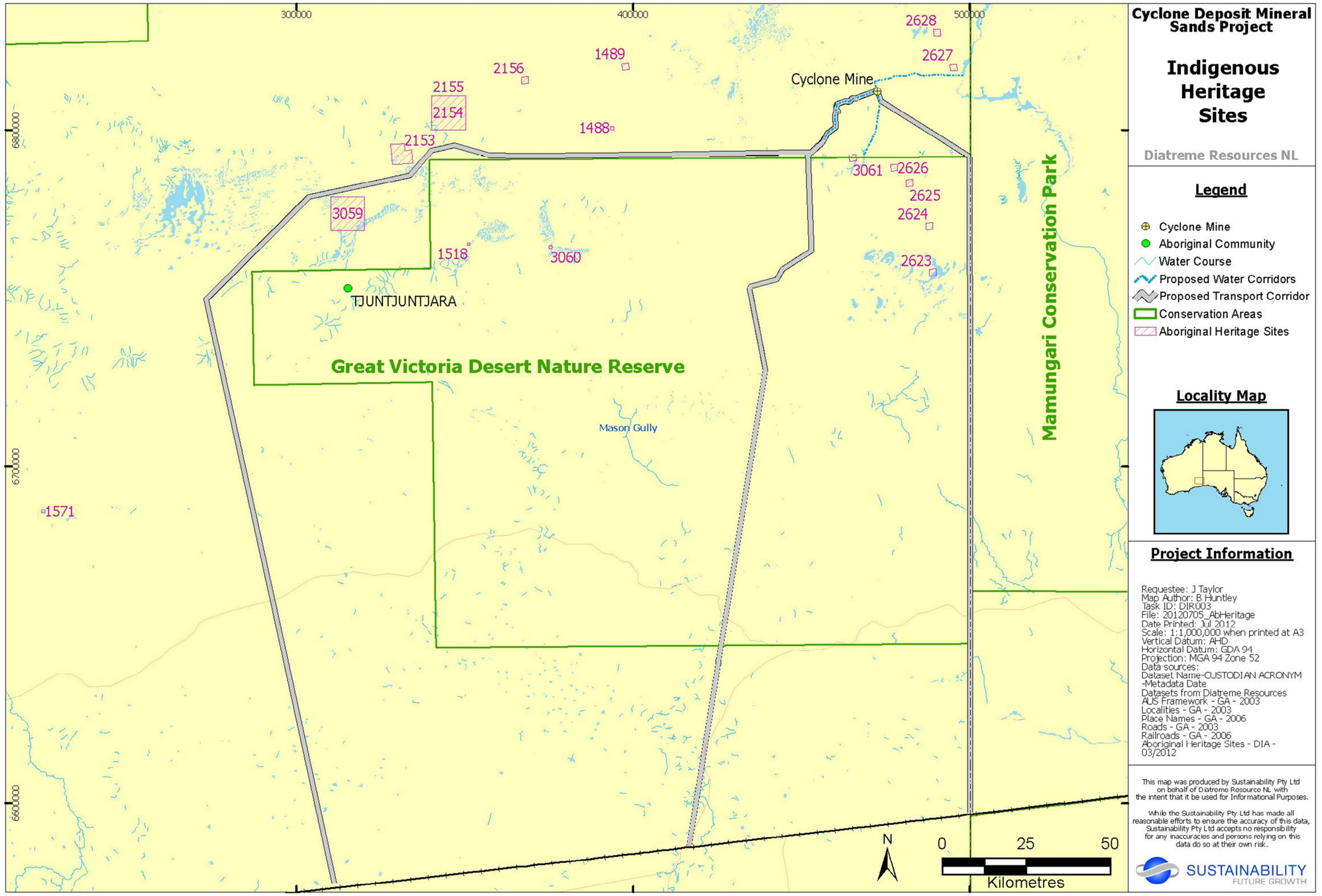


Figure 2.8 Location of Registered Aboriginal Heritage Sites (DIA 2011)

3. VEGETATION AND FLORA

3.1 OVERVIEW OF REGIONAL VEGETATION AND FLORA

The Project is located in the GVD bioregion of WA (Figure 2.4). Large expanses of the GVD bioregion are inaccessible, and as a consequence the area is relatively pristine and has retained most of its biological integrity. Condition is therefore good, apart from the western fringes of the western subregion, GVD1, which have been degraded by grazing from stock and feral herbivores such as camels and rabbits. The vegetation biomass of the region has been reduced by large and intense summer wildfires (ANRA 2002).

The proposed mine site, associated facilities and northern section of the transport corridors are located within the eastern subregion, GVD3. This subregion is characterised by extensive sandplains of deep Quaternary aeolian sands, which support primarily a tree steppe of *Eucalyptus gongylocarpa, E. youngiana* and *Acacia aneura* (Mulga) over hummock grassland dominated by *Triodia basedowii* (Barton & Cowan 2001a). *Acacia* dominates colluvial soils with *Eremophila* and *Santalum* spp., with halophytes confined to the edges of salt lakes and saline drainage systems (Barton & Cowan 2001a).

Immediately to the south of GVD bioregion is the Nullarbor bioregion, of which two subregions are recognised. The proposed transport corridors traverse through both the northern Nullarbor subregion, NUL1, and the southern Nullarbor subregion, NUL2. In the northern section of NUL1, sandplains, colluvial areas, salt lakes and saline drainage systems occur, with the vegetation identical to that of the sandplains of GVD3 (Barton & Cowan 2001b). In the central and southern areas, low woodlands of *Acacia papyrocarpa* (Western Myall) over *Maireana sedifolia* (Pearl Bluebush) are present, along with *Myoporum platycarpum* and *Eucalyptus oleosa* in the east and west, and woodlands dominated by *Acacia aneura* (Mulga) (Barton & Cowan 2001b).

The transport corridor options all extend into the northern part of subregion NUL2. NUL2 is dominated by the Nullarbor Plain; a vast, flat, treeless plain determined by the combination of aridity and calcareous soils (Barton *et al.* 2002). The vegetation is comprised of Bluebush – Saltbush steppe in central areas, with low woodlands of *Acacia papyrocarpa* over bluebush present in peripheral areas, along with *Myoporum platycarpum* and *Eucalyptus oleosa* in the east and west (Barton *et al.* 2002). The condition of the biodiversity of Nullarbor subregion is only fair, and declining, due to the spreading of weeds, fire and feral predators all substantially modifying extensive areas of habitat within the entire bioregion (ANRA 2002).

Significant conservation areas within Western Australia include National Parks, Nature Reserves, Threatened Ecological Communities ('TECs'), Priority Ecological Communities ('PECs'), Environmentally Sensitive Area ('ESAs'), Schedule 1 Areas, Red Book Areas and other types of DEC managed lands such as purchased ex-pastoral leases. The western Loongana transport corridor option is close to the northern and western boundary of the GVDNR and the Central Forrest transport corridor option passes through the GVDNR in a north-south direction. The eastern Deakin transport corridor option is located at the eastern boundary of the GVDNR and the western boundary of the Mumnungari Nature Reserve (Figure 2.6).

The PEC: *Yellow sandplain community of the Great Victoria Desert* is listed as Priority 3ii: "communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat" (DEC 2012b).

3.2 SURVEY METHODOLOGY

3.2.1 Desktop Review

A desktop review was undertaken by Woodman of existing literature (including previous surveys in the vicinity of the Project) and government databases to provide both local and regional context, and to identify flora and vegetation of significance known in the area (Woodman 2011). Preliminary vegetation type boundaries were transcribed onto aerial photography to enable ground-truthing in the field, and site selection for detailed survey of the flora.

3.2.2 Field Survey

A "Level 1" reconnaissance survey was conducted across the area of the Project (including the three transport options) by Woodman from 22–27 March 2012, in accordance with EPA Guidance Statement No. 51 (EPA 2004). Most of the survey was undertaken by helicopter due to both the size of the survey and the lack of vehicular access to the majority of the Project area. Personnel were landed at selected sites to survey the flora. However, the northern part of the Central (Forrest) transport corridor option and the east-west section of the western (Loongana) transport corridor option were accessed by vehicle and on foot.

The flora were surveyed in detail at 96 sites across the three transport corridor options (Figure 3.1) which, combined, cover a total distance of approximately 700km. The majority of sites were established in the northern half of the Project area, corresponding to areas of more complex vegetation types associated with sand dunes, sand plains and loamy plains. Fewer sites were established in the southern half of each transport corridor option, as the southern half corresponded with the relatively homogenous Nullarbor Plain, where large areas of similar vegetation types occurred. Portions of the western and eastern alignments were unable to be surveyed because of occurrence in culturally sensitive areas.

The field survey sites measured approximately 25m in radius from a central point. All vascular taxa that were visually identifiable at each site were recorded, and at least one reference collection for each taxon identified was made. However, collections could not be made in the portion of the Project area located on tribal lands owned by the Pila Nguru people outside of the Great Victoria Desert Nature Reserve, as permission to collect had not been granted to collect specimens at the time of survey. No specific searching for significant flora was undertaken. However, some opportunistic recording of such species was undertaken.

3.2.3 Species Identification

At least one reference specimen for each discreet vascular taxon identified was collected. In the field survey sites, vascular taxa were matched to collections made in the Great Victoria Desert Nature Reserve, where possible, or photographed for later identification. Species identification of specimens and photographs was undertaken at the WA Herbarium. The conservation status of each species was checked against *Florabase* (DEC 2012b).

3.2.4 Survey Limitations

The limitations of the vegetation and flora survey are presented in Table 3.1 (Woodman 2012).

Table 3.1 Field Survey Limitations

Aspect	Woodman (2012) survey
Level of survey.	Level 1 Reconnaissance Survey: A desktop survey was undertaken prior to the commencement of field survey, with field survey undertaken in March 2012. Detailed recording sites were established in all discernible vegetation types, with opportunistic recording of flora taxa conducted while traversing to and between detailed recording sites.
Competency/experience of the consultant(s) carrying out the survey.	Senior personnel are experienced in conducting similar assessments in WA, with mentoring given to less experienced botanists throughout the survey. Personnel have not had specific experience in the Great Victoria Desert region. However this is not expected to have influenced the results.
Scope (floral groups that were sampled; some sampling methods not able to be employed because of constraints?)	All vascular groups that were present during the survey were sampled. However, permission was not obtained to collect specimens of taxa within Pila Nguru tribal lands outside of the Great Victoria Desert Nature Reserve. Therefore, only photographs of taxa were taken in these areas, which has resulted in incomplete identification of some taxa. No survey could be conducted in several areas because of their cultural sensitivity. Foot transecting was very limited because of time constraints, and because most access was by helicopter.
Proportion of flora identified, recorded and/or collected.	Relatively high proportion of perennial vascular taxa (approx. 60 %) collected and recorded based on intensity and method of survey. Very low proportion of expected ephemeral vascular taxa collected (less than 10 %) and recorded based on intensity and method of survey and lack of any significant rainfall prior to commencement of survey. All vascular taxa recorded had at least 1 reference specimen collected, with specimens identified at the WA Herbarium.

Aspect	Woodman (2012) survey
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	Sources include government databases (DEC, EPBC), broad-scale vegetation reports (e.g. Beard 1974; 1975) and a limited number of unpublished reports located in the general region of the Project area. However, no specific historical information available for the Project area, and very limited information available for the vicinity of the Project area.
The proportion of the task achieved and further work which might be needed.	Level 1 survey complete, however comprehensive survey required for the purposes of EIA.
Timing/weather/season/cycle.	Field survey conducted in March; this coincides with a period where significant rainfall associated with cyclonic activity in the north of the country occasionally occurs (e.g. in 2011 – 209 mm recorded at Forrest for February (Bureau of Meteorology 2012)). However apparently very little rain prior to survey (no rain in February, 24.8 mm in January (Bureau of Meteorology 2012), which likely affected proportion of ephemeral taxa recorded, and quality of perennial material collected, with limited flowering material observed and collected.
Disturbances (e.g. fire, flood, accidental human intervention etc.), which affected results of survey.	Previous fire history of parts of the Project area influenced patterns discernible from aerial photography, and also existing structure and composition of the vegetation in parts of the Project area as observed during survey. However this did not significantly affect survey results.
Intensity of survey.	Survey intensity adequate to identify broad structural groupings of terrestrial flora as required by a Level 1 survey, with replication of detailed recording sites through most discernible plant community types. Relatively Low intensity of survey over much of Project area, because of large size of Project area, and large size of most vegetation types. No specific searching for significant flora undertaken, however some opportunistic recording undertaken.
Completeness and mapping reliability.	Survey of Project area considered complete in terms of Level 1 survey. Mapping of VTs considered reliable for the purposes of a Level 1 survey, as high resolution aerial photography was used, and detailed recording sites were replicated throughout most VTs. However, fire history affected vegetation patterns discernible on aerial photography. Western haul road alignment option was less comprehensively surveyed and mapped than the other haul road alignment options due to constraints with the helicopter and cultural sensitivity; a greater emphasis was placed on aerial photography interpretation and extrapolation.
Resources and experience of personnel.	Adequate resources including experienced field personnel and taxonomists with appropriate expertise were utilised, with relevant experts consulted during plant identifications.
Remoteness and/or access problems.	Project area extremely remote and very large, and therefore majority of access by helicopter. This meant that all areas were accessible, but limited foot transecting was employed, as personnel were generally dropped at specific locations.

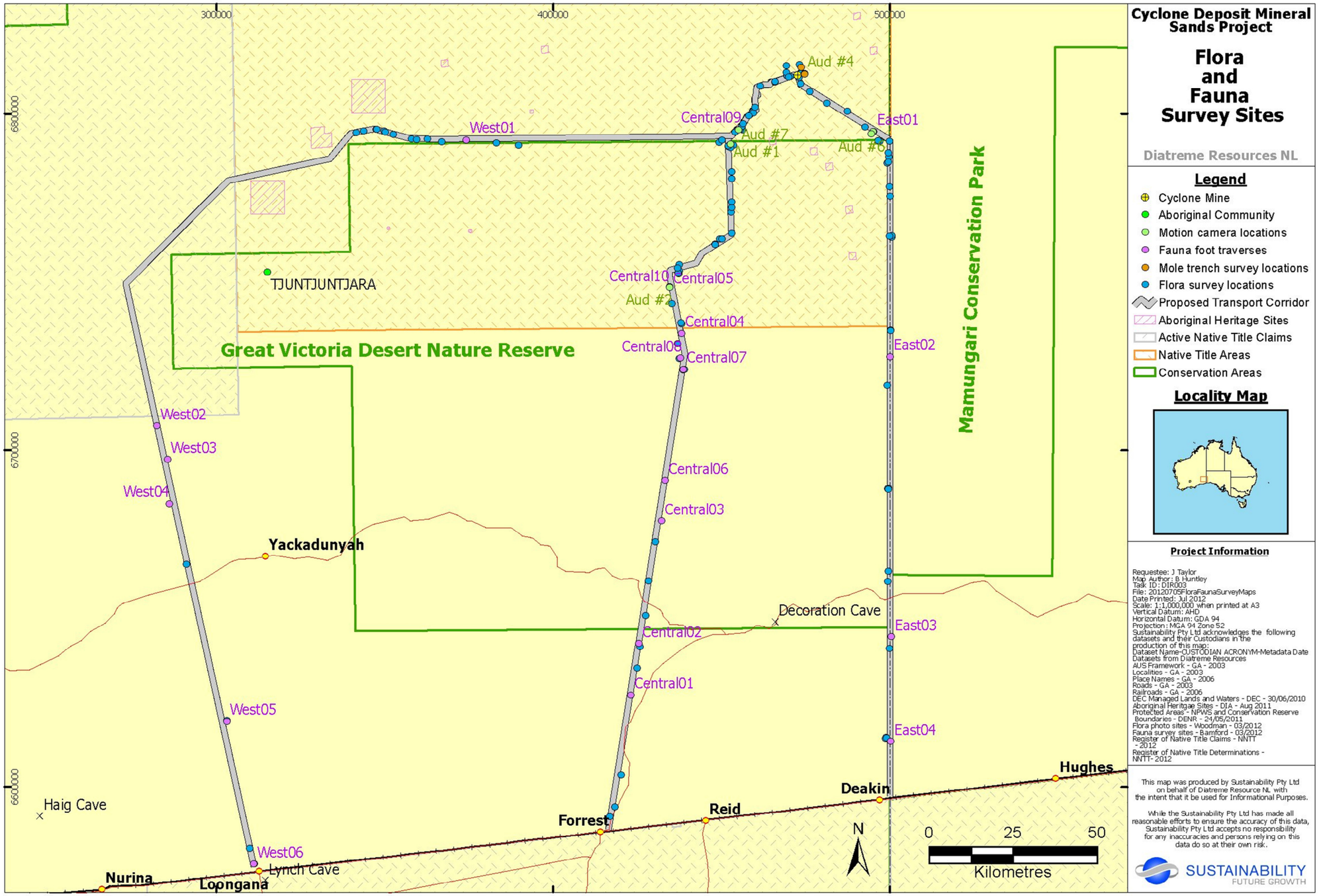


Figure 3.1 Field Vegetation Survey Sites

3.3 VEGETATION OF THE THREE TRANSPORT CORRIDOR OPTIONS

3.3.1 Vegetation Mapping

A total of sixteen broad structural vegetation types were mapped over the three transport corridor options (Table 3.2). Vegetation types 1 to 9 occurred in the northern half of the transport corridors, associated with sandy dunal and clay-loam areas. Vegetation types 10 to 16 occurred over the southern half of the transport corridors and related to clay soils of the Nullarbor Plain. None of the vegetation types recorded represented the PEC (Priority 3) *Yellow sandplain communities of the Great Victoria Desert*. Table 3.2 presents a description of each of the vegetation types, including representative photographs. An atlas of vegetation maps for each transport corridor option (Appendix D) is provided on a compact disk on the inside cover at the back of this report.

Table 3.2 Vegetation Types Identified in the Three Transport Corridor Options

Vegetation type Description	Representative Appearance of Vegetation type
Vegetation Type 1 (VT1) Mid Woodland to Mid Isolated Trees of *Eucalyptus gongylocarpa* over Mid Mallee Woodland to Mid Isolated Mallee Trees of mixed *Eucalyptus* spp. over Tall Open Shrubland to Mid Open Shrubland of mixed species with Isolated Trees of *Acacia aneura/aptaneura* (Mulga) and/or *Casuarina pauper* over Low Isolated Clumps of Tussock Grasses and/or Hummock Grasses on red sandy dunes and swales (Plates 1 to 4). VT1 was mapped over large areas in the northern half of all three transport corridor options, as well as over the majority of the mining area (Appendix A). It is possible that a number of vegetation types occur on dunes and in swales in the Project area. However, a floristic analysis is required to delineate these units, and for the purposes of this report, VT1 was mapped on all dunes and swales. The conservation significant flora taxa *Dampiera ?eriantha* (P1), *Eucalyptus pimpiniana* (P3) and *Acacia eremophila* numerous-nerved variant (A.S. George 11924) (P3) were recorded in VT1, as well as the taxon of *interest Eucalyptus canescens* subsp. *beadellii*. The conservation significant taxon *Ptilotus blackii* (P3) was recorded in this VT1. No introduced taxa were recorded in VT1.	 Plate 1 – Vegetation type 1, Sand Dunes with *Eucalyptus gongylocarpa*, Mixed Shrub Species and Mallee (Site C1-52)  Plate 2 – Vegetation type 1, Sand Dunes with Mixed Shrub Species and Mallee (Site C1-V)

Vegetation type Description	Representative Appearance of Vegetation type
	 Plate 3 – Vegetation type 1, Sandy Swales with Mixed Shrub Species and Mallee (Site C2-108)  Plate 4 – Vegetation type 1, Sandy Swales with Scattered Mulga/Casuarina and Mixed Shrub Species (Site C1-Z)
Vegetation type 2 (VT2) Low Open Woodland of *Acacia aneura* (Mulga) over Mid Sparse Shrubland of *Eremophila latrobei* subsp. *glabra* and *Senna artemisiodes* subsp. aff. *petiolaris* over Mid Hummock Grassland of *Triodia basedowii* on plains of red clayey sand or sandy loam (Plate 5). VT2 was relatively restricted in occurrence, being mapped in a few relatively small areas in the very northern part of the Central transport corridor option (Appendix D). No conservation significant flora taxa or introduced taxa were recorded in VT2.	 Plate 5 – Vegetation Type 2 (Site M-01-A)

Vegetation type Description	Representative Appearance of Vegetation type
Vegetation type 3 (VT3) Mid Woodland to Mid Open Woodland of *Casuarina pauper* and Low Isolated Clumps of Trees of Acacia *caesaneura/ aptaneura/ aneura* (Mulga) over Tall to Mid Shrubland of mixed species over Low Sparse Shrubland of mixed species and/or Chenopods over Low Sparse Tussock Grassland to Isolated Clumps of *Aristida* spp. and *Eragrostis laniflora* on undulating plains of red sand/sandy-clayey loam/clayey sand (Plate 6). VT3 was mapped over large areas in the northern half of all three transport corridor options (Appendix A). The conservation significant flora taxon *Dampiera ?eriantha* (P1) was recorded in VT3. No introduced taxa were recorded in VT3.	 Plate 6 – Vegetation type 3 (Site C1-53)
Vegetation type 4 (VT4) Low Woodland to Low Open Woodland of *Acacia caesaneura/ aptaneura/aneura* (Mulga) with Low Isolated Clumps of Trees of Casuarina pauper and/or *Myoporum playtycarpum* subsp. *playtcarpum* over Tall Isolated to Low Isolated Clumps of Shrubs of mixed species over Low Open Chenopod Shrubland over Low Closed Tussock Grassland of *Aristida* spp., *Enneapogon avenaceus* and *Eragrostis laniflora* on flats and depressions of red clay loam (Plate 7). VT4 was mapped in small areas in the northern half of all three transport corridor options, usually in association with depressions (Appendix A). No conservation significant flora taxa or introduced taxa were recorded in VT4.	 Plate 7 – Vegetation type 4 (Site C2-110)
Vegetation type 5 Chenopod vegetation in claypans in the northern part of the Project area, in the Great Victoria Desert. Several small claypans containing vegetation dominated by chenopod species in the Project area were mapped as VT5. However, the species composition varied between claypans in the Western, Central and Eastern transport corridor options. Therefore, 2 sub-types of VT5 were identified: VT5a - Low Open Samphire Shrubland of *Tecticornia* spp. and Low Isolated Clumps of Chenopod Shrubs of mixed species over Low Isolated Clumps of Tussock Grasses of *Eragrostis ?pergracilis* in claypans of red-brown light silty clay (Plate 8).	 Plate 8 – Vegetation type 5a (Site C3-T)

Vegetation type Description	Representative Appearance of Vegetation type
VT5a was restricted in occurrence, being mapped in several small areas in the very north-eastern part of the Western and Central transport corridor options (Appendix A). It was similar to VT5b in occurring in claypans, however VT5b was dominated by *Atriplex vesicaria* rather than *Tecticornia* spp. No conservation significant flora taxa or introduced taxa were recorded in VT5a. VT5b - Low Chenopod Shrubland of *Atriplex vesicaria* over Low Open Tussock Grassland of predominantly *Enneapogon avenaceus* with Low Isolated Trees of *Casuarina pauper* and *Myoporum playtycarpum* subsp. *playtcarpum* in claypans of red clay loam (Plate 9). VT5b was restricted in occurrence, being mapped in two small areas in the northern part of the Eastern transport corridor option (Appendix A). No conservation significant flora taxa or introduced taxa were recorded in VT5b.	 Plate 9 – Vegetation type 5b (Site C1-62)
Vegetation type 6 (VT6) Low Open to Low Sparse Forbland of *Scaevola collaris* and *Goodenia gypsicola* over Low Open Tussock Grassland of *Austrostipa nullnulla* and Low Isolated Chenopod Shrubs with Low Isolated Clumps of Trees of Casuarina pauper or *Myoporum playtycarpum* subsp. *playtcarpum* and *Alectryon oleifolius* subsp. *canescens* on gypsum lunettes/calcrete breakaways of pale brown clay or red sandy clay (Plate 10). VT6 was restricted in occurrence, being mapped in several small areas in the very north-eastern part of the Western and Central transport corridor options, on gypsum or calcrete lunettes or breakaways associated with claypans (Appendix A). No conservation significant flora taxa were recorded in VT6. However the taxa of interest *Austrostipa nullanulla* and *Eucalyptus* sp. were recorded in this unit. No introduced taxa were recorded in VT6.	 Plate 10 – Vegetation type 6 (Site C3-U)

Vegetation type Description	Representative Appearance of Vegetation type
Vegetation type 7 (VT7) Low Mallee Woodland of mixed *Eucalyptus* spp. over Tall Isolated Clumps of Shrubs of mixed species over Mid Open Shrubland to Mid Isolated Clumps of Shrubs of mixed species over Low Closed to Low Open Hummock Grassland of *Triodia* spp. and over Low Open to Low Isolated Clumps of Tussock Grasses of *Eragrostis laniflora* on broad sandplains of red clayey sand or sand (Plate 11). VT 7 was mapped over large areas in the northern half of all three transport corridor options, as well as over the majority of the mining area (Appendix A). It is possible that a number of vegetation types occur on sandplains in the Project area. However, a floristic analysis is required to delineate these units, and for the purposes of this report, VT7 has been mapped on all dunes and swales. The conservation significant flora taxa *Eucalyptus pimpiniana* (P3) and *Acacia* eremophila numerous-nerved variant (A.S. George 11924) (P3) were recorded in VT7, as well as the taxa of interest *Eucalyptus canescens* subsp. beadellii and *Eucalyptus canescens* subsp. *canescens*. No introduced taxa were recorded in VT7.	 Plate 11 – Vegetation type 7 (Site C3-M)
Vegetation type 8 (VT8) Bare claypan (no perennial vegetation present) (Plate 12). VT8 was mapped in two small areas in the Central transport corridor option, in small claypans with no perennial vegetation. It is possible that the claypans may contain ephemeral vegetation following significant rainfall events, and hence they have been mapped as a vegetation type.	 Plate 12 – Vegetation type 8

Vegetation type Description	Representative Appearance of Vegetation type
Vegetation type 9 (VT9) Low Open Forest of *Acacia aptaneura* (Mulga) over Tall Isolated Clumps of *Acacia tetragonophylla* over Mid Isolated Clumps of *Eremophila latrobei* subsp. *glabra* over Low Open Chenopod Shrubland (Bluebush) of mixed species over Low Isolated Clumps of Shrubs of *Ptilotus obovatus* over Low Open Tussock Grassland of mixed species (predominantly *Aristida contorta*) on gently undulating plains of red clay loam (Plate 13). VT9 was restricted in occurrence, being mapped in several small areas in the central part of the Central transport corridor option, near the top of the Nullarbor Plain (Appendix A). No conservation significant flora taxa or introduced taxa were recorded in VT9.	 Plate 13 – Vegetation type 9 (Site C2-25)
Vegetation type 10 (VT10) Vegetation in dongas or depressions in the southern part of the Project area on the Nullarbor Plain. Dongas and depressions were common on the Nullarbor Plain in the Project area, however frequently differed from each other in their species composition. Therefore, nine sub-types of VT10 were described: VT10a: Mid Isolated Clumps of *Muehlenbeckia florulenta, Senna artemisioides* subsp. aff. *petiolaris* and/or Eremophila longifolia over Low Tussock Grassland of *Eragrostis xerophila* or Poaceae species (dead) in dongas of light clay (red) (Plate 14 and 15). VT10a was relatively restricted in occurrence, being mapped in several small areas in the southern part of the Western transport corridor option, on the Nullarbor Plain (Appendix A). No conservation significant flora taxa or introduced taxa were recorded in VT10a. VT10b: Mid Isolated Clumps of *Senna*	 Plate 14 – Vegetation type 10a, *Muehlenbeckia florulenta* Over Grasses (Site C3-B)  Plate 15 – Vegetation type 10a, *Muehlenbeckia florulenta* with *Eremophila longifolia* (Site C3-F)

Vegetation type Description	Representative Appearance of Vegetation type
artemisioides subsp. aff. *petiolaris* and Low Isolated Clumps of Shrubs of *Rhagodia spinescens* with Low Isolated Trees of *Acacia aptaneura* (Mulga), *Alectryon oleifolius* and *Pittosporum angustifolium* in dongas of light clay (red). No photograph available. VT 10b was mapped in numerous small areas in the southern part of the Central transport corridor option, on the Nullarbor Plain (Appendix A). No conservation significant flora taxa or introduced taxa were recorded in VT10b.	
VT 10c: Mid Woodland of *Acacia aptaneura* (Mulga) and *Grevillea nematophylla* subsp. *supraplana* over Tall Sparse Shrubland to Tall Isolated Shrubs of *Eremophila longifolia, Pittosporum angustifolium, Senna artemisioides* subsp. x *artemisiodes* and/*or Senna artemisioides* subsp. aff. *petiolaris* over Mid Sparse Chenopod Shrubland *of Rhagodia spinescens* or Low Isolated Clumps of Chenopod Shrubs of mixed species over Low Open Forbland of **?Carrichtera annua* or Low Isolated Clumps of Tussock Grass of *Eragrostis xerophila* in dongas of red to pale brown clay loam (Plate 16). VT 10c was mapped in numerous small areas in the southern part of the Central and Eastern transport corridor options, on the Nullarbor Plain (Appendix A). No conservation significant flora taxa, were recorded in VT10c. However, the potential introduced taxon ?*Carrichtera annua* was recorded in VT10c.	 Plate 16 – Vegetation Type 10c (Site C2-38)
VT10d: Low Isolated Clumps of Trees of *Alectryon oleifolius* subsp. *canescens* over Mid Isolated Chenopod Shrubs of *Rhagodia spinescens* over Low Isolated Chenopod Shrubs of mixed species in dongas of light clay (red) (Plate 17). VT10d was restricted in occurrence, being mapped in several small areas in the southern part of the Central and Western transport corridor options, on the Nullarbor Plain (Appendix A). No conservation significant flora taxa or introduced taxa were recorded in VT10d.	 Plate 17 – Vegetation Type 10d (Site MS-06)
VT10e: Low Tussock Grassland of	

Vegetation type Description	Representative Appearance of Vegetation type
Rytidosperma ?acerosum and *Enneapogon avenaceus* or *Eragrostis xerophila* with Low Isolated Chenopod Shrubs of *Atriplex acutibractea* subsp. *acutibractea, A. vesicaria* and *Rhagodia spinescens* in drainage channels of light clay (red) (Plate 18). VT10e was restricted in occurrence, being mapped in several small areas in the southern part of the Central and Eastern transport corridor options, on the Nullarbor Plain (Appendix A). No conservation significant flora taxa, were recorded in VT10e. However, the potential introduced taxon ?*Carrichtera annua* was recorded in VT10e.	 Plate 18 – Vegetation Type 10e (Site MS-05)
VT10f: Mid Isolated Clumps of Trees of *Casuarina pauper* over Low Open Woodland of Alectryon oleifolius subsp. canescens over Tall Isolated Clumps of *Acacia kempeana* over Mid Open Shrubland of *Senna artemisioides* subsp. aff. *petiolaris* and *Senna artemisioides* subsp. *petiolaris* over Low Sparse Chenopod Shrubland of *Chenopodium desertorum* subsp. *desertorum* and *Maireana pentatropis* on plains of red sand (Plate 19). VT10f was restricted in occurrence, being mapped in several small areas in the southern part of the Eastern transport corridor option, on the Nullarbor Plain (Appendix A). No conservation significant flora taxa or introduced taxa were recorded in VT10f.	 Plate 19 – Vegetation Type 10f (Site C1-54)
VT10g: Low Open Woodland to Low Isolated Clumps of Trees of *Acacia aptaneura* (Mulga) over Tall Open Shrubland of Acacia tetragonophylla and *Eremophila longifolia* over Mid Sparse Shrubland to Mid Isolated Clumps of Chenopod Shrubs of *Rhagodia spinescens* and Mid Isolated Clumps of *Senna artemisioides* subsp. aff. *petiolaris* over Low Isolated Clumps of Tussock Grasses of *Enneapogon* spp. in dongas of red clay loam (Plate 20). VT10g was mapped in numerous small areas in the southern part of the Western and Eastern transport corridor options, on the Nullarbor Plain (Appendix A). No conservation significant flora taxa, were	 Plate 20 – Vegetation Type 10g (Site C1-23)

Vegetation type Description	Representative Appearance of Vegetation type
recorded in VT10g. However, the potential introduced taxon *Malvastrum americanum* was recorded in VT10g. VT10h: Low Shrubland of *Eremophila ?attenuata* and Low Open Chenopod Shrubland of *Atriplex nummularia* subsp. *nummularia* in claypans of light clay (Plate 21). VT10h was restricted in occurrence, being mapped in several small areas in the southern part of the Western transport corridor option, on the Nullarbor Plain (Appendix A). The conservation significant flora taxon *Eremophila ?attenuata* (P1) was recorded in VT10h, with no introduced taxa recorded in VT10h. VT10i: - Low Isolated Chenopod Shrubs of *Maireana sedifolia* (Bluebush) and *Sclerolaena obliqicuspis* over Low Tussock Grassland of Enneapogon avenaceus and *Eragrostis xerophila* with Low Isolated Clumps of Forbs of *Streptoglossa ?adscendens* in dongas of red sandy clay (Plate 22). VT10i was restricted in occurrence, being mapped in several small areas in the central part of the Central transport corridor option, near the top of the Nullarbor Plain (Appendix A). No conservation significant flora taxa or introduced taxa were recorded in VT10i.	 Plate 21 – Vegetation Type 10h (Site C3-A)  Plate 22 – Vegetation Type 10i (Site C2-26a)
Vegetation type 11 (VT11) Low Open Chenopod Shrubland of *Maireana sedifolia* (Bluebush) over Low Tussock Grassland of *Enneapogon cylindricus* on plains of red clay loam (Plate 23). VT11 was mapped over large areas as a mosaic with VT12 in the southern part of the Western, Central and Eastern transport corridor options, on the Nullarbor Plain (Appendix A). It is possible that VT11 and VT12 represent a single unit. However, a floristic analysis is required to determine whether this is the case, and therefore they are considered separate for the purposes of this report. No conservation significant flora taxa or introduced taxa were recorded in VT11.	

Vegetation type Description	Representative Appearance of Vegetation type
	Plate 23 – Vegetation Type 11 (Site C1-56)
Vegetation type 12 (VT12) Low Woodland of *Acacia papyrocarpa* over Low Open Chenopod Shrubland of *Maireana sedifolia* (Bluebush), *Sclerolaena uniflora* and *Atriplex vesicaria* over Low Open Tussock Grassland of *Enneapogon cylindricus* and *E. avenaceus* on plains of red clay loam or white/red sandy clay (Plate 24). VT12 was mapped over large areas as a mosaic with VT11 in the southern part of the Western, Central and Eastern transport corridor options, on the Nullarbor Plain (Appendix A). No conservation significant flora taxa or introduced taxa were recorded in VT12.	 Plate 24 – Vegetation Type 12 (Site C2-41)
Vegetation type 13 (VT13) Low Sparse Chenopod Shrubland of Atriplex acutibractea subsp. *acutibractea, Maireana sedifolia* (Bluebush) and *Sclerolaena patenticuspis* over Low Tussock Grassland of *Enneapogon cylindricus* and Poaceae sp. (dead) with Mid Isolated Shrubs of *Eremophila longifolia* or *Pittosporum angustifolium* on plains of brown clay loam (Plate 25 and 26). VT13 was mapped over large areas in the southern part of the Western, Central and Eastern transport corridor options, on the Nullarbor Plain (Appendix A). It was frequently mapped as a mosaic with VT14, as it was often difficult to differentiate these vegetation types on aerial photography. No conservation significant flora taxa were recorded in VT13. However, the potential introduced taxon ?*Carrichtera annua* was recorded in an area mapped as a mosaic of VT13 and VT14; it is likely to occur in both of these units.	 Plate 25 – Vegetation Type 13, Sparse Chenopod Shrubland and Grasses (Site C1-57)  Plate 26 – Vegetation Type 13, Sparse Chenopod Shrubland and Grasses with Mid Isolated Shrubs (Site C3-E)

Vegetation type Description	Representative Appearance of Vegetation type
Vegetation type 14 (VT14) Low Closed to Low Sparse Chenopod Shrubland of *Atriplex acutibractea* subsp. *acutibractea* and/or *A. vesicaria* and *Maireana ?trichoptera* over Low Sparse Tussock Grassland of Poaceae sp. (dead) with Mid Isolated Shrubs of *Pittosporum angustifolium* on plains of red silty loam or clay loam (Plate 27). VT14 was mapped over large areas in the southern part of the Western, Central and Eastern transport corridor options, on the Nullarbor Plain (Appendix A). It was frequently mapped as a mosaic with VT13, as it was often difficult to differentiate these vegetation types on aerial photography. No conservation significant flora taxa were recorded in VT14. However, the potential introduced taxon ?*Carrichtera annua* was recorded in an area mapped as a mosaic of VT13 and VT 14; it is likely to occur in both of these units.	 Plate 27 – Vegetation Type 14 (Site MS-03)
Vegetation type 15 (VT15) Low Woodland of *Acacia caesaneura* and *A. pteraneura* (Mulga) to Low Isolated Clumps of Trees of *Acacia aptaneura* (Mulga) and *Casuarina pauper* over Tall Isolated Clumps of Shrubs of *Acacia kempeana* and *A. tetragonophylla* over Mid Isolated Clumps of Shrubs of *Eremophila latrobei* subsp. *glabra* over Low Shrubland of *Ptilotus obovatus* and Low Open Chenopod Shrubland of *Maireana sedifolia* (Bluebush) over Low to Low Open Tussock Grassland of *Eriachne helmsii* and *Enneapogon caerulescens* or *E. cylindricus* on undulating plains of red clay loam (Plate 28). VT15 was mapped over large areas in the central part of the Central and Eastern transport corridor options, at the top of the Nullarbor Plain (Appendix A). It was frequently mapped as a mosaic with VT12, as it was often difficult to differentiate these vegetation types on aerial photography. No conservation significant flora taxa or introduced flora taxa were recorded in VT15.	 Plate 28 – Vegetation Type 15 (Site C2-32)

Vegetation type Description	Representative Appearance of Vegetation type
Vegetation type 16 (VT16) Low Woodland of *Acacia aneura, A. pteraneura* (Mulga) and *Casuarina pauper* over Tall Isolated Clumps of Shrubs of *Acacia kempeana* over Mid Isolated Clumps of Shrubs of *Eremophila latrobei* subsp. *glabra/E. longifolia* and *Senna artemisioides* subsp. x artemisioides/aff. petiolaris over Low Isolated Clumps of Shrubs of *Ptilotus obovatus* over Low Closed to Low Tussock Grassland of *Aristida contorta*, *A. ?inaequiglumis* and *Eragrostis laniflora* on plains of red clayey sand (*Plate 29*). VT16 was relatively restricted, being mapped in several areas, some of which were large, in the north-western part of the Western transport corridor option, near the top of the Nullarbor Plain (Appendix A). No conservation significant flora taxa or introduced flora taxa were recorded in VT16.	 Plate 29 – Vegetation Type 16 (Site C3-G)

Areas that could not be surveyed because of cultural heritage restrictions were mapped as Not Surveyed (NS). These primarily related to the Carlisle Lakes chain in the Western (Loongana) transport corridor option, and the Forrest Lakes chain in the Eastern (Deakin) transport corridor option.

Several areas near the Trans-Australian Railway line were mapped as 'Disturbed' (D). These included areas near Forrest in the Central transport corridor option, and near Loongana in the Western transport corridor option. The conservation significant flora taxon *Lepidium fasciculatum* (P3) has previously been recorded in an area mapped as 'Disturbed'.

3.3.2 Vegetation Condition

The vegetation types (VTs) in the northern half of the Project area (VTs 1 to 9) was mostly in excellent condition, with little to no disturbance or weeds. The southern half of the transport corridor options (relating to the Nullarbor Plain and VTs 10 to 16) ranged from Excellent to Good. Very recent fire, a high density of rabbit warrens and high rabbit numbers, the presence of weed species and heavy grazing by rabbits resulted in lower condition scores in approximately half of the sites recorded in the Nullarbor area (Woodman 2012).

3.3.3 Potential Conservation Significance of Vegetation Types

The distributions of sixteen vegetation types mapped in the survey area are outlined in Table 3.3. A number of vegetation types were mapped over large areas, including over two or more of the transport corridor options. However, several vegetation types were either highly locally restricted in their distribution, including some that were only mapped in one of the transport corridor options, or were mapped in a limited number of small areas across two or all of the transport corridor options, often associated with uncommon land forms. These vegetation types are currently considered to be of local conservation significance (Woodman 2012), but almost certainly occur outside of the Project area. This is particularly relevant for the sub-types of VT10 (vegetation in dongas and other depressions on the Nullarbor Plain), as dongas were seen from the air to be prevalent beyond the haul road alignment of each corridor option.

Table 3.3 Distribution of Vegetation Types in the Project Area

Vegetation Type	Western Corridor	Central Corridor	Eastern Corridor	Conservation Significance
1	Present	Present	Present	• Habitat for conservation significant flora taxa
2		Present		• Mapped over a limited range in the Project area (mining area and adjacent Central transport corridor option) • Area mapped relatively small
3	Present	Present	Present	• Habitat for conservation significant flora taxon
4	Present	Present	Present	• No conservation significant flora taxa or introduced taxa
5a	Present	Present		• Mapped in a few very small areas;
5b			Present	• Mapped over a limited range in the Project area (Central transport corridor option and immediately adjacent Western transport corridor option)
6	Present	Present		• Mapped in a few very small areas;
7	Present	Present	Present	• Mapped over a limited range in the Project area (Central transport corridor option and immediately adjacent Western transport corridor option)
8		Present		• Mapped in a few very small areas;
9		Present		• Mapped over a limited range in the Project area (Central transport corridor option and immediately adjacent Western transport corridor option)
10a	Present			• Mapped in a few very small areas; • Mapped over a limited range in the Project area (Western transport corridor option)
10b	Present	Present		• No conservation significant flora taxa or introduced taxa

Vegetation Type	Western Corridor	Central Corridor	Eastern Corridor	Conservation Significance
10c		Present	Present	• No conservation significant flora taxa • Potential introduced taxon ?*Carrichtera annua* recorded
10d	Present	Present		• Mapped in a few very small areas; • Mapped over a wide range in the Project area (Central and Western transport corridor options)
10e		Present	Present	• Mapped in a few very small areas; • Mapped over a wide range in the Project area (Central and Eastern transport corridor options) • Potential introduced taxon ?*Carrichtera annua* recorded
10f			Present	• Mapped in a few very small areas; • Mapped over a limited range in the Project area (Eastern transport corridor option)
10g	Present		Present	• No conservation significant flora taxa • Potential introduced taxon *Malvastrum americanum* recorded
10h	Present			• Mapped in a few very small areas; • Mapped over a limited range in the Project area (Western transport corridor option) • Habitat for conservation significant flora taxon
10i		Present		• Mapped in a few very small areas; • Mapped over a limited range in the Project area (Central transport corridor option)
11	Present	Present	Present	• No conservation significant flora taxa or introduced taxa
12	Present	Present	Present	• No conservation significant flora taxa or introduced taxa
13	Present	Present	Present	• No conservation significant flora taxa • Potential introduced taxon ?*Carrichtera annua* recorded
14	Present	Present	Present	• No conservation significant flora taxa • Potential introduced taxon ?*Carrichtera annua* recorded
15		Present	Present	• No conservation significant flora taxa or introduced taxa
16	Present			• Mapped over a limited range in the Project area (Western transport corridor option) • Area mapped relatively large

It is impossible to determine the regional conservation significance of vegetation types in the Project area with any certainty because of the lack of regional information regarding vegetation types. However, given that the majority of vegetation types mapped in the Project area were recorded across multiple transport corridor options, it is unlikely that the majority of vegetation types will be of regional conservation significance. At the current level of knowledge, vegetation type VT10h is the only one considered to be of potential regional conservation significance as it was dominated by *Eremophila ?attenuata* (P1), a species (if the tentative identification proves correct) which is currently only known from one other location in WA. However, as it occurs in an area that has received little survey effort, this species may prove to be more common, albeit in small localised depressions and dongas. Also, as mentioned previously, dongas were not thought to occur within the haul road alignment of each corridor option.

3.4 FLORA OF THE PROJECT AREA

A total of 175 discrete vascular flora taxa and 1 known hybrid were recorded within the survey area (Woodman 2012). These taxa represent 28 families, 82 genera and 168 species. The most well-represented families were Fabaceae (25 taxa and 1 known hybrid), Chenopodiaceae (25 taxa), Poaceae (21 taxa) and Myrtaceae (18 taxa). The majority of the vascular plant taxa recorded during the survey were collected at least once and positively identified at the WA Herbarium. A full list of taxa is presented in Appendix A.

3.4.1 Conservation Significant Flora Taxa

No threatened flora were recorded on any of the three transport corridor options. A total of two confirmed and two potential conservation significant flora taxa were recorded in the Project area: *Acacia eremophila* numerous-nerved variant (A.S. George 11924) (P3), *Dampiera ?eriantha* (P1), *Eremophila ?attenuata* (P1) and *Eucalyptus pimpiniana* (P3). These taxa are discussed in detail below.

Dampiera ?eriantha (P1)

Dampiera ?eriantha may represent *D. eriantha* (P1), a species that has been collected in the Great Victoria Desert approximately 300km west of the Project (DEC 2012a). These specimens were sterile, and therefore it could not be confirmed that the collection from the Project area, which had old floral material, was the same taxon. However, the old floral material collected does not appear to match the description of *D. eriantha* in Flora of Australia (Australian Biological Resources Study 1992), and therefore the collection may represent a new taxon. Further material, including fresh floral material, is required to confirm the taxonomic status of this entity. However it is likely to be of conservation significance regardless. *D. ?eriantha* was recorded at two locations in the Project area in 2012: one in the Central transport corridor option, where a single plant was noted, and one in the Western transport corridor option, where several plants were noted.

Eremophila ?attenuata (P1)

Eremophila ?attenuata may represent only the second collection of *E. attenuata* (P1) ever made. Although the specimen collected during this survey superficially differs from the single collection of *E. attenuata* in some minor aspects, it is considered likely that these differences could be the result natural variations in the anatomy of the species and/or due to the poor condition of the original sample. As there is only one other collection it may mean that any natural variation has not been seen before. Further investigation by an expert in the genus is required to determine whether this collection represents *E. attenuata*; or a new taxon.

E. attenuata is a very distinct species, and is a much-branched, intricate shrub to 1m with branch tips becoming spinescent (Chinnock 2007). The sole existing collection was made in 1970 from a swampy area in Myall (*Acacia papyrocarpa*) country, approximately 130km north of Rawlinna on the Nullarbor Plain (DEC 2012c). Despite several searches of what was believed to be the location of the collection between 2003 and 2010, it has not been relocated (Brown & Buirchell 2011). The collection of *E. ?attenuata* was from the Western transport corridor option, from an open depression, where it was growing with *Atriplex nummularia* subsp. *spathulata*. This collection will be submitted to the WA Herbarium.

Acacia eremophila (P3)

Acacia eremophila numerous-nerved variant (A.S. George 11924) (P3) is a dense, spreading shrub to 2m high (DEC 2012c). It is found on sandy soils on flats and plains (DEC 2012c) in the GVD over a range in WA of approximately 550km, from near Yarri Station north-east of Kalgoorlie to the northern edge of the Great Victoria Desert Nature Reserve, with disjunct records east of Norseman (DEC 2012a). There are 18 DEC records of this species, representing approximately 9 populations (DEC 2012a). This taxon was recorded at five locations in the survey area (Woodman 2012): one each in the Eastern and Central transport corridor options, and three in the Western transport corridor option. Abundances were not noted at any location, but it was noted as being relatively common at each location (Woodman 2012).

Eucalyptus pimpiniana (P3)

Eucalyptus pimpiniana (P3) is a straggly, shrubby mallee to 2m high (DEC 2012a). It is found on sandy soils on plains and dunes (DEC 2012a) in the Great Victoria Desert in WA over a range of approximately 600km, from near Queen Victoria Springs Nature Reserve east of Kalgoorlie to the centre of the Great Victoria Desert Nature Reserve (DEC 2012a). There are also numerous records of this species in the Great Victoria Desert in the eastern part of SA (The Council of Heads of Australasian Herbaria 2012). There are 26 DEC records of this species, representing approximately 12 populations (DEC 2012a).

This taxon was recorded at three locations in the survey area in 2012: one in the Eastern transport corridor option, and two in the Central transport corridor option (Woodman 2012). In excess of 250 individuals were recorded across the two locations in the Central transport corridor option, with in excess of 50 individuals recorded at the location in the Eastern transport corridor option. Additionally, it was recorded at two locations outside the Project area in the vicinity of the Central transport corridor option, with more than 50 individuals noted at both locations.

Lepidium fasciculatum (P3) & *Ptilotus blackii* (P3)

Two further conservation significant flora taxa, *Lepidium fasciculatum* (P3) and *Ptilotus blackii* (P3), have been historically collected in the area of the three transport corridor options, but were not collected during this survey. *Lepidium fasciculatum* was recorded from an area that comprises the very southern end of the Central transport corridor option near Forrest. *Lepidium fasciculatum* is an annual species, and it is likely that this species was not present at the time of survey because of lack of rainfall prior to the survey.

Ptilotus blackii was recorded in an area that comprises the northern part of the Western transport corridor option. *Ptilotus blackii* is a perennial species, but is unlikely to have been flowering at the time of survey, and therefore may not have been easily visible. Only a limited survey was conducted in the Western haul road alignment corridor, which may have also contributed to this species not being collected during this survey.

3.4.2 Other Flora of Interest

One *Eucalyptus* specimen could not be matched to material of any taxon held at the WA Herbarium, and may represent an undescribed taxon, or a taxon not previously recorded in WA. The collection of this entity appears to be most similar to *E. leptophylla*, a species also recorded in the Project area. However, the specimen has slightly different shaped buds, and has rough bark extending over the trunk and much of the branches (*E. leptophylla* almost always has entirely smooth bark). This specimen also grew in relatively unusual and specific habitat as it was recorded on a single gypsum lunette dune on the edge of a small salt pan within the Central transport corridor option, and nowhere else in the survey area (Woodman 2012). Further material, including fruits, as well as an assessment by an expert in the genus, is required to determine the taxonomic and conservation status of this entity. This specimen will be submitted to the WA Herbarium for further investigation.

Two separate *Eucalyptus* specimens from the survey have been tentatively identified as *Eucalyptus canescens* subsp. *canescens* and *E. canescens* subsp. *beadellii* (Woodman 2012). Neither taxon has been recorded in WA previously, but both have been recorded in the Great Victoria Desert in SA, just east of the border with WA. As the WA Herbarium does not hold any material of these taxa, the collections could not be matched to any existing collections, and the identification is based on information contained in Nicolle (1997). These specimens will be submitted to the WA Herbarium for investigation by an expert in the genus and determination of their conservation status within WA. The specimens will be considered as *E. canescens* subsp. *canescens* and *E. canescens* subsp. *beadellii* for the present time. Although these taxa have not been collected before in WA and their conservation status in WA is therefore unknown, the flora is relatively widely distributed in SA (The Council of Heads of Australasian Herbaria 2012). *E. canescens* subsp. *canescens* was recorded at one location in the Central transport corridor option, with *E. canescens* subsp. *beadellii* recorded at one location in the Eastern transport corridor option, and three locations in the Central transport corridor option.

Two separate collections of a grass were identified by a Poaceae expert at the WA Herbarium as *Austrostipa nullanulla*. Although this taxon is common and relatively widely distributed in SA (The Council of Heads of Australasian Herbaria 2012), it has not previously been recorded in WA. *A. nullanulla* was recorded from the Western and Central transport corridor options in the survey, growing in clayey soils on gypsum lunette/calcrete breakaways on the edge of claypans (Woodman 2012). As *Austrostipa nullanulla* has not been collected before in WA, the conservation status of this taxon in WA is unknown. These specimens will be submitted to the WA Herbarium for further investigation and determination of its conservation status within WA.

3.4.3 Introduced Taxa

Two introduced flora taxa were recorded in the survey: *?Carrichtera annua* and *Malvastrum americanum* (Woodman 2012). Although ?*Carrichtera annua* could not be positively confirmed as *C. annua* as all individuals recorded at the time of survey were senescent, it is highly likely that it represents *C. annua.* *C. annua* (Ward's Weed) is an annual herb to 0.4m high, and is a widespread weed of shrublands in the Goldfields and Nullarbor shrublands in WA (Hussey *et al.* 2007). This taxon was rated as High Priority under the Environmental Weed Strategy for WA, due to its high level of invasiveness, wide current and potential distribution and impact on native biodiversity (CALM 1999). This taxon was recorded at four locations in the survey; with two locations each in the Central and Eastern transport corridor options (Woodman 2012). It is expected that this taxon would be prevalent on the Nullarbor Plain within all three transport corridor options following significant rainfall.

Malvastrum americanum (Spiked Malvastrum) is an erect, perennial herb or shrub to 1.5m high, that is widespread throughout the northern half of WA, particularly the Pilbara and Kimberley regions (Hussey *et al.* 2007). It is usually found near creeks, rivers, and on floodplains, particularly in disturbed areas such as areas frequented by cattle. It was noted for its high level of invasiveness and wide current distribution, and was rated as Moderate under the Environmental Weed Strategy for WA (CALM 1999). It was recorded at a single location within the Eastern transport corridor option.

3.5 COMPARISON OF OPTIONS IN RELATION TO VEGETATION AND FLORA

A comparison of the flora and vegetation aspects of the three transport corridor options is provided in Table 3.4.

Table 3.4 Comparison of the Vegetation and Flora of the Three Transportation Corridors

Criteria		Western Corridor	Central Corridor	Eastern Corridor
Species Composition Species not previously recorded in WA	*Austrostipa nullanulla*	Not recorded but possibly present VT6 (in which species occurs) present	Present	Not recorded VT6 (in which species occurs) does not occur in this corridor option
	Eucalyptus canescens subsp. *beadellii*	Not recorded but possibly present VT 1 & 7 (in which species occurs) present	Present	Present
	Eucalyptus canescens subsp. *canescens*	Not recorded but possibly present VT7 (in which species occurs) present	Present	Not recorded but possibly present VT7 (in which species occurs) present
Species Composition Listed conservation significant taxa	*Dampiera ?eriantha* (P1)	Present	Present	Not recorded but possibly present Recorded to west of corridor and VT1 (in which species occurs) present
	Eremophila ?attenuata (P1)	Present	Not recorded VT10h (in which species occurs) does not occur in this corridor option	Not recorded VT10h (in which species occurs) does not occur in this corridor option
	Acacia eremophila numerous-nerved variant (A.S. George 11924) (P3)	Present	Present	Present
	Eucalyptus pimpiniana (P3)	Not recorded but possibly present VT7 (in which species occurs) present	Present	Present

Criteria		Western Corridor	Central Corridor	Eastern Corridor
Species Composition Potentially Undescribed Taxa	*Eucalyptus* sp.	Not recorded but possibly present VT6 (in which species occurs) present	Present	Not recorded VT6 (in which species occurs) does not occur in this corridor option
Rarity of Vegetation Types	VT10h is potentially of regional conservation	Present. Large area associated with lake chain not surveyed	No VTs likely to be of regional conservation significance	No VTs likely to be of regional conservation significance Large area associated with lake chain not surveyed
Conservation Risks **e.g. Weeds**	*Carrichtera annua?*	Possibly present	Present	Present
	Malvastrum americanum	Possibly present	Not present	Present
Erosion Risk	Large areas of dune fields prone to erosion	Present	Present	Present
Surface Drainage Risk	Significant lake chain which may represent a significant surface drainage risk	Present	Not present	Present
	Small claypans and dongas which may represent a low surface drainage risk	Present	Present	Present

4. FAUNA

4.1 SURVEY METHODOLOGY

4.1.1 Desktop Review

A desktop review carried out by BCE (2011) was used as the basis for planning the "Level 1" field survey so it is relevant to summarise the information sources used during the review. Information on the fauna assemblage of the Project area was drawn from a wide range of sources. These included state and federal government databases and results of regional studies (Table 4.1).

Table 4.1 Types of Records Held on Database, Areas Searched and Their Source Location

Database	Type of records held on database	Area searched
NatureMap (DEC 2011)	Records in the WAM and DEC databases. Includes historical data and records on Threatened and Priority species in WA.	The four IBRA regions covered by the three transport corridor options: GVD2, GVD3, NUL1, NUL2
Birds Australia Atlas Database	Records of bird observations in Australia, 1998-2011.	A block covering 12 one degree squares: NW corner: 28°S, 126°E, SE corner: 31°S, 130°E
EPBC Protected Matters Search Tool	Records on matters of national environmental significance protected under the EPBC Act, including threatened species and conservation estate.	A block with the NW corner @ 28.5°S, 126.2°E and the SE corner @ 31.2°S, 129.4°E.

Barton and Cowan (2001a, 2001b and 2001c) and Barton et al. (2002) provided information on significant species and ecosystems in each bioregion. Regional studies included the 1984 Nullarbor survey (McKenzie and Robinson, 1987) and work by Brooker and others (Brooker et. al. 1979; Brooker and Wombey, 1978; Brooker 1977).

Information from the above sources was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns were:

- Frogs: Tyler & Doughty (2009);
- Reptiles: Storr et al. (1983); Storr et al. (1990); Storr et al. (1999); Storr et al. (2002) and Wilson & Swan (2008);
- Birds: Blakers et al. (1984); Johnstone and Storr (1998, 2004) and Barrett et al. (2003); and
- Mammals: Menkhorst & Knight (2001); Strahan (2004); Churchill (2008); and Van Dyck and Strahan (2008).

4.1.2 Reconnaissance Survey

The reconnaissance survey took place from the 22–26 March 2012. Due to the lack of vehicle access to the three transport corridor options, helicopters were used to fly-over the three routes and access areas of interest for further investigation. Over the five days the entire length of all three routes were flown over and different VSAs investigated along each route. This generally involved landing and conducting foot traverses for 0.5-1.5 hrs. Activities undertaken during the flight and/or foot traverses included:

- Searching for evidence of significant fauna either in-flight (e.g. Malleefowl) or during foot traverses (e.g. Giant Desert Skink, Mulgara);
- Recording vegetation and soil types throughout the alignment;
- Opportunistic observations on fauna (particularly birds); and
- Deploying motion-sensitive cameras set at five locations.

In addition to a fauna assessment of the transport corridor options, a small-scale Marsupial Mole survey was undertaken within the area of the Cyclone Deposit.

4.1.3 Survey Limitations

The limitations of the Level 1 fauna survey are presented in Table 4.2 (BCE 2012).

Table 4.2 Field Survey Limitations

Aspect	BCE (2012) survey
Level of survey.	Level 1 (reconnaissance survey). This survey was designed to assess the three transport corridor options, with more detailed work to be completed in Spring 2012.
Competency/experience of the consultant(s) carrying out the survey.	The on-ground consultants have had extensive experience in conducting fauna assessments.
Scope. (What faunal groups were sampled and were some sampling methods not able to be employed because of constraints?)	Vertebrate fauna was identified to species (or genus) where possible, but the aim was to identify available habitats.
Proportion of fauna identified, recorded and/or collected.	All vertebrate fauna observed were identified to species level where possible.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	Sources include previous reports on the fauna of the region and databases (Naturemap, Birds Australia Atlas and EPBC Protected Matters Database).
The proportion of the task achieved and further work which might be needed.	Level 1 Survey complete. Further work may be required once the final transport corridor option is chosen.
Timing/weather/season/cycle.	The area had received above average rainfall in 2011, but there had been little in 2012 prior to the March survey. During the survey period conditions were generally cool to warm, with several overcast days and occasional very light showers; these conditions were considered suitable for the survey.
Disturbances (e.g. fire, flood, accidental human intervention etc.), which affected results of survey.	No disturbances affected the survey.
Intensity. (In retrospect, was the intensity adequate?)	Survey intensity was adequate for the purpose of assessing habitat suitability and identifying areas likely to support conservation significant fauna.

Aspect	BCE (2012) survey
Completeness (e.g. was relevant area fully surveyed).	Although the entire length of all three transport corridor options was flown over, several areas of interest i.e. salt lakes, along the Eastern and Western corridor options were not accessible for cultural reasons.
Resources (e.g. degree of expertise available in animal identification to taxon level).	All vertebrate species identified to species level where possible. All staff were competent to conduct animal identification to taxon level.
Remoteness and/or access problems.	Helicopters were used to overcome access difficulties. Some areas were inaccessible for cultural reasons (in respect to the Pila Nguru people), although the likely fauna values of these areas are discussed.
Availability of contextual (e.g. biogeographic) information on the region.	Some regional information was available and was consulted.

4.2 FAUNA AND HABITAT OF THE THREE TRANSPORT CORRIDOR OPTIONS

4.2.1 Fauna Assemblage

The desktop study identified 267 vertebrate fauna species as potentially occurring in the project area (Table 4.3). The presence of 72 of the expected vertebrate species was confirmed during the field survey (BCE 2012). The vertebrate fauna assemblage includes at least 30 species of conservation significance, which are discussed further in Section 4.3.

Table 4.3 Composition of Vertebrate Fauna Assemblage Recorded or Expected to Occur Along the Transport Corridor Options

Taxon	Number of native (and introduced) species expected.	*Number of native (and introduced) species recorded.*	Significant fauna expected *(recorded)*		
			CS1	CS2	CS3
Frogs	5 (0)	*0 (0)*	0	0	0
Reptiles	91 (1)	*8 (1)*	3	1	2*(1)*
Birds	140 (0)	*53 (0)*	12*(1)*	6*(3)*	0
Mammals	31 (5)	*5 (5)*	3*(1)*	2	1*(1)*
Total	**267 (6)**	***66 (6)***	**18***(2)*	**9***(3)*	**3***(2)*

Conservation Significance (CS) 1: Species listed under State or Commonwealth Acts.
Conservation Significance (CS) 2: Species listed as Priority by the DEC but not listed under State or Commonwealth Acts.
Conservation Significance (CS) 3: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

Key features of the vertebrate fauna assemblage are:

- Uniqueness: The assemblage varies considerably along the length of the three transport corridor options, with higher diversity in the north compared to that recorded in the central Nullarbor, at the southern end of the routes. Although quite depauperate, the Nullarbor does support a unique fauna assemblage, due to its unique VSAs. Because of the size and shape of the project area, many of the species included in the predicted assemblage are only expected along parts of the three corridor options.

- Completeness: The assemblage almost entirely lacks a major component i.e. medium sized ("critical weight range") mammals. These have declined across much of southern Australia due to factors such as predation by feral species (particularly the Red Fox and feral Cat) and altered fire regimes (Burbidge and McKenzie 1989). Despite this, the assemblage is otherwise substantially complete because the transport corridor options cover largely undisturbed environments.
- Richness: the richness of the assemblage is expected to vary considerably along the length of the three route options, with higher richness in the north and lower richness in the south. The fauna assemblage at specific locations is likely to be a subset of the project area's assemblage, determined by factors such as biogeography, vegetation, soils and fire history.

These attributes apply equally to each of the three transport corridor options. As a fauna value, the most important features of the assemblage are that it is substantially complete and contains several threatened species.

4.2.2 Species of Conservation Significance

Details on species of conservation significance are presented in Table 4.4 the list includes five reptile species and 18 bird species, migratory waterbirds and six mammal species. Some of these species are considered unlikely to be present or to occur only as vagrants, but some are expected to be resident or regularly present, with some of these recorded during field investigations. Further information on these is presented below. No known conservation significant invertebrate species are expected to occur in the project area, but there is potential for short range endemic invertebrate species to occur.

Significant species expected to occur along the each of the transport corridor options, in particular, include:

- Southern Marsupial Mole (or Itjari-itjari).
- Sandhill Dunnart.
- Great Desert Skink.
- Nullarbor Quail-thrush.
- Nullarbor Bearded Dragon.
- SRE invertebrates (if karst landforms are present in the lower Nullarbor Plateau).

Table 4.4 Conservation Status of Significant Fauna Species Expected to Occur in the Study (Based on Desktop Review and Field Investigation)

COMMON NAME	SPECIES NAME	DESCRIPTION	CONSERVATION STATUS						Status in Project area
			CS1				CS2	CS3	
			EPBC	WA Act	JAMBA	CAMBA			
REPTILES									
Woma	*Aspidites ramsayi*	Possibly present throughout the northern sections of the transport corridor options where the VSAs are more suitable i.e. the sandplains of the Great Victoria Desert and the Carlisle Plain.		S4					Probable Resident
South-western Carpet Python	*Morelia spilota imbricata*	Probably present throughout the northern sections of the transport corridor options where the VSAs are more suitable.		S4			P4		Probable Resident
Great Desert Skink	*Liopholis* (*Egernia*) *kintorei*	Possibly present throughout the northern sections of the transport corridor options where the VSAs are more suitable i.e. dunefields of the Great Victoria Desert.	VT	S1 (VT)					Probable Resident
A blind snake	*Ramphotyphlops margaretae*	Possibly occurs in the northern section of the project area; known from areas to the west and north-west of the GVD Nature Reserve.					P2		Possible Resident
A skink	*Hemiergis millewae*	Several small isolated populations west of the project area and with the main population to the east of the project area. Considering the limited amount of work conducted in the region, it is possible that the species does occur with the project area.						+	Possible Resident

COMMON NAME	SPECIES NAME	DESCRIPTION	CONSERVATION STATUS						Status in Project area
			CS1				CS2	CS3	
			EPBC	WA Act	JAMBA	CAMBA			
Nullarbor Bearded Dragon	*Pogona nullarbor*	Endemic to the Nullarbor Plain.						+	Resident (Endemic to the Nullarbor)
BIRDS									
Malleefowl	*Leipoa ocellata*	Known to occur in the Great Victoria Desert. Possibly present in sandplain areas in the northern sections of the study area but, if present, likely to be in very low densities.	VT/Mig	S1 (VT)					Possible Resident (at very low densities)
Eastern Cattle Egret	*Ardea ibis*	Listed under the CAMBA and JAMBA agreements as a migratory species. May occur after cyclonic rainfall.	Mig	S2 (Mig)					Irregular Visitor
Peregrine Falcon	*Falco peregrinus*	Probably present throughout the northern sections of the transport corridor options where the VSAs are more suitable. Likely to breed only where there are large trees that provide hollows, or old nests of other species (e.g. Australian Raven).		S4					Probable Resident
Common Greenshank, Wood Sandpiper, Common Sandpiper, Red-necked Stint, Curlew Sandpiper	*Tringa nebularia* *Tringa glareola* *Actitis hypoleucos* *Calidris ruficollis* *Calidris ferruginea*	All migratory waterbirds that may utilise salt-lakes and depressions within the study area during wet years.	Mig	S2 (Mig)					Occasional visitors to the area (following suitable weather conditions)
Major Mitchell's Cockatoo	*Cacatua leadbeateri*	Probably a scarce resident of the Great Victoria Desert and northern edges of the Nullarbor.		S4					Possible resident

COMMON NAME	SPECIES NAME	DESCRIPTION	CONSERVATION STATUS						Status in Project area
			CS1				CS2	CS3	
			EPBC	WA Act	JAMBA	CAMBA			
Naretha Blue-bonnet	*Northiella haematogaster narethae*	Resident of the Myall woodland bordering the Nullarbor Plain. Moderately common in this vegetation type during the March 2012 survey.		S4					Resident (common in the Myall woodlands bordering the true Nullarbor Plain)
Night Parrot	*Pezoporus occidentalis*	Possibly visits the area during suitable conditions, utilising salt-lake margins and surrounds.	EN	S1 (CR)					Possible irregular visitor
Rainbow Bee-eater	*Merops ornatus*	Summer breeding visitor throughout project area. May construct nesting burrows on the edge of tracks or in sand-dunes.	Mig	S2 (Mig)					Regular visitor
Australian Bustard	*Ardeotis australis*	Probably a resident of the area, with numbers expected to increase during better seasons. Likely to occur over the entire project area, but more commonly in the north. One recorded from the Nullarbor during this survey and several seen during the September 2011 trip.					P4		Resident (seen throughout the project area)
Princess Parrot	*Polytelis alexandrae*	Known to occur at least periodically in the region; likely to utilise dunefields vegetated with Spinifex and shrublands, such as those present in the northern end of the project area.					P4		Irregular visitor
Striated Grasswren	*Amytornis striatus striatus*	Possibly occurs in the northern sections of the study area, in those VSAs with a high cover of Spinifex. Known to occur north of the project area, as a resident in the GVD.					P4		Possible resident

COMMON NAME	SPECIES NAME	DESCRIPTION	CONSERVATION STATUS						Status in Project area
			CS1				CS2	CS3	
			EPBC	WA Act	JAMBA	CAMBA			
Western (Thick-billed) Grasswren	*Amytornis textilis*	Possibly occurs in the northern sections of the study area, in those VSAs with a high cover of Spinifex.					P4		Possible resident
Nullarbor Quail-thrush	*Cinclosoma alisteri*	Endemic to the Nullarbor Plain; one recorded from a donga on the plain during the March 2012 survey.					P4		Resident (endemic to the Nullarbor)
Crested Bellbird (southern)	*Oreoica gutturalis gutturalis*	Resident of the GVD and Myall woodland bordering the northern edge of the Nullarbor Plain. The population within this region is not exposed to the same threats as the Wheatbelt population; it is the Wheatbelt population's decline, largely in response to land-clearing, on which the taxa's status is based.					P4		Resident (recorded in northern sections of the alignment)
MAMMALS									
Crest-tailed Mulgara	*Dasycercus cristicauda*	Status unknown within the study area. There is taxanomic uncertainty between the Crest-tailed and Brush-tailed Mulgara's, with records of both from nearby to the project area. If one or both species are present, it is likely to be within the north of the project area, where areas of mature Spinifex were recorded.	VT	S1 (VT)					Possible Resident
Sandhill Dunnart	*Sminthopsis psammophila*	Possibly occurs within the dune fields at the northern end of the project area. Known to utilise areas of mature Spinifex grassland.	EN	S1 (EN)					Probable Resident

COMMON NAME	SPECIES NAME	DESCRIPTION	CONSERVATION STATUS						Status in Project area
			CS1				CS2	CS3	
			EPBC	WA Act	JAMBA	CAMBA			
Marsupial Mole	*Notoryctes typhlops*	Resident within dune fields at the northern end of the project area. Evidence, in the form of "moleholes", was recorded from within the Project area during this survey.	EN	S1 (EN)					Resident (evidence found within the Project area)
Brush-tailed Mulgara	*Dasycercus blythi*	Status unknown within the study area. There is taxonomic uncertainty between the Crest-tailed and Brush-tailed Mulgara, with records of both from nearby to the project area. If one or both species are present, it is likely to be within the north of the project area, where areas of mature Spinifex were recorded.					P4		Possible Resident
Central Long-eared Bat	*Nyctophilus major tor*	Probably resident within the northern sections of the project area, utilising larger trees for roosting sites.					P4		Probable Resident
Southern Hairy-nosed Wombat	*Lasiorhinus latifrons*	The south-eastern corner of the project area represents the western edge of the species distribution, although there are anecdotal records of the species near Loongana (the southern end of the Western route)						+	Resident (known from areas south of the study area)
INVERTEBRATES									
SRE invertebrates								+	Some rare/unusual VSAs have features suitable for SRE species

Conservation significance categories are definied in Bamford 2012 (Appendix B).

4.2.3 Vegetation and Substrate Associations

The three transport corridor options for the Project traverse a range of land systems, soils, vegetation and even climates. Despite this, much of the route passes through VSAs that are extensive and broadly similar, with only a few locations with distinctive VSAs.

Six VSAs that provide habitat for fauna were identified during the site reconnaissance and are described in Table 4.5. Of these, Mallee Eucalypt woodlands on red sand dunes and Sheoak woodlands on calcareous soils are widespread across the northern parts of the project area, covering much of the GVD subregions. Gypsum salt lakes are scattered throughout the GVD, with several larger lake systems in the north-west and north-east. An extensive band of Myall/Mulga woodland runs through the middle of the study area, forming a northern edge to the Nullarbor Plain. The Nullarbor Plain is dominated by a mosaic of low shrublands and grasslands, with dongas scattered throughout.

The gypsum salt lakes of the GVD and the dongas of the Nullarbor Plain are the most restricted VSAs. Although not recorded during the reconnaissance survey, there is potential for karst features in the southern end of the study area, with numerous caves known from the Nullarbor bioregion. These caves are recognised for their unique assemblages of troglodytes and stygofauna (Barton et al. 2002).

The fauna assemblage can be expected to vary between VSAs, but as a broad overview it is expected to decrease in richness across a north-south gradient, with higher species diversity expected in the GVD and lower species diversity expected on the Nullarbor Plain.

- Mallee Eucalypt woodlands on sand dunes are expected to have a rich overall species with a variety of reptiles (especially fossorial species), woodland birds and numerous mammals, including conservation significant species.
- Sheoak woodlands and the Myall/Mulga woodlands are likely to support a rich bird fauna, but a limited number of reptile and mammal species.
- Although gypsum salt lakes are expected to support a limited number of fauna species, the assemblage is likely to be unique, including several reptiles and bird species that preferentially utilise this VSA.
- The shrublands and grasslands of the Nullarbor Plain are known to support a poor diversity of fauna (McKenzie and Robinson, 1987), possibly exacerbated by the overabundance of Feral Rabbits and their direct impact on vegetation/soil degradation.
- The dongas of the Nullarbor Plain are expected to support higher densities of fauna than the surrounding plain, but again these areas have been significantly degraded by overabundant Feral Rabbits. Some dongas may support waterbirds during periods of inundation.

- There is potential for karst formations in the Nullarbor bioregion, which would need to be avoided by the transport corridor.

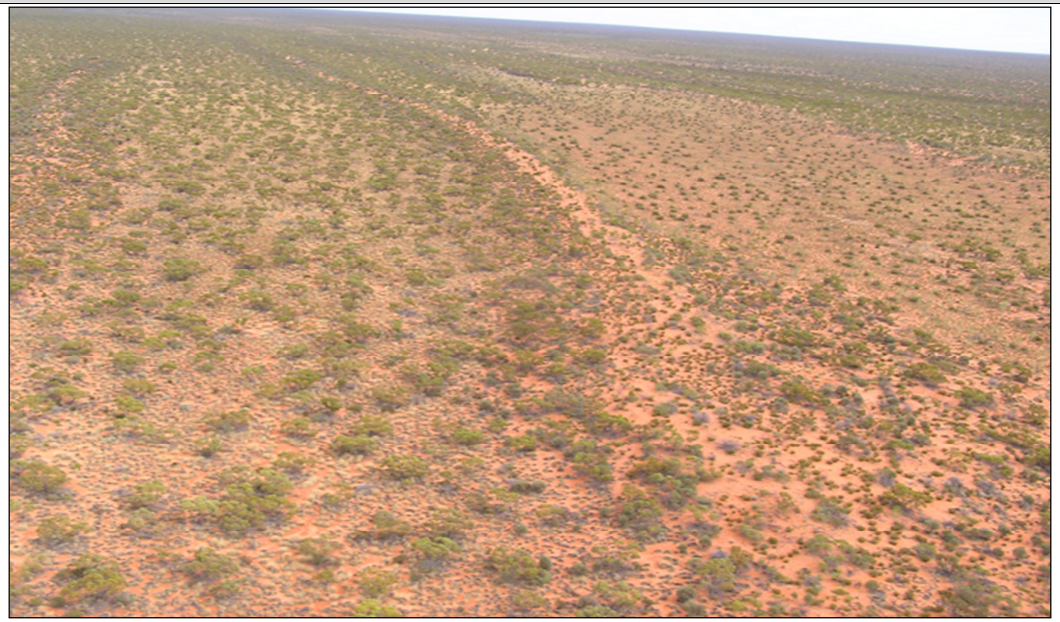
The expected fauna assemblages correlated with the limited data collected during the March 2012 survey. It should be noted that changing climatic conditions may dramatically alter the fauna assemblage e.g. flooding from cyclonic rains may introduce a suite of waterbird/migratory shorebird species to VSAs where they are generally not recorded.

4.3 COMPARISON OF OPTIONS IN RELATION TO FAUNA

Table 4.6 provides an overview of the fauna, VSAs and land-use conflict factors applicable to each transport corridor option and provides a mechanism for comparing the preferred transport corridor option from a fauna conservation perspective.

Table 4.5 Vegetation Substrate Associations (VSAs) and Associated Conservation Significant Fauna

Vegetation Substrate Association (VSA)	Appearance	Significant fauna expected
Mallee Eucalypt woodland over mixed shrubland and spinifex hummock grassland on red sand dunes This VSA was very extensive across the northern parts of the project area, covering much of the GVD and some areas of the northern Nullarbor Plain. It is expected that a number of conservation significant mammal species would preferentially utilise the dunes as corridors to move through the landscape. Traditional landscape burning practices undertaken by the local Pila Nguru people have ensured a range of fire ages are well represented across the extent of this VSA. This would aid in maintaining an intact assemblage of fauna species across the landscape.	 Plate 30 Mallee Eucalypt Woodland over Mixed Shrubland and Spinifex Hummock Grassland on Red Sand Dunes. Photograph Taken at 52 J 438730 6723974	This VSA is expected to support a range of conservation significant species including Woma, Malleefowl, Princess Parrot, Sandhill Dunnart, Marsupial Mole, Brush-tailed/Crest-tailed Mulgara.

Vegetation Substrate Association (VSA)	Appearance	Significant fauna expected
	 Plate 31 Mallee Eucalypt Woodland Over Mixed Shrubland and Spinifex Hummock Grassland on Red Sand Dunes. Photograph Taken Between 52 J 452722 6791011 and 52 J 434644 6748421 Note the three fire ages visible across the landscape i.e. oldest in the top right corner, younger vegetation on the left half of the picture and the youngest in the middle on the right side.	

Vegetation Substrate Association (VSA)	Appearance	Significant fauna expected
Sheoak (*Casuarina pauper*) woodland with mixed understorey on shallow calcareous loams This VSA is widespread across the northern section of the study area. Some areas support low breakaways, but the areas geology precludes the formation of deeper caves within these breakaways.	 Plate 32 Sheoak (*Casuarina pauper*) Woodland with Mixed Understorey on Shallow Calcareous Loams. Photograph Taken at 52 J 455115 6795258	Likely to support a rich diversity of species, but not expected to be a preferred habitat for conservation significant fauna species.

Vegetation Substrate Association (VSA)	Appearance	Significant fauna expected
	 Plate 33 Sheoak *(Casuarina pauper)* Woodland with Mixed Understorey on Shallow Calcareous Loams. Photograph Taken at 52 J 438730 6723974	

Vegetation Substrate Association (VSA)	Appearance	Significant fauna expected
Gypsum salt lakes with low samphire There are numerous small isolated lakes spread across the study area along with several larger lake systems e.g. Carlisle, Shell and Forrest Lakes. Although these larger lake systems were within the impact area of two of the transport corridor options, they are culturally significant for the Pila Nguru people and consequently weren't visited during the March 2012 survey. This VSA often occurs in association with the Sheoak Woodland VSA.	 Plate 34 Gypsum Salt Lakes with Low Samphire. Photograph Taken at 52 J 455115 6795258	This VSA may support several conservation significant fauna including Night Parrot and Slender-billed Thornbill. This VSA is also significant due to its restricted occurrence.

Vegetation Substrate Association (VSA)	Appearance	Significant fauna expected
Myall/Mulga woodland with mixed understorey on shallow calcareous soils Widespread through the middle of the study area, as a band between the GVD and Nullarbor Plain. Myall (*Acacia papyrocarpa)* appears to be the more dominant towards the Nullarbor Plain, whilst Mulga (*Acacia aneura*) is more dominant towards the GVD. The understorey is dominated by various chenopod and grass species.	 Plate 35 Myall Woodland with Mixed Understorey on Shallow Calcareous Soils. Photograph Taken at 52 J 425495 6642492	This VSA appears to be preferred by Naretha Blue-bonnets and may provide habitat for several other conservation significant fauna species e.g. Nullarbor Quail-thrush, Nullarbor Bearded Dragon.

Vegetation Substrate Association (VSA)	Appearance	Significant fauna expected
Nullarbor Plain – a mosaic of low shrublands and grasslands on thin calcareous soils underlain by limestone An extensive VSA, covering much of the NUL2 sub-bioregion and parts of the NUL1 sub-bioregion. This VSA is notable for its complete lack of any trees over such an extensive area.	 Plate 36 Nullarbor Plain – a Mosaic of Low Shrublands and Grasslands. Photograph on Left Taken at 52 J 285417 6697217, Middle at 52 J 311004 6576992 and Right at 52 J 285938 6684056	This VSA supports two endemic, conservation significant fauna species i.e. Nullarbor Quail-thrush and Nullarbor Bearded Dragon.

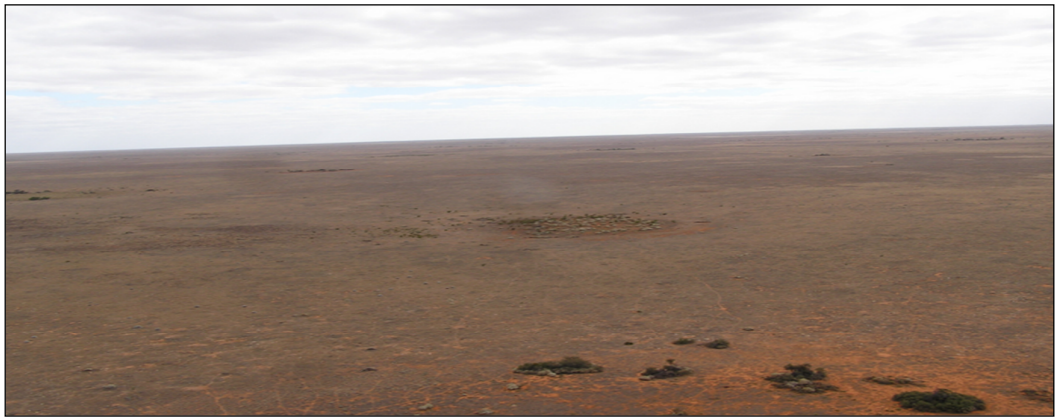
Vegetation Substrate Association (VSA)	Appearance	Significant fauna expected
Dongas These depressions, found in large numbers in the northern parts of the Nullarbor Plain, are notable for the tall shrublands/low open woodlands they support in comparison to the surrounding VSA of the Nullarbor Plain low shrubland/grassland mosaic. The Dongas vary in size with some between 10-150 metres in diameter recorded during the March 2012 survey. Although they collectively support a range of plant species, each Donga is usually dominated by one or perhaps two plant species.	 Plate 37 Donga in Centre of Photograph With Numerous Others in the Background. Photograph Taken Between 52 J 318850 6767028 and 52 J 500404 6644523	These areas may support higher densities of the Nullarbor endemic conservation significant fauna (e.g. Nullarbor Quail-thrush and Nullarbor Bearded Dragon) than the surrounding Nullarbor Plain and some are known to support a range of waterbird species when inundated (Brooker et. al. 1979).

Table 4.6 Comparative Assessment of the Fauna Issues Associated with Each of the Three Transport Corridor Options

Criterion	Western Option (405km)	Central Option (252km)	Eastern Option (229km)
Fauna impacts	This option skirts the northern and western boundaries of the GVDNR and is therefore 60-75% longer than the other routes and consequently has a much larger footprint. Initial and ongoing impacts from this transport corridor option will be larger than the Eastern and Central options due to the increased length. The two lake systems it crosses are also considered conservation significant (as well as culturally significant).	This route is of medium length relative to the other corridor options, 37% shorter than the Western option and 10% longer than the Eastern option. Therefore direct impacts associated with the footprint of the transport corridor are expected to intermediate of the other two options.	The route is the shortest option, being 9% shorter than the Central option and 43% shorter than the Western option. As such, the direct impacts from creating the corridor will be less than the other options. The current alignment passes in close proximity the Forrest Lake system which is conservation significant due to the unique fauna assemblage it may support. Re-alignment of the corridor would be required in order to avoid impacts on the Forrest Lake system and the fauna it supports.
Impact to VSAs	The gypsum salt lake VSA is extensively represented within this corridor option i.e. Shell and Carlisle Lake systems. All other VSAs have similar representation relative to other corridor options.	The gypsum salt lake VSA is poorly represented within this corridor option i.e. several small un-named lakes. All other VSAs have similar representation relative to other corridor options.	The gypsum salt lake VSA is well represented within this corridor option i.e. Forrest Lake system. All other VSAs have similar representation relative to other corridor options.
Land-use conflicts	Whilst this route avoids the GVDNR, it does cross the Shell and Carlisle Lake systems, both considered culturally significant by the Pila Nguru people.	The route crosses through the middle of the GVDNR, thereby impacting the area's conservation value.	The route follows the WA/SA border, with some potential impacts to the GVDNR (WA) and the Mamungari Conservation Park (SA) whose boundaries meet each other along the WA/SA border for part of this option's length. Additionally, this route also impacts Forrest lakes, an area considered culturally significant by the Pila Nguru people.

5. OTHER RELEVANT FACTORS

5.1 CULTURALLY SIGNIFICANT AREAS

The field surveys of flora and fauna were undertaken in collaboration with the Pila Nguru, Native Title Holders of the Pila Nguru lands Determination Area (WC95/51). Planning of the field surveys involved extensive consultation and collaboration with the Pila Nguru and their legal representatives (Central Deserts). As a result of these consultations and field collaboration, it became apparent that both the Western option and the Eastern option could potentially impact on areas of great cultural significance to the Pila Nguru. This was particularly pertinent for the Western option. The Pila Nguru expressed considerable concern about this option as the routing passes through an area where there are a number of significant cultural sites. As such, the field surveys along the Western corridor were limited to the areas away from these sites. Similar restrictions were also imposed on area of the Eastern corridor. Most notable of these limitations was that neither of the field teams was able to survey the salt lake systems present in close proximity to these two options (Figure 5.1).

5.2 CONSERVATION ESTATE

The Western option traverses to the west of the GVDNR and avoids impacts to conservation estate. The Central option traverses through the GVDNR and therefore involves some impact on this nature reserve. The GVDNR is listed on the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Register of the National Estate and is classified as an International Union for the Conservation of Nature (IUCN) Category 1a nature reserve (Protected Planet 2011) which is a "Strict Nature Reserve". IUCN 1a areas are strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values.

The Eastern option follows the WA / SA border, with some potential impacts to the GVDNR (WA) and the Mamungari Conservation Park (SA), whose boundaries meet each other along the WA / SA border for part of this option's length. The Mamungari Conservation Park (MCP) has been classified as a UNESCO World Biosphere Reserve. The MCP management plan also indicates an open camping area in the south western corner of the park (southern access zone open camping), which could potentially lead to health and safety concerns through illicit use of the ore transport corridor by the public wishing to access the southern open camping area. Therefore, if the Eastern corridor is considered as the preferred option, LSPL will need to review and discuss the findings of the level 1 surveys and any subsequent (level 2) surveys within the MCP to ensure that the approach and methodology for these works follows SA DEC and EPA guidelines as well as those of WA.

5.3 INFRASTRUCTURE

In addition to the environmental and cultural considerations, it is also important to consider the infrastructure and rail siding which will be required at the road/rail intersection. Neither Loogana (Western option) nor Deakin (Eastern option) have a rail siding or support infrastructure, which will be needed for the transport of product to port. As such, LSPL would seek permission from the WA EPA for the construction of new sidings at either of these sites as well as from P&O Trans Australia, current operators for the rail line. The station at Forrest provides the advantage of an existing siding as well as accommodation and support infrastructure in the form of the Forrest airport and lodgings.

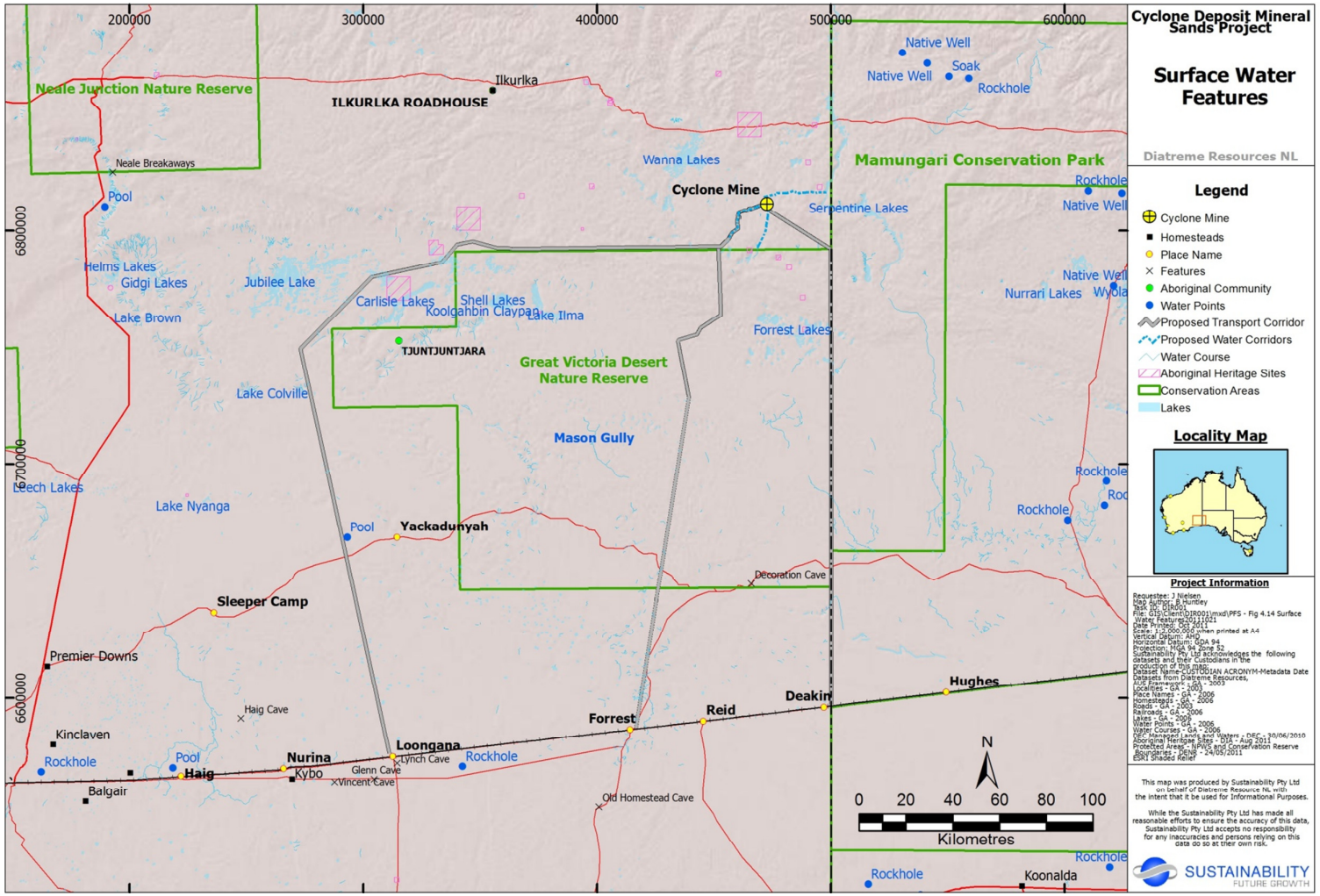


Figure 5.1 Surface Water Features of the Project Area and Surrounds

6. LEGISLATIVE FRAMEWORK

This section provides a comparative assessment of the key environmental legislation requirements relevant to each of the transport corridor options. A detailed account of the legislative framework governing the development of the Project is provided in Section 8 of the PFS report (Sustainability 2012). An overview of the key environmental legislation is provided in Table 6.1, and Table 6.2 summarises how each of these legislative instruments relate to each of the three transport corridor options. Relevant heritage and native title legislation is also discussed.

In summary, the main differences between the three transport corridor options in regards to legislation are:

- The Western (Loongana) option does not cross DEC managed land and therefore the *Conservation and Land Management Act 1984* is not relevant.
- The Central (Forrest) and Eastern (Deakin) transport corridor options would require a Miscellanesous Licence over areas within DEC managed lands. This approval would require consent from both houses of State parliament.
- The Western (Loongana) and the Eastern (Deakin) tramsport options would require approval from the WA EPA for the construction of new sidings at either of these sites, as well as from P&O Trans Australia, current operators for the rail line.
- A Native Vegetation Clearing Permit application for the Deakin option would require the least area of disturbance due to being the shortest route.

Table 6.1 Environmental approvals legislation and regulations applicable to the Project

Legislation / Regulation	Description
Commonwealth Legislation	
Environment Protection and Biodiversity Conservation Act 1999	Protects matters of national environmental significance.
Native Title Act 1993	Provides for the recognition and protection of native title. Native title is the recognition by Australian law that some Indigenous people have rights and interests to their land that come from their traditional laws and customs.
Western Australian Legislation and Regulations	
Aboriginal Heritage Act 1972	Protects places, sites or objects that are important or significant to Aboriginal Culture. Approval under Section 18 is required to impact on an Aboriginal place, site or object.
Environmental Protection Act 1986	The principal statute governing environmental compliance, including causing pollution, causing unreasonable emissions, discharge of waste in circumstances likely to cause pollution, causing serious or material environmental harm, conduct affecting the environment without authorisation. Part IV regulates assessment of development proposals referred to the EPA. Part V regulates the construction and licensing of prescribed premises

Legislation / Regulation	Description
	and activities and the approvals for emissions of wastes. Mineral sand mining and processing is a prescribed activity.
Environmental Protection (Clearing of Native Vegetation) Regulations 2004 *(Environmental Protection Act 1986)*	Regulates the clearing of native vegetation.
Environmental Protection (Controlled Waste) Regulations 2004 *(Environmental Protection Act 1986)*	Regulates the transport and disposal of controlled wastes as defined in Schedule 1 of the Regulations.
Heritage of Western Australia Act 1990	Protects places that are important due to their cultural heritage significance. Approval is required to impact on a listed heritage place (non-indigenous).
Mining Act 1978	The principal statute governing mining in Western Australia covering tenements, prospecting licences, mining leases, general provisions relating to mining and mining tenements.
Radiation Safety Act 1975	Regulates the keeping and use of radioactive substances, including the mining and milling of radioactive ores and the storage, transportation and disposal of radioactive substances
Rights in Water and Irrigation Act 1914	Manages water resource allocation, use and protection. A license under Section 26D is required to construct or alter wells. A license under Section 5C licence is required to take water.
Wildlife Conservation Act 1950	Protection of flora and fauna, in particular threatened flora, fauna and ecological communities.

Table 6.2 Comparative assessment of key environmental legislative requirements associated with each option

Legislation / Regulation	Western Option	Central Option	Eastern Option
Commonwealth Legislation			
Environment Protection and Biodiversity Conservation Act 1999	Relevant: Nationally threatened species and ecological communities is one of the eight matters of National Environmental Significance listed under the Act. The potential presence of threatened fauna or flora and habitat within the transport corridor could trigger referral of the project for assessment under the *EPBC 1999*.	Relevant: Nationally threatened species and ecological communities is one of the eight matters of National Environmental Significance listed under the Act. The potential presence of threatened fauna or flora and habitat within the transport corridor could trigger referral of the project for assessment under the *EPBC 1999*.	Relevant: Nationally threatened species and ecological communities is one of the eight matters of National Environmental Significance listed under the Act. The potential presence of threatened fauna or flora and habitat within the transport corridor could trigger referral of the project for assessment under the *EPBC 1999*.
Native Title Act 1993	Relevant: In the event that the Pila Nguru Native Title determination provides for exclusive possession an Indigenous Land Use Agreement	Relevant: In the event that the Pila Nguru Native Title determination provides for exclusive possession an Indigenous Land Use Agreement	Relevant: In the event that the Pila Nguru Native Title determination provides for exclusive possession an Indigenous Land Use Agreement

Legislation / Regulation	Western Option	Central Option	Eastern Option
	(ILUA) would need to be negotiated before development of the project could proceed. Furthermore, the negotiation of an ILUA with the Pilki People (Native Title Application Area WC02/3) is recommended.	(ILUA) would need to be negotiated before development of the project could proceed.	(ILUA) would need to be negotiated before development of the project could proceed.
Western Australian Legislation and Regulations			
Aboriginal Heritage Act 1972	Relevant if artefacts found when construction of transport route occurs. Approval under Section 18 is required to impact on an Aboriginal place, site or object.	Relevant if artefacts found when construction of transport route occurs. Approval under Section 18 is required to impact on an Aboriginal place, site or object.	Relevant if artefacts found when construction of transport route occurs. Approval under Section 18 is required to impact on an Aboriginal place, site or object.
Conservation and Land Management Act 1984	Not relevant: the Western transport corridor option is not located over DEC managed land.	Relevant: The Central transport corridor option is located over DEC managed land.	Possibly relevant: the Eastern transport corridor option is possibly located over DEC managed land. The status of the tract of land bordering the WA/SA border between the GVDNR and the Mamungari Conservation Park requires confirmation.
Environmental Protection Act 1986	Relevant: Under Section 38 of the EP Act, a Mining Proposal may be referred to the EPA by: • DMP (or other Decision Making Authority (DMA)); • the proponent; • a member of the public; or • called in by the EPA. If it is considered that the proposal appears likely, if implemented, to have a significant effect on the environment. If the Western option was proposed, it is almost certain that the project would be referred by the Pila Nguru.	Relevant: The location of the transport corridor within the GVDNR would trigger automatic referral to the EPA by either DEC or DMP.	Relevant: The location of the transport corridor within or adjacent to the GVDNR would trigger automatic referral to the EPA by either DEC or DMP.
Environmental Protection (Clearing of Native Vegetation) Regulations 2004 *(Environmental Protection Act 1986)*	Longer route requires more vegetation clearing	Longer route requires more vegetation clearing	Shortest route and least amount of vegetation clearance required

Legislation / Regulation	Western Option	Central Option	Eastern Option
Mining Act 1978	Relevant: The Project would require an approved Mining Proposal under the *Mining Act 1978*.	Relevant: The Project would require an approved Mining Proposal under the *Mining Act 1978*. The Central transport corridor option would require a Miscellaneous License over DEC managed lands from DMP under the *Mining Act 1978*. Under Section 24 of the *Mining Act 1978*, the granting of a Miscellaneous License over DEC managed lands requires consent from both houses of State parliament.	Relevant: The Project would require an approved Mining Proposal under the *Mining Act 1978*. It is possible that the Eastern transport corridor option would require a Miscellaneous License over DEC managed lands from DMP under the *Mining Act 1978*. Under Section 24 of the *Mining Act 1978*, the granting of a Miscellaneous License over DEC managed lands requires consent from both houses of State parliament.
Rights in Water and Irrigation Act 1914	Source of water for dust suppression on roads may be required	Source of water for dust suppression on roads may be required	Source of water for dust suppression on roads may be required

7. DISCUSSION AND RECOMMENDATION

7.1 POTENTIAL VEGETATION, FLORA AND FAUNA IMPACTS

The main ecological processes that affect the flora and fauna assemblage along the transport corridor options include landscape permeability, local hydrology, fauna interactions and habitat degradation due to weed invasion (BCE 2012) (Appendix C). The potential environmental impacts of the construction of a transport corridor, including those upon these processes, are discussed below.

7.1.1 Native Vegetation and Flora

7.1.1.1 Clearing of Vegetation

Regardless of which option is implemented, construction of the haul road will inevitably involve the clearing of native vegetation. In the northern section of the transport corridor, the cleared vegetation is expected to comprise a mosaic of aeolian soils supporting a tree steppe of *Eucalyptus gongylocarpa*, *Acacia aneura* (Mulga) and *E. youngiana* over hummock grassland dominated by *Triodia basedowii* or colluvial soils supporting *Acacia* with *Eremophila* and *Santalum* spp. In the central and southern sections of the transport corridor, the vegetation is expected to comprise either low woodlands of *Acacia papyrocarpa* over *Maireana sedifolia* or *Myoporum platycarpum* and *Eucalyptus oleosa*.

The Eastern (Deakin) transport corridor option will be the shortest route, and cause the least area of clearing required (460ha). Conversely, the Western (Loongana) corridor will require 810ha of vegetation clearance.

7.1.1.2 Conservation Significant Flora

All three transport corridor options contain flora taxa of conservation significance but the Western haul road alignment corridor option appears to contain greater flora-related constraints than the Central or Eastern corridors, as it contains *Eremophila ?attenuata* (P1), a species only known from a single other collection in Western Australia. The Eastern and Central transport corridor options appear similar with no taxa of conservation significance recorded only within these corridors.

It is possible that although not recorded or mapped, further conservation significant flora may occur within the boundary of any of the proposed transport corridors and that the PEC *Yellow sandplain communities of the Great Victoria Desert* may also be traversed. Botanical surveys consistent with the standard of a "Level 2" flora survey, as defined in the Environmental Protection Authority's (EPA) Guidance Statement 51 (EPA 2004a), will be required to better determine the presence of either conservation significant flora or PECs.

7.1.1.3 Loss of Significant Vegetation Types

All three transport corridor options contain vegetation types (VTs) considered to be of local significance. The Western transport corridor option contains a donga community dominated by *Eremophila ?attenuata* (P1) which may be of regional significance.

7.1.1.4 Weed Invasion

The proposed transport corridor options cover areas that currently have limited vehicle traffic. The construction of a transport corridor and associated vehicle movements are associated with the risk of introducing a variety of weed species into these areas, some of which have the potential to significantly alter the VSAs of the area and thereby impacting the local ecosystems with unknown severity. In addition, the movement of people and equipment between urban areas and the Project site has the potential to introduce soil pathogens. The impact of weed and soil pathogen invasion is especially significant for the Central (Forrest) and Eastern (Deakin) options as they pass through nature reserves.

7.1.2 Fauna

7.1.2.1 Landscape Permeability

The construction of the transport route has the potential to modify the ability of fauna to move through the landscape (landscape permeability) in two ways: the disruption of linear habitats such as sand dunes that may form fauna corridors; and the altering of traditional fire regimes currently maintained by the Pila Nguru people.

All three transport corridor options will pass through dunefields, likely crossing numerous east-west orientated dunes. These dunes are potentially utilised by Great Desert Skink, Marsupial Moles and Sandhill Dunnarts (all Conservation Significance (CS1) species) as as fauna corridors. Consequently, any disruption to the sand dunes has the potential to disrupt the movement of fauna, and ultimately gene flow, through the landscape (BCE 2012).

The traditional fire regimes maintained by the Pila Nguru have created a mosaic of different fire ages within the VSAs within the GVDNR section of the study area. It is expected that this mosaic effect has aided a range of fauna species, including conservation significant species, to maintain a viable population within the region. Although there is potential for conflict between maintaining the traditional burning regime and operation of the Cyclone deposit and associated transport corridor, it is expected that the area of land affected by such a situation would be minimal. The management of transport activities to prevent potential new ignition sources that could lead to fire will be required on each of the three transport route options.

7.1.2.2 Fauna Interactions

Introduced species, both predators and herbivores, are a major factor in the decline and local extinction of some mammal and bird species (Burbidge & McKenzie 1998). Construction of a transport corridor is unlikely to impact feral cat and/or rabbit numbers but may aid the movement of the fox and camel (Mahon *et. al.* 1998) as both species are known to readily utilise roads to move through the landscape (BCE 2012). This has the potential to impact native fauna through increased predation (foxes), alteration of VSAs (camels) and competition for food resources (foxes and camels). The impact of introduced fauna may be especially significant for the Central (Forrest) and Eastern (Deakin) routes as the transport corridor passes through the centre of nature reserves.

7.1.2.3 Loss of Habitat Leading to Population Decline

The area of habitat loss, regardless of which option is chosen, is small in any one location because the footprint is long and narrow, and most of the vegetation types and VSAs are widespread. Those that are not widespread i.e. Gypsum salt lakes and Dongas, can be readily avoided, and not crossed by the proposed transport corriors. Little or no effect of habitat loss or fragmentation upon significant species is therefore expected.

7.1.2.4 Ongoing Mortality

With the construction and operation of the transport corridor, there is potential for species to be impacted by ongoing mortality from road kills. This has the potential to impact conservation significant species such as Woma, Malleefowl and Nullarbor Quail-thrush. For such species, the loss of only one or two individuals could be significant. The effects of such mortalities may be increased if the transport route is longer (e.g. Western (Loongana) option).

7.1.3 Landforms & Local Hydrology

Hydrological impacts are expected to be localised as the Project area has limited surface drainage, much of it terminating in either Gypsum salt lakes (in the GVDNR) or Dongas (on the Nullarbor). Both of these VSAs are uncommon within the landscape and therefore are considered to be conservation significant. Large chains of lakes are present in the Western and Eastern transport corridor options, with smaller claypans present in all options. The gypsum salt lake VSA is least represented within the Central corridor option. All other VSAs have similar representation relative to other corridor options. The local hydrology of the Central option will therefore be least affected by the construction of a transport corridor as it only contains small claypans and dongas, whilst the Western transport corridor option contains an intricate chain of small lakes. All three options contain landforms prone to erosion (dune fields). Therefore, irrespective of the final option considered, drainage requirements would need to be considered to ensure that susceptible VSAs are not adversely impacted, especially during periods of inundation.

7.1.4 Other Potential Impacts

Construction and operation of a transport corridor will result in an increase in dust, light, air emissions and potential hydrocarbon spills along the length of the corridor. Due to the narrow footprint of the transport corridor and widespread nature of the VSAs to be affected, the impacts of such an increase in disturbance, dust and light are expected to be minor.

The Central and Eastern options are significantly shorter than the Western option and so reduce the transport corridor's footprint.

7.1.4.1 Dust

Transport on unsealed roads is an inherently dust-generating activity. Dust has the potential to affect vegetation by settling on leaves, reducing photosynthesis, increasing moisture loss and disrupting reproductive activities. The management of dust generated from road transport in the Great Victoria Desert region will be required on all three routes.

7.1.4.2 Third Party Access

Although it is intended that the transport corriodor will be a private road, there is the potential for access by third parties. This access may result in the disturbance of the surrounding landscape through physical disturbance, transport of weeds or soil pathogens, risk of fauna mortalities through vehicle strikes or release of litter into the surrounding countryside. The use of the transport corridor by third parties is highly undesirable in all three route options, but the threats would be particularly detrimental to the GVDNR which is crossed in the Central (Forrest) and Eastern (Deakin) options.

7.2 COMPARISON BETWEEN TRANSPORT CORRIDOR OPTIONS

The three corridor options cover the same VSAs across their length, with the main differences being:

- The length of the transport corridor option (between 229 and 405km);
- The extent of representation of different flora & VSA within the footprint of the three transport corridor options; and
- The existing land-uses and cultural values (e.g. GVD-NR, cultural significance for the Pila Nguru) and potential conflicts with the construction and operation of a transport corridor.

Table 7.1 presents a comparative assessment of the vegetation, flora, fauna and land use issues associated with the three transport corridor options.

Table 7.1 Comparative assessment of environmental impacts of the three transport corridor options

Criteria	Aspect	Western Option	Central Option (252km)	Eastern Option (229km)
Land-use conflicts	GVDNR	Does not cross	The route crosses through the middle of the GVD-NR, thereby impacting the area's conservation value.	The route follows the WA/SA border, with some potential impacts to the GVD-NR (WA) and the Mamungari Conservation Park (SA)
	Shell and Carlisle Lake systems (conservation significant & culturally significant by the Pila Nguru people)	In the vicinity	Not in the vicinity	Not in the vicinity
	Forrest Lakes - an area considered culturally significant by the Pila Nguru people.	Not in the vicinity	Not in the vicinity	In the vicinity
Corridor length & disturbance footprint	Disturbances such as clearance footprint and ongoing mortality of fauna and dust effects will be affected by comparative length of corridor	405km	252km	229km
Flora Species Composition Species Not Previously Recorded in WA	*Austrostipa nullanulla*	Not recorded but possibly present	Present	Not present
	Eucalyptus canescens subsp. *beadellii*	Not recorded but possibly present	Present	Present
	Eucalyptus canescens subsp. *canescens*	Not recorded but possibly present	Present	Not recorded but possibly present
Flora Species Composition Listed conservation significant taxa	*Dampiera ?eriantha (P1)*	Present	Present	Not recorded but possibly present
	Eremophila ?attenuata (P1)	Present	Not present	Not present
	Acacia eremophila numerous-nerved variant (A.S. George 11924) (P3)	present	present	present

Criteria	Aspect	Western Option	Central Option (252km)	Eastern Option (229km)
	Eucalyptus pimpiniana (P3)	not recorded but possibly present	present	present
Flora Species Composition Potentially Undescribed Taxa	*Eucalyptus* sp.	not recorded but possibly present	present	not present
Significance of Vegetation Types (VTs)	VT 10h potentially of regional conservation significance	present	not present	not present
Weeds	*?Carrichtera annua*	not recorded but possibly present	present	present
	Malvastrum americanum	not recorded but possibly present	not present	present
Erosion Risk	Large areas of dune fields prone to erosion	present	present	present
Surface Drainage Risk	Significant lake chain which may represent a significant surface drainage risk	present	present	present
	Small claypans and dongas which may represent a low surface drainage risk	present	present	present

7.3 CONCLUSIONS & RECOMMENDATION

The primary consideration with respect to potential impact on vegetation, flora and fauna would be to select the option(s) with the least overall disturbance footprint, thereby minimising overall impact. In this regard, the Western corridor represents the least favourable option due to its length and therefore footprint. The Western option is also unfavourable due to its proximity to the Carlisle and Jubilee Lake systems and several culturally sensitive sites. Therefore, in relation to minimising impacts on vegetation, flora and fauna the Central and Eastern corridor options would be preferable to the Western option.

The Central and Eastern options represent a significantly lower impact on vegetation, flora and fauna due to their reduced length and therefore footprint. However, the Eastern corridor is least favourable of the two shorter corridors as its alignment takes it through the Forrest Lakes system and close to the Mamungari Conservation Park. Although the Central option traverses the GVDNR, the vegetation types and fauna habitats of this option were found to be widespread and similar to those of the Western and Eastern options. Given that no cultural issues associated with the Central option were identified, the Central option is thought to have the least potential impact to vegetation, flora, fauna and cultural values of the region.

The main strategy for minimising the potential impacts upon flora and fauna assemblages is to:

- minimise the transport corridor disturbance footprint;
- ensure that the final route avoids unique or isolated habitats;
- ensure that the final route minimise changes in the topography of fauna and surface drainage corridors;
- conduct a "Level 2" flora and fauna survey of the preferred transport corridor option to support the detailed planning of the alignment to avoid significant vegetation, flora and fauna; and
- ensure that the final route avoids Aboriginal Heritage sites with an adequate distance to ensure that these sites are preserved without any form of disturbance from the passing road trains.

In addition, it is also important to also consider the requirement for infrastructure and a rail siding to be constructed at the Loogana or Deakin stations. LSPL would be required to seek permission from the WA EPA for the construction of new sidings at either of these sites as well as from the current operators for the rail line. The station at Forrest benefits from existing sidings as well as accommodation and support infrastructure in the form of the Forrest airport and lodgings.

Level 2 flora and fauna surveys will be required to verify and supplement the data presented. Any route alignment changes or the development of specific conservation / protection actions plans could therefore be implemented prior to the submission of any approvals for the development of a transport corridor.

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APPENDIX A:

PRELIMINARY FLORA AND VEGETATION SURVEY

WOODMAN ENVIRONMENTAL CONSULTING (2012)

APPENDIX B:

FAUNA ASSESSMENT OF TRANSPORT CORRIDOR OPTIONS FOR THE LOST SANDS PROJECT (CYCLONE DEPOSIT)

BAMFORD CONSULTING ECOLOGISTS (2012)

APPENDIX C:

TRANSPORT CORRIDOR OPTIONS VEGETATION ATLAS

Appendix C: An atlas of vegetation maps for each transport corridor option is provided on a compact disk on the inside cover at the back of this report.

APPENDIX D:

PROPOSED TRANSPORT CORRIDOR OPTIONS FLORA AND FAUNA SURVEY METHODOLOGY (1 NOVEMBER 2011)

APPENDIX E:

DEC COMMENT AND PROPONENT RESPONSE ON PROPOSED TRANSPORT CORRIDOR OPTIONS FLORA AND FAUNA SURVEY METHODOLOGY (21 DECEMBER 2012)