Manuwarra Red Dog Highway

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Main Roads Western Australia

Manuwarra Red Dog Highway

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Contents

1. Introduction 1
1.1 Background 1
1.2 Purpose and Scope 1
1.3 Proponent Details 2
2. Revised Proposal Description 3
2.1 Approved Proposal 3
2.1.1 Overview 3
2.1.2 Approved Proposal – Stage 4 3
2.2 Current Status of the Approved Proposal 5
2.3 Description of the Proposed Changes 6
2.4 Options Considered 9
2.5 Revised Proposal Justification 11
2.6 Local and Regional Context 12
2.6.1 Overview and Socio-Economic Environment 12
2.6.2 Tenure and Land Use 12
2.6.3 Climate 15
2.6.4 Bioregional Context 17
2.6.5 Landforms and Land Systems 17
2.6.6 Hydrology 20
3. Stakeholder Consultation 21
3.1 Stakeholder Identification 21
3.2 Stakeholder Engagement 22
4. Environmental Principles and Factors 27
4.1 Environmental Principles 27
4.2 Identification of Environmental Factors 28
5. Key Environmental Factors 32
5.1 Flora and Vegetation 32
5.1.1 EPA Objective 32
5.1.2 Policy and Guidance 32
5.1.3 Receiving Environment 32
5.1.4 Potential Impacts 40
5.1.5 Mitigation 41
5.1.6 Assessment of Impacts 42
5.1.7 Predicted Outcome 43
5.2 Terrestrial Fauna 44
5.2.1 EPA Objective 44
5.2.2 Policy and Guidance 44
5.2.3 Receiving Environment 44

5.2.4 Potential Impacts 51
5.2.5 Mitigation 51
5.2.6 Assessment of Impacts 52
5.2.7 Predicted Outcome 52
5.3 Inland Waters 53
5.3.1 EPA Objective 53
5.3.2 Policy and Guidance 53
5.3.3 Receiving Environment 53
5.3.4 Potential Impacts 56
5.3.5 Mitigation 57
5.3.6 Assessment of Impacts 58
5.3.7 Predicted Outcome 59
5.4 Social Surroundings 59
5.4.1 EPA Objective 59
5.4.2 Policy and Guidance 59
5.4.3 Receiving Environment 59
5.4.4 Potential Impacts 61
5.4.5 Mitigation 61
5.4.6 Assessment of Impacts 62
5.4.7 Predicted Outcome 62
6. Offsets 63
7. Matters of National Environmental Significance 64
7.1 Northern Quoll 64
7.2 Ghost Bat 64
7.3 Pilbara Leaf-nosed Bat 65
7.4 Olive Python 65
7.5 Night Parrot 65
7.6 Grey Falcon 65
7.7 Potential Impacts 66
7.8 Mitigation 66
8. Holistic Impact Assessment and Conclusion 67
9. References 69

Appendix A. Weed Survey (Ecologia Environment 2018)
Appendix B. Protected Matters Search Tool (PMST) Report
Appendix C. Northern Quoll Survey (GHD 2017)

Glossary

Term/Abbreviation/Acronym	Definition
Approved Proposal	The Proposal as described in Ministerial Statement 677
AHIS	Aboriginal Heritage Inquiry System
ARI	Average Recurrence Interval
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulfate Soils
CER	Consultative Environmental Review
CME	Chamber of Commerce and Energy
CSES	Community and Stakeholder Engagement Strategy
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DMIRS	Department of Mines, Industry Regulation and Safety
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EAA	East Asian – Australasian Flyway
EPA	Environmental Protection Authority
EP Act	Environmental Protection Act 1986
EPBC	*Environment Protection and Biodiversity Conservation Act 1999*
DFES	Department of Fire and Emergency Services
IBRA	Interim Biogeographic Regionalisation for Australia
ISCA	Infrastructure Sustainability Council of Australia
KTP	Karratha – Tom Price Road
LGA	Local Government Authority
MS 677	Ministerial Statement 677
PDC	Pilbara Development Commission
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
Proposed changes	The changes to the Proposal due to changes to the alignment for Stage 4
RAV	Restricted Access Vehicle
Revised Proposal	The Approved Proposal together with the proposed changes
SPRAT	Species Profile and Threats Database
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Committee

Term/Abbreviation/Acronym	Definition
WGAC	Wintawari Garuma Aboriginal Corporation
WONS	Weed of National Significance
YAC	Yindjibarndi Aboriginal Corporation

1. Introduction

1.1 Background

The requirement for a direct sealed road between the Pilbara coastal communities and inland communities was identified in the 1990's. Prior to the commencement of construction of Stages 1 to 3 of the Karratha – Tom Price Road (now known as the Manuwarra Red Dog Highway), access between Karratha/Dampier and Roebourne (coastal communities) to Tom Price/Paraburdoo on the public road system was via the Roebourne – Wittenoom Road, the Nanutarra – Munjina Road and the Tom Price Spur Road. However, historical traffic data showed that most vehicles commuting between Karratha and Tom Price were using the shorter Pilbara Rail Company's Dampier to Paraburdoo railway access road rather than the public roads.

The Roads 2020 regional road development strategy: Pilbara Region, developed by Main Roads Western Australia (Main Roads) together with local government authorities (Main Roads, 1997), and the Pilbara Regional Transport Strategy, developed by the Department of Transport (DoT), recognised there was a requirement for a more direct link between Karratha and inland communities such as Tom Price and Paraburdoo. The completed road will ultimately provide a sealed link between the coastal and inland communities of the central Pilbara that will best meet the needs of all stakeholders.

Main Roads referred Stages 2, 3 and 4 of the Manuwarra Red Dog Highway (then referred to as the Karratha – Tom Price Road) to the Western Australian (WA) Environmental Protection Authority (EPA), under section 38 of the *Environmental Protection Act 1986* (EP Act), in September 1998. The EPA determined that the potential environmental impacts were sufficient to warrant formal assessment of the Proposal under the EP Act. In October 1998, the EPA determined the level of assessment for the Proposal to be a Consultative Environmental Review (CER – Assessment Number 1244). The CER was prepared by Main Roads and released for public review in January 2003. In January 2005, the EPA finalised its decision report and recommended conditional approval of the Proposal to the Minister for the Environment. Subsequent to this, the Proposal was granted conditional Ministerial approval via Ministerial Statement (MS) 677 in April 2005.

Construction of Stage 2 was completed in 2008 with Stage 3 completed in 2020. During the construction of Stage 3, Main Roads became aware that the disturbance footprint required to construct the road had been underestimated in the original assessment. This, combined with changed road design standards since the 2005 approval, meant that the majority, if not all, of the authorised extent of disturbance would be used at the completion of Stage 3.

The alignment for Stage 4 is undergoing additional planning, stakeholder consultation and investigations to further refine the alignment, which is expected to differ from that originally proposed. Main Roads has therefore elected to refer Stage 4 of the Manuwarra Red Dog Highway under section 38 of the EP Act as a Revised Proposal.

1.2 Purpose and Scope

The purpose of this document is to provide supplementary information to support the referral of a Revised Proposal for Stage 4 of the Manuwarra Red Dog Highway. This document details the key characteristics of the Revised Proposal and provides a preliminary assessment of the potential impacts that may occur to each of the EPA's environmental factors. This assessment details:

- the EPA environmental factors that may be impacted;
- the EPA Policy and Guidance that has been considered;
- outcomes of consultation that has been undertaken;
- the condition of the receiving environment;

- the Revised Proposal activities that may impact the environment along with proposed management and mitigation; and
- an assessment of the potential impacts against the EPA objectives together with any assumptions that have been made in the assessment.

1.3 Proponent Details

The proponent for the Revised Proposal is:

Commissioner of Main Roads Western Australia
ABN: 50 860 676 021
PO Box 6202
East Perth WA 6004

The key contact for the Revised Proposal is:

Wayne Ennor - Environment Officer
Main Roads Western Australia
Phone: (08) 9323 6497
Email: wayne.ennor@mainroads.wa.gov.au

2. Revised Proposal Description

2.1 Approved Proposal

2.1.1 Overview

As described in the CER, the original Proposal was to construct and maintain a new road from the North West Coastal Highway, near Karratha, to the Nanutarra-Munjina Road, north of Tom Price (**Figure 2-1**) comprised of:

- a new 93 km section from the North West Coastal Highway near Karratha to about 20km north of the Millstream turn-off on the existing Roebourne – Wittenoom Road (Stage 2). In addition to the preferred concept alignment, there are three options joining the North West Coastal Highway near Karratha, two alternatives at the railway crossing area and two in the Chichester Range near the Harding River which were considered;
- a 46 km section in common with the existing Roebourne – Wittenoom Road (Stage 3); and
- a 109 km section from Wallyinya Pool (on the existing Roebourne – Wittenoom Road) to the Nanutarra – Munjina Road (Stage 4) adjacent to the existing Pilbara Rail Company railway.

The Key Proposal Characteristics detailed in MS677 are shown in **Table 2-1**.

Since approval of the Proposal in April 2005, two changes to the Proposal have been approved:

- a section 46C request to change implementation conditions resulting in modification of Condition 7-2 to allow an increase in the total amount of clearing within Millstream -Chichester National Park to not more than 145 ha (originally 110 ha); and
- a section 45C request for minor changes to the Proposal's key characteristics to:
  - create a total disturbance footprint of 574 ha by combining the two areas of disturbance described in the original approval; and
  - remove elements that were no longer considered key characteristics for the purposes of environmental approval.

Table 2-1 details the current authorised extents resulting from this s45C change.

2.1.2 Approved Proposal – Stage 4

As described above, Stage 4 of the Manuwarra Red Dog Highway starts at Wallyinya Pool (Point A on **Figure 2-2**), traverses the Fortescue River Valley and Hamersley Range, ending at junction with the Nanutarra – Munjina Road (Point B on **Figure 2-2**). The approval alignment is adjacent to the existing Rio Tinto (Pilbara Rail Company) railway. Between Wallyinya Pool and the crossing of Weelumurra Creek by the rail, the approved alignment is to the east of the railway. At the creek crossing, the alignment moves to the west of the railway.

Due to the different requirements and expectations of environmental assessment documentation in the early 2000's compared to now, it is difficult to quantify the disturbance and potential impacts of Stage 4 in isolation. Review of the information presented in the CER suggests the following impacts were expected for Stage 4 of the Approved Proposal:

- disturbance footprint of approximately 250 ha;
- clearing of 17.5 ha of the Themeda Grasslands Threatened Ecological Community (TEC), based on a 7 km long and 25m wide corridor;
- no clearing was stated for the Brockman Iron Cracking Clay Communities of the Hamersley Range Priority Ecological Community (PEC); and
- clearing of habitat for the Pilbara Olive Python was noted in the CER but not quantified.

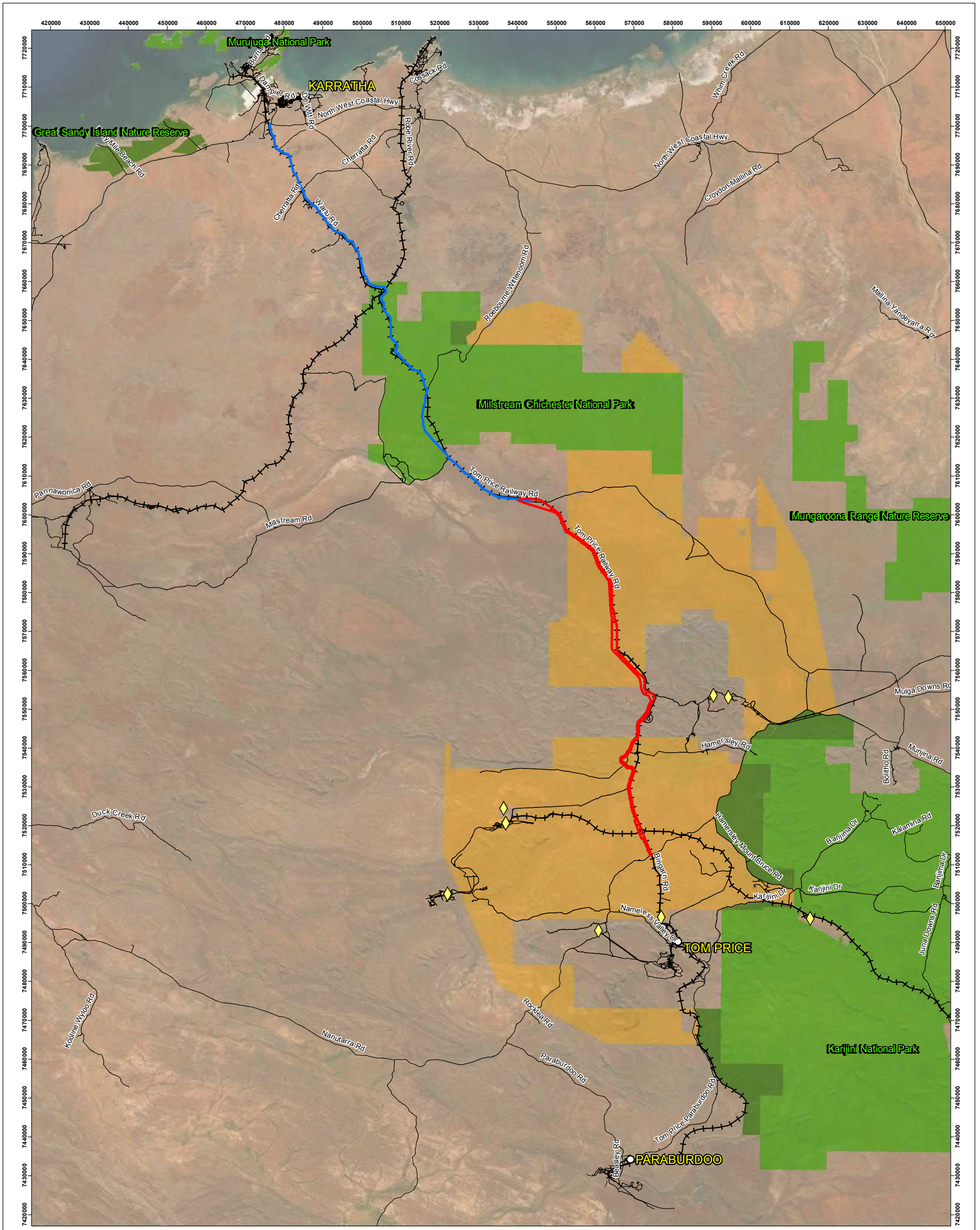

Figure 2-1: Proposal Location

Legend

- Mining Centres
- Development Envelope
- Manuwarra Red Dog Highway - Completed Sections
- Pastoral Leases
- DBCA Lands of Interest
- DBCA Managed Lands

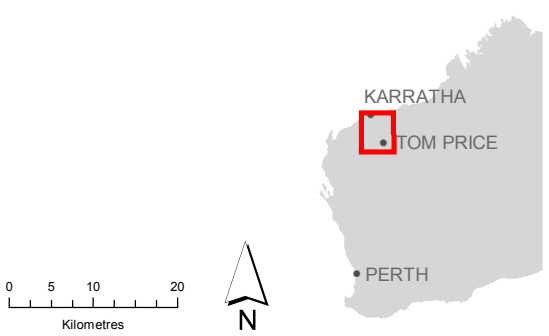

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Table 2-1: Key Characteristics of the Approved Proposal and Current Authorised Extents

Element	MS 677	
	Previous Quantities/ Description	**Current Authorised Extent (as amended by s45C application)**
Length	Approximately 245 km.	Approximately 245 km.
Connections to existing roads	North West Coastal Highway Roebourne Wittenoom Road Millstream-Yaraloola Road Mt Bruce Road Nanutarra-Munjina Road	North West Coastal Highway Roebourne Wittenoom Road Millstream-Yaraloola Road Mt Bruce Road Nanutarra-Munjina Road
Area of disturbance	Road formation Approximately 474 ha – of this, approximately 137 ha will be rehabilitated following construction. Material sources Approximately 100 ha.	Clearing and disturbance of no more than 574 ha – of this no less than 137 ha will be rehabilitated following construction of the road formation.
Design speed	110 km per hour.	Removed.
Formation width	Approximately 9 m.	Approximately 9 m.
Waterway crossings	Up to nine bridges across major watercourses and railway lines. Culverts and low-level floodways will be used for all other waterway crossings.	Up to nine bridges across major watercourses and railway lines. Culverts and low-level floodways will be used for all other waterway crossings.
Railway crossings	One road-over-rail bridge. Four new level crossings.	Removed.
Fencing of road reserve	Approximately 200 km of fence will be erected along the road reserve outside the Millstream-Chichester National Park.	Approximately 200 km of fence will be erected along the road reserve outside the Millstream-Chichester National Park.

2.2 Current Status of the Approved Proposal

Construction of Stage 2 was completed in 2008 while Stage 3 was completed in August 2020. During the construction of Stage 3, it became apparent that the footprint required to construct the road had been underestimated in the original assessment and that the majority, if not all, of the authorised extent of disturbance would be used at the completion of construction of Stage 3.

A review of the alignment for Stage 4 has been undertaken, informed by ongoing consultation with stakeholders, including Traditional Owners and the owners of Hamersley Homestead. This review has resulted in substantial modifications to the alignment of Stage 4 in order to avoid areas of particular significance to the Traditional Owners, avoid or minimise potential social and amenity impacts and minimise interactions between existing infrastructure and other land owners/managers. In light of this, and due to the previously mentioned shortfall in the approved disturbance extent, Main Roads has chosen to refer Stage 4 of the Manuwarra Red Dog Highway to the EPA as a Revised Proposal.

A Preliminary Environmental Impact Assessment was undertaken of the existing environment and the activities associated with the Manuwarra Red Dog Highway Stage 4 to understand the likely environmental and heritage

impacts of the revised route. Following on from this, additional surveys and investigations have been commented and are in the final stages of completion:

- flora, vegetation and fauna surveys, including targeted searches for species and communities of conservation significance;
- Aboriginal heritage surveys and ongoing consultation with Traditional Owners; and
- hydrological investigations, including identification of potential construction water sources.

2.3 Description of the Proposed Changes

Pending completion of Stage 3 of the Manuwarra Red Dog Highway, it is anticipated that most of the approved 574 ha disturbance footprint (as per MS677) will have been used in the construction of the previous two stages. As such, the proposed changes requested for this Revised Proposal relate specifically to the construction of Stage 4.

Stage 4 of the Manuwarra Red Dog Highway is located in the Pilbara region of Western Australia, with the northern end of Stage 4 approximately 110 km south east of Karratha (**Figure 2-1**). Stage 4 of the Revised Proposal (the proposed changes) involves the construction of 107 km of new road from the southern end of Stage 3 of the Manuwarra Red Dog Highway (Wallyinya Pool), Point A on Figure 2-2, to the Nanutarra - Munjina Road, Point B on Figure 2-2. Construction works will include:

- clearing and topsoil removal;
- blasting;
- material pits;
- water abstraction;
- creation of temporary side-tracks and turnaround locations;
- off formation drainage;
- accommodation works (i.e. fencing) and potential relocation of services;
- site office and construction compound establishment;
- construction of the road formation, including application of asphalt and bitumen;
- haulage of construction materials and any excess materials generated on site;
- stockpiling and laydown areas (mulch, aggregate, material);
- landscaping and revegetation; and
- ongoing maintenance activities.

In addition, blasting will be required in areas of cut which cannot be excavated by standard earthmoving machinery.

Figure 2-2 shows the original alignment for Stage 4, as approved under MS 677, and the Development Envelope for the proposed changes. This shows a shift in the alignment from the eastern side of the Rio Tinto Railway to the western side between Wallyinya Pool and the rail crossing at Weelemurra Creek. A deviation to the west of Hamersley Homestead is also proposed as part of the Revised Proposal in order to minimise potential amenity impacts.

Stage 4 is estimated to require up to an additional 800 ha of disturbance, compared to the 250 ha originally anticipated in the CER. The original disturbance was based on an average width of 20 – 25 m whereas the disturbance required for the proposed change has been based on an average width of 70 – 75 m. This increase allows for the increased formation width (9 m as compared to 12 m) and larger disturbance footprint required in areas of cut and fill through the Hamersley Ranges.

In addition to the overall increase in the disturbance footprint, the follow new or changed impacts may occur as a result of the proposed changes:

- Increase in clearing of the Themeda Grasslands TEC from 17.5 ha predicted in the original approval to 75 ha for the proposed change. This is likely due to changes in mapping of the extents of the TEC.
- Clearing of 115 ha of the Brockman Iron PEC. This PEC was not discussed in the CER, most likely as this PEC was not listed at the time.
- Clearing of habitat for the night parrot (up to 530 ha), northern quoll (up to 530 ha), Pilbara leaf-nosed bat (up to 200 ha), ghost bat (up to 200 ha) and Pilbara olive python (up to 200 ha). The CER only discussed potential impacts to the Pilbara olive python and did not quantify the extent of habitat disturbance.

Table 2.2 provides a summary of the Revised Proposal with the key characteristics of the Revised Proposal detailed in **Table 2-3**. **Table 2-4** presents a comparison of the key characteristics currently listed on MS 677 and the key characteristics for the Revised Proposal. The Development Envelope is shown on Figure 2-2.

Table 2.2: Summary of Revised Proposal

Proposal Title	Manuwarra Red Dog Highway
Proponent Name	Main Roads Western Australia
Short Description	The Revised Proposal is to construct and maintain a sealed new road from the North West Coastal Highway, near Karratha, to the Nanutarra-Munjina Road, north of Tom Price. The Revised Proposal includes a greater area of vegetation clearing and a larger disturbance footprint compared to the original Approved Proposal.

Table 2-3: Key Characteristics of the Revised Proposal

Element	Location	Proposed Extent
Physical Elements		
Road Construction and Associated Infrastructure	Along the alignment shown on **Figure 2-1** and within the Disturbance Envelope shown on Figure 2-2	Clearing and disturbance of no more than 1,374 ha. This disturbance includes up to 800 ha within a Development Envelope of 7,142 ha for Stage 4 and: • up to 75 ha of the Themeda Grasslands TEC and up to 115 ha of the FA ▪ up to 100 ha of temporary disturbance.
Waterway crossings	Western Creek, Harding River, Fortescue River, Weelumurra Creek and Barnett Creek. Other minor tributaries and creek systems crossed by the alignment.	Bridges, culverts and low-level floodways across watercourses, as determined by the conditions at each crossing.
Fencing	Millstream-Chichester National Park	Approximately 200 km of fence will be erected along the road reserve outside the Millstream-Chichester National Park.

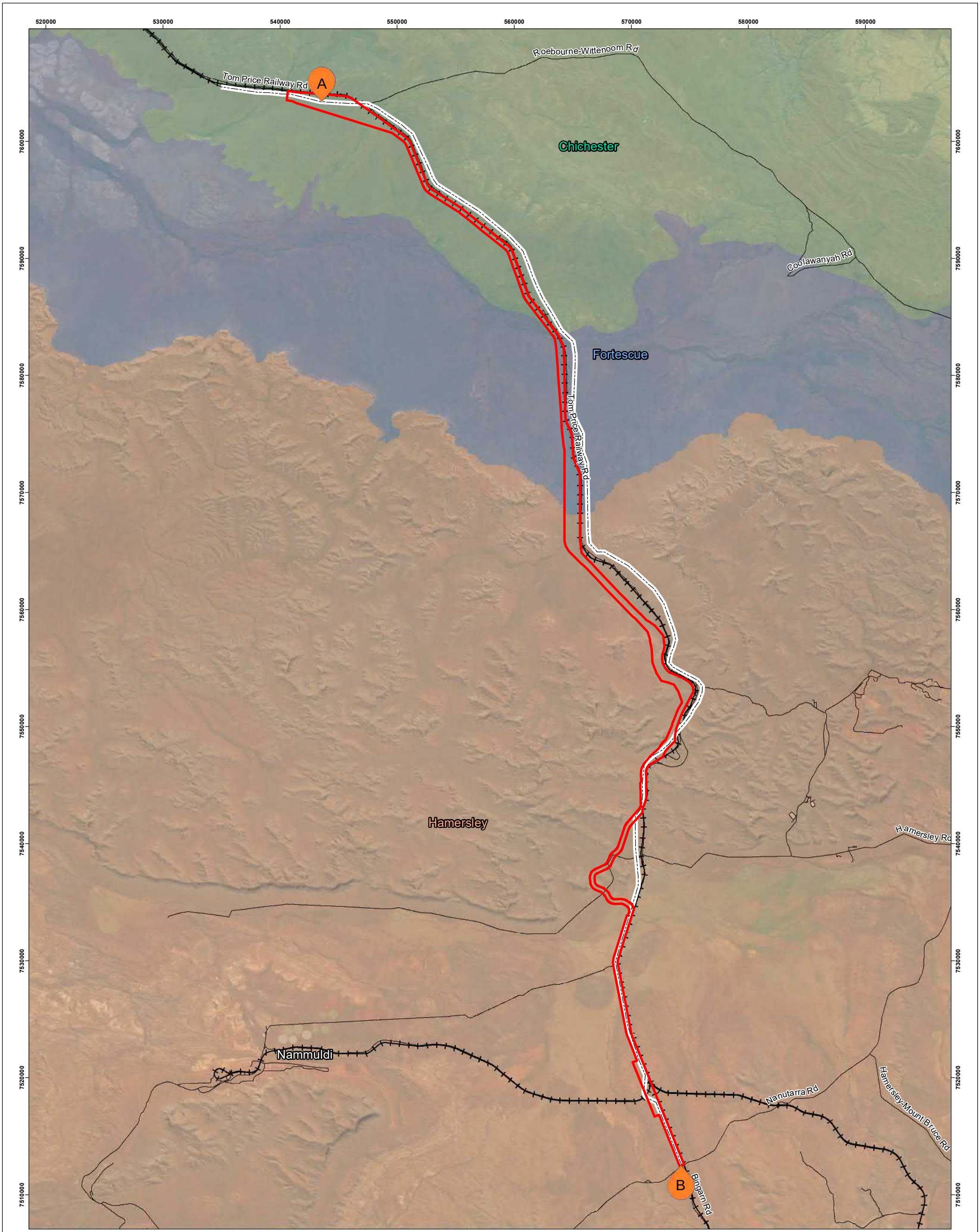

Figure 2-2: Development Envelope, Approved Alignment and Bioregional Boundaries

Legend

- Development Envelope for Proposed Change
- Approximate Stage 4 Alignment as Approved under MS677

IBRA 7.0 Bioregions

- Chichester
- Fortescue
- Hamersley

0 2.5 5 10
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Table 2-4: Comparison of Key Characteristics of the Approved Proposal and the Revised Proposal

Element	MS 677 Current Authorised Extent	Proposed Changes	Revised Proposal
Length	Approximately 245 km.	No Change.	Approximately 245 km.
Connections to existing roads	North West Coastal Highway. Roebourne Wittenoom Road. Millstream-Yaraloola Road. Mt Bruce Road. Nanutarra-Munjina Road.	Remove.	
Area of Disturbance	Clearing and disturbance of no more than 574 ha – of this no less than 137 ha will be rehabilitated following construction of the road formation.	Total disturbance footprint for Stage 4 of up to 800 ha within a Development Envelope of 7,142 ha. This disturbance includes: • up to 75 ha of the Themeda Grasslands TEC and up to 115 ha of the Brockman Iron PEC. • up to 100 ha of temporary disturbance.	Clearing and disturbance of no more than 1,374 ha. This disturbance includes up to 800 ha within a Development Envelope of 7,142 ha for Stage 4 and: • up to 75 ha of the Themeda Grasslands TEC and up to 115 ha of the Brockman Iron PEC. • up to 100 ha of temporary disturbance.
Formation width	Approximately 9 m.	Remove.	
Waterway crossings	Up to nine bridges across major watercourses and railway lines. Culverts and low-level floodways will be used for all other waterway crossings.	No Change.	Bridges, culverts and low-level floodways across watercourses, as determined by the conditions at each crossing.
Fencing of road reserve	Approximately 200 km of fence will be erected along the road reserve outside the Millstream-Chichester National Park.	No Change.	Approximately 200 km of fence will be erected along the road reserve outside the Millstream-Chichester National Park.

2.4 Options Considered

Information regarding the options considered as part of the original assessment can be found in the CER. In summary, the following options were considered in relation to Stage 2 of the Approved Proposal:

- three options for the approach into Karratha from North West Coastal Highway:
  - following the water pipeline to within 5km of Harding Dam.
  - following the railway on the western side to Millstream – Chichester National Park, where it crosses to the eastern side, joining the preferred alignment.
  - just east of the main entry to Karratha and heading due south towards the railway.
- two options for the railway crossing area at the Millstream -Chichester National Park; and

- two options in the Chichester Ranges near the Harding River.

For the purposes of identification and assessment of alignment options for Stage 4 of the Revised Proposal (the proposed changes), the route was divided into three sections based on topographical, geological and site conditions as follows:

- Coolawanyah Section:

  Starting at the Roebourne Wittenoom Road, this section crosses the Fortescue River, traversing its associated floodplains and channels originating from the Chichester Range. The Coolawanyah Section is topographically flat.

- Hamersley Section:

  Traverses the Hamersley Ranges which are characterised by steep slopes and cliffs, crossing of Weelumurra Creek and its incised tributaries.

- Tom Price Section:

  Traverses a small portion of the Hamersley Ranges before crossing the southern Hamersley Plateau flats – an extensive floodplain with clay soils – and finishing at the Nanutarra - Munjina Road.

Two options have been considered for the Coolawanyah Section. Both options are adjacent to and follow the Rio Tinto railway with Option 1 being on the eastern side of the rail and Option 2 on the western side. Within the Hamersley Section 15 options have been considered. The majority of these are on the western side of the railway with a single option on the eastern side (**Figure 2-3**). As with the Coolawanyah Section, two options have been considered for the Tom Price Section, both options being adjacent to and following the Rio Tinto railway with Option 1 being on the eastern side of the rail and Option 2 on the western side, with a deviation to the west of Hamersley Homestead.

A rapid options assessment was undertaken by Cardno (2020) to evaluate the alignments and identify a preferred corridor. The criteria against which each option was assessed were:

- Earthworks – cut fill volumes, rock potential and route length.
- Serviceability – risk of flood water inundation and/or backwater effects.
- Infrastructure impacts – interactions between the option and existing assets.
- Railway and mining leases – severance.
- Heritage – presence of known sites.
- Environmental – presence of known values/sites (threatened flora and fauna species & their habitats, ecological communities)

For the Coolawanyah Section, the preferred alignment is Option 2 (western side of the railway) as Option 1 required a crossing of the railway and Rio Tinto is planning to expand the rail (via a triplication) to the east. The environmental and heritage risks were considered to be similar for each option.

The presence of Rio Tinto's Mining Lease ML4SA was a major constraint for the Hamersley Range alignments as Rio Tinto has stipulated that this lease is to be avoided due to it being granted through a State Agreement Act. Six of the 15 options were ruled out as they intersected ML4SA. The option to the east of the railway was ruled out due to high flood and backwater risks and the need for a rail crossing to join the preferred Coolawanyah option on the western side of the rail. The westernmost option was excluded as it would result in significantly longer travel time. The environmental and heritage risks were considered to be similar for all options. The remaining options will undergo a detailed options assessment to determine the preferred route through the Hamersley Section.

The preferred option for the Tom Price section is the option to the western side of the railway. The eastern alignment would require a crossing of the Rio Tinto railway as well as the future FMG Eliwana Railway. The environmental and heritage risks were considered to be similar for each option.

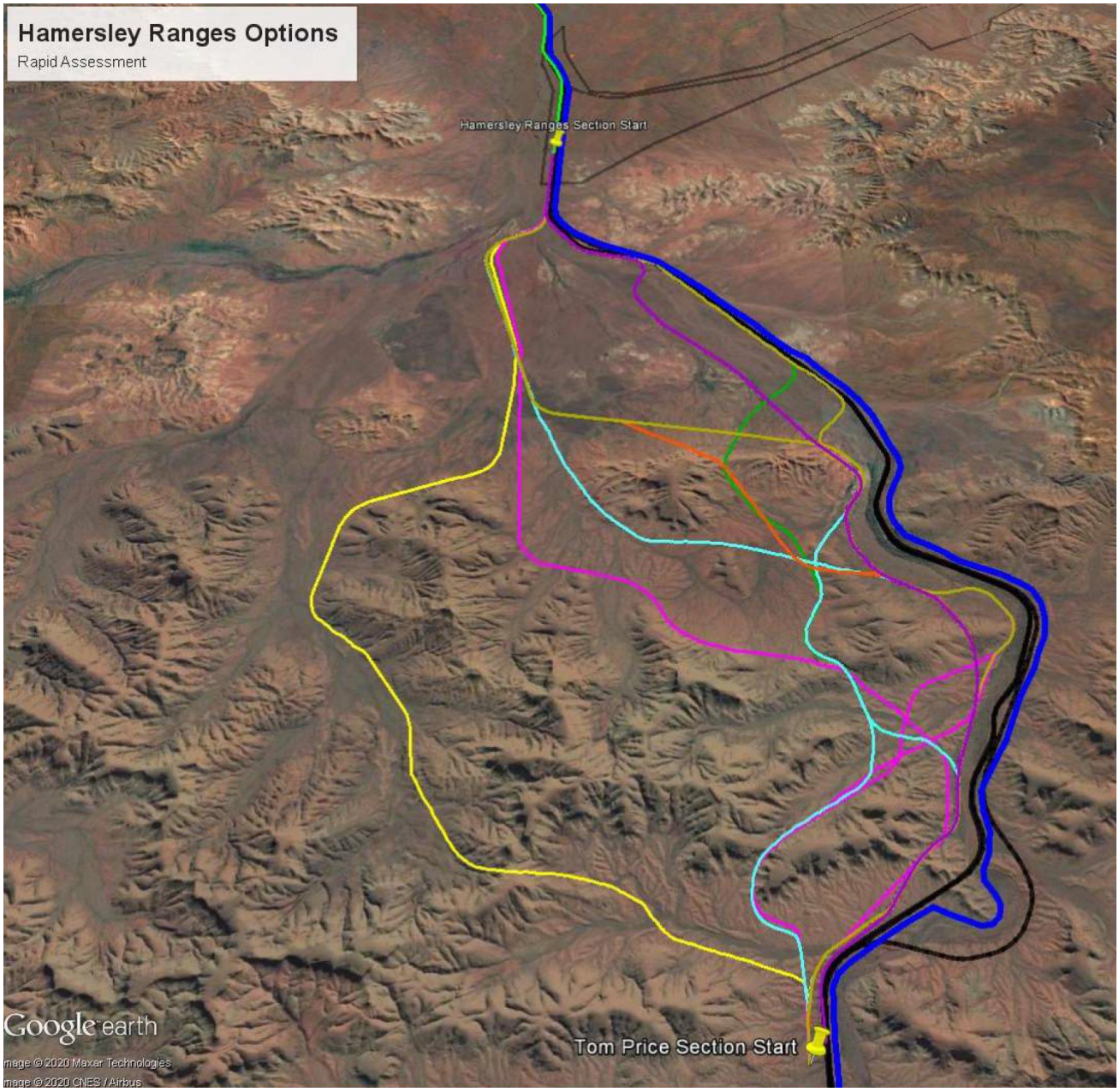

Figure 2-3: Hamersley Section Options (Cardno, 2020)

2.5 Revised Proposal Justification

Since the Manuwarra Red Dog Highway Project was originally approved by the Minister for the Environment in 2005, there have been significant changes to road design standards and community expectations regarding safety of regional roads. As a result, design standards that were acceptable in the early and mid-2000's are now outdated and no longer considered appropriate. In order to meet the requirements of the current design standards (as detailed in the Austroads Guide to Road Design (2020) and Main Roads' supplements to this) a larger area of disturbance has been required than originally anticipated for the previous stages of construction and will be required for construction of Stage 4. Specific areas where changed design and safety standards have increased the footprint include:

- increased width of formation. Main Roads standard formation is now 12 m width whereas the CER stated a 9 m wide formation;
- changes to vertical geometry which aims to reduce the angle at which roads traverse hills and steep terrain. This may increase the amount of cut and fill required, thereby increasing the footprint; and
- updated Restricted Access Vehicle (RAV) requirements for roads.

In addition, the specific alignment of Stage 4 has changed as a result of stakeholder feedback and other considerations as detailed in **Section 2.4**.

2.6 Local and Regional Context

2.6.1 Overview and Socio-Economic Environment

The Revised Proposal is located in the Pilbara region of WA within the Shire of Ashburton (**Figure 2-1**). In 2017, the Shire had a population of 13,261 people with about half living in the towns of Onslow (848), Pannawonica (695), Paraburdoo (1,359) and Tom Price (2,956).

In 2018, over 40 million tonnes of iron ore were produced by mines located within the Shire, with the Shire's mining sector representing over 18% of WA's mining industry value (Shire of Ashburton, 2019). The strong presence of the resource sector is reflected in the Shire's high average personal income and low unemployment rate (the lowest of any local government area in Australia). The reliance on mining also presents risks for the community. The downturn in the mining sector in 2012 had a significant impact to the Shire's population with the sudden reduction in population having a flow-on impact resulting in many small businesses either shutting down or relocating (Shire of Ashburton, 2019).

The tourism market, which contributes almost $300 million to local expenditure, making up 1.3% of the economy and 6.5% of all jobs, also plays an important role in the economy of the Shire. For the year ending March 2018, it was estimated that there were over 330,000 visitors to the Shire of Ashburton. Most visits (61%) were for business purposes, with leisure visitors making up 35% of the total. Leisure visitation is dominated by older Australian visitors (55 years +), predominantly from Western Australia, travelling with a caravan (Shire of Ashburton, 2019).

2.6.2 Tenure and Land Use

Land use in the wider Pilbara region includes mining and petroleum operations, pastoralism, tourism and recreation, and conservation. The Development Envelope for the proposed change is situated within the Coolawanyah and Hamersley Pastoral Leases, with the remainder of the land designated as Unallocated Crown Land (**Figure 2-2**). A number of mining tenements also overlay the Development Envelope (**Figure 2-4**).

The following Crown Reserves are within or near to the Development Envelope for the proposed change (**Figure 2-5**):

- 38991 - the Millstream Water Reserve, managed by the Department of Water and Environmental Regulation (DWER) and Water Corporation;
- 40743 - owned by Australian Telecommunications Commission (Telstra) and is for a repeater station;
- 39013 - owned by Telstra and is for a repeater station; and
- 27915 - owned by the Department of Primary Industries and Regional Development (DPIRD) and is for a Resting Place.

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Figure 2-4: Mining Tenure

Legend

- Development Envelope

Mining Tenements

- Prospecting Licence
- Retention Licence
- Miscellaneous Licence
- Exploration Licence
- General Purpose Lease
- Mineral Lease
- Mining Lease

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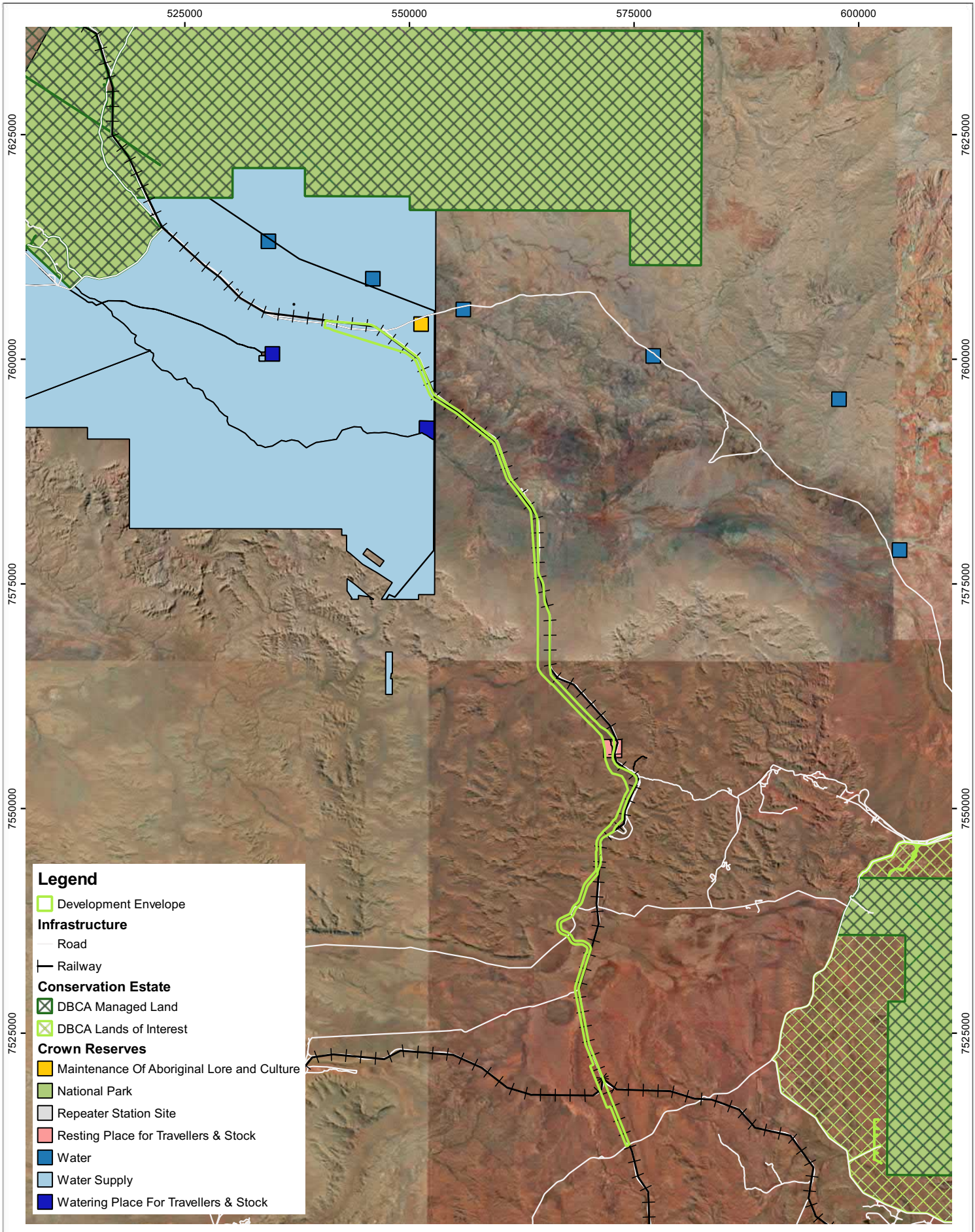

Figure 2-5: Crown Reserves and Conservation Estate

The nearest conservation estates are Karijini National Park, located approximately 18 km south-east of the Development Envelope for the proposed change , and Millstream – Chichester National Park, located approximately 14 km north of the northern extent of the Development Envelope for the proposed change (**Figure 2-5**). Stage 3 of the Revised Proposal was constructed through a portion of the Millstream – Chichester National Park, as authorised under MS677.

Native Title exists across the Development Envelope for the proposed change with the Yindjibarndi People having Native Title rights in the northern portion of the Development Envelope and the Eastern Guruma People having Native Title rights in the southern portion (**Figure 2-6**).

2.6.3 Climate

The Pilbara is a semi-arid and arid region with a monsoonal climate. Peak rainfalls occur in the warmer summer months between December and March (i.e. the wet season) as a result of monsoonal thunderstorm activity (**Figure 2-7;** Sudmeyer, 2016). Tropical lows or cyclones may occur during these months also. Climate data has been collected by the Bureau of Meteorology (BoM) weather station at Pannawonica (Station Number 005069), about 110 km due west of the Development Envelope, since November 1971. Temperature data is available for a period of 33 years (2071 – 2005) while rainfall data is available for a period of 47 years (1971 – 2020). Review of the available data indicates mean maximum monthly temperatures vary between 26.9°C (June) and 41.2°C (January) and mean minimum temperatures range between 12.6 (July) and 25.2°C (January and February) (BoM, 2020).

Temperature ranges are generally greater in inland districts away from the moderating effects of the onshore winds common to the coastal districts. Temperatures within the local area of the Development Envelope are, therefore, likely to be more variable than those at Pannawonica. For comparison, mean monthly maximum temperatures at the BoM weather station located in Paraburdoo (Station Number 007185) about 77 km south of the Development Envelope, vary between 24.9°C (June) and 40.7°C (January) and mean minimum temperatures range between 9.8°C (July) and 26°C (January) (BoM, 202). Mean annual rainfall is lower; 317 mm compared with 407.2 mm at Pannawonica (BoM, 2020).

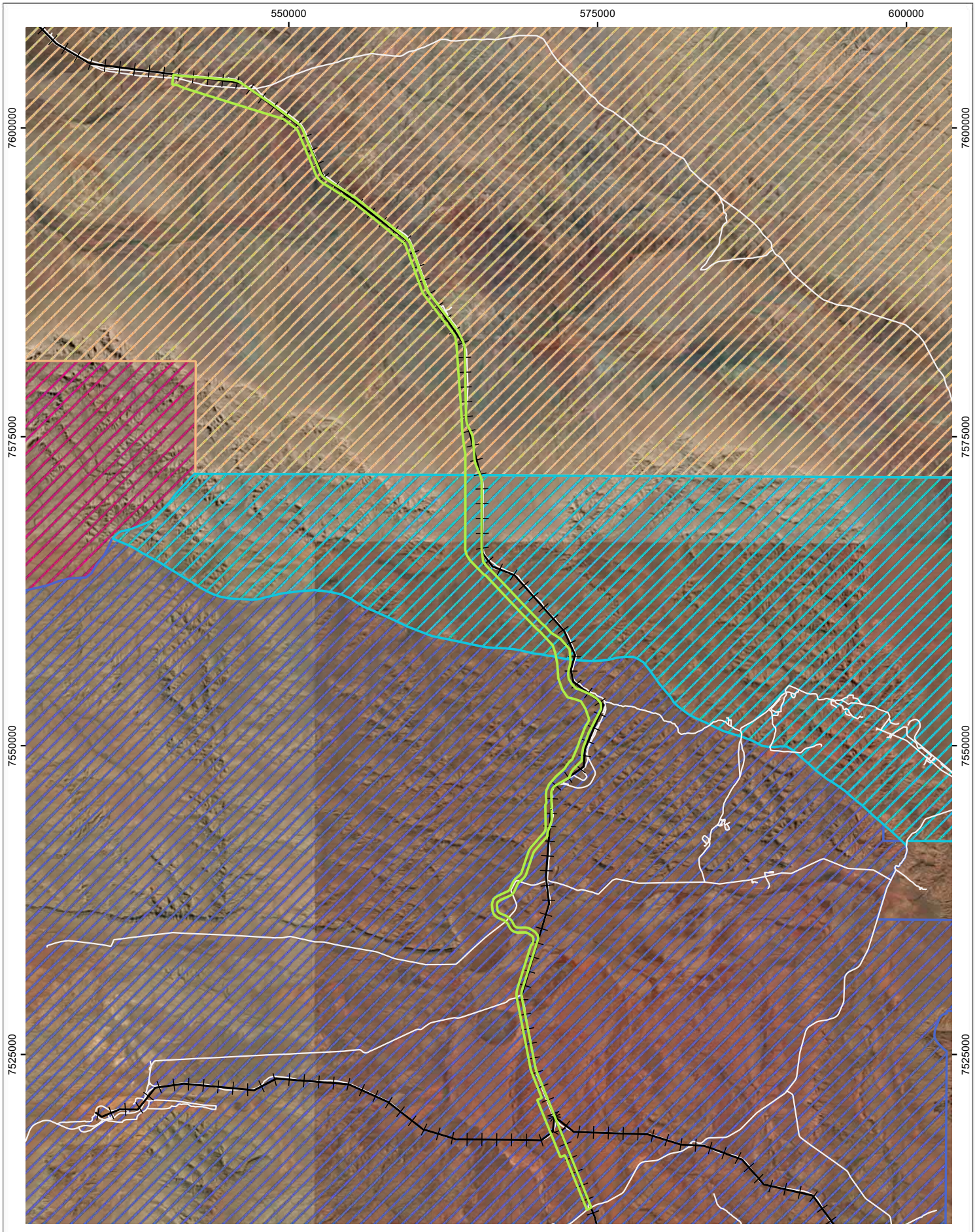

Figure 2-6: Native Title Boundaries

Development Envelope

Infrastructure

Road

Railway

Native Title Boundaries

EASTERN GURUMA

KURUMA MARTHUDUNERA (PART A)

NGARLUMA / YINDJIBARNDI

YINDJIBARNDI #1

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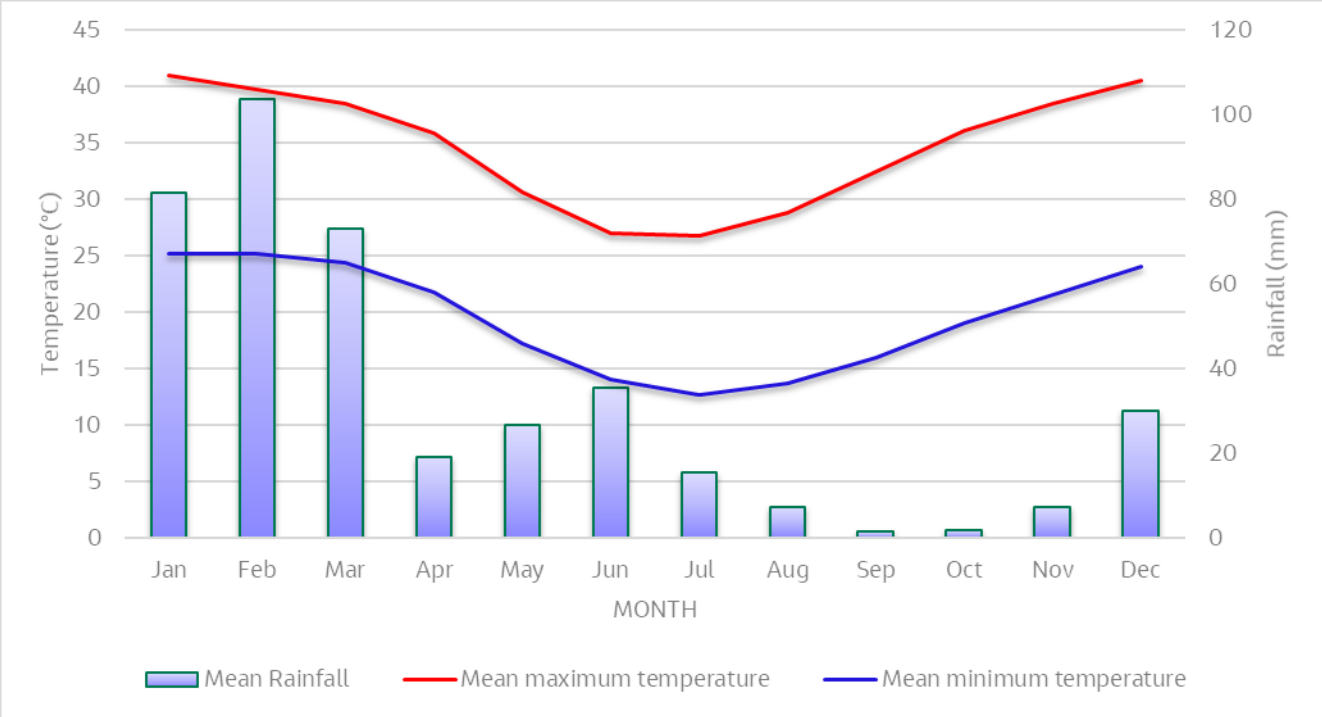

Figure 2-7: Climate Data Recorded at the Pannawonica BoM Climate Station (BoM, 2020)

2.6.4 Bioregional Context

The Development Envelope for the proposed change sits within the Pilbara Bioregion and the Chichester, Fortescue and Hamersley subregions as defined by the Interim Biogeographic Regionalisation for Australia (IBRA) Version 7 (Department of Agriculture, Water and the Environment [DAWE], 2020a) as shown in **Figure 2-2**. The key features of these the subregions are as follows (Environment Australia, 2000):

- Chichester subregion: archaean granite and basalt plains supporting shrub steppe characterised by *Acacia pyrifolia* over *Triodia pungens* hummock grasses. Snappy gum tree steppes occur on ranges.
- Fortescue subregion: alluvial plains and river frontages; salt marsh, mulga-bunch grass and short grass communities on alluvial plains; river gum woodlands fringe the drainage lines; this is the northern limit of mulga (*Acacia aneura*).
- Hamersley subregion: mountainous area of Proterozoic sedimentary ranges and plateaux with mulga low woodland over bunch grasses on fine textured soils and snappy gum over *Triodia brizoides* on skeletal sandy soils of the ranges.

2.6.5 Landforms and Land Systems

The topography within and adjacent to the Development Envelope for the proposed change is heavily governed by the underlying geology, the majority of which is extremely ancient and very hard. The landforms that the proposed route for Stage 4 (the proposed changes) will traverse can be divided into broad units defined as follows:

- foothills and ranges of the Chichester and Hamersley Ranges, which rise to approximately 350 metres (m) and 580 m respectively in the Development Envelope and consist of highly dissected, weathered plateau remnants.
- Fortescue River valley which is a wide, relatively flat valley incorporating numerous creeks and drainage lines as part of the Fortescue River system.

- eastern outwash plain of the Hamersley Range, which is dominated by very low alluvial ridges with scattered outcrops.

The Development Envelope for the proposed change intersects the following land systems (van Vreeswyk *et al,* 2004*;* **Figure 2-8**):

- Boolgeeda Land System – Stony lower slopes, level stony plains and narrow sub-parallel drainage floors, relief up to 20 m. A common system in shallow valleys below hill systems such as Newman and Rocklea.
- Brockman Land System – Level alluvial plains with clay soils and gilgai microrelief.
- Hooley Land System – Broad alluvial plains with clay soils and a mosaic of stony non-gilgaied and less stony gilgaied surfaces.
- Jurrawarrina Land System – Level alluvial plains with loamy soils over hardpan, broad alluvial tracts receiving more concentrated sheet and channelled through flow and with deeper more clayey soils.
- McKay Land System – Hills, ridges, plateaux remnants and minor breakaways of sedimentary and meta sedimentary rocks, relief up to 100 m.
- Newman Land System – Rugged high mountains, ridges and plateaux with near vertical escarpments of jaspilite, chert and shale, the second largest system in the survey area of van Vreeswyk (2004) and prominent in southern parts (e.g. Ophthalmia Range, Hamersley Range), relief up to 450 m.
- Nooingnin Land System – Level hardpan wash plains characterised by parallel bands of very large (up to 5 km long by 40 m wide) groves of dense vegetation with much wider and sparsely vegetated intergrove areas with variable density mantles of ironstone pebbles and shallow loamy soils over hardpan; minor sandy banks and plains receiving more concentrated through flow.
- Pindering Land System – Level to gently undulating hardpan wash plains with surface mantles of ironstone pebbles and gravel, some patterns of small groves and minor tracts receiving more concentrated through flow; relief up to 10 m.
- Platform Land System – Narrow, raised plains and highly dissected slopes on partly consolidated colluvium below the footslopes of hill systems such as Newman, relief mostly up to about 30 m but occasionally considerably greater.
- River Land System – Narrow floodplains and major channels.
- Urandy Land System - Alluvial plains with or without stony mantles and river channels.
-

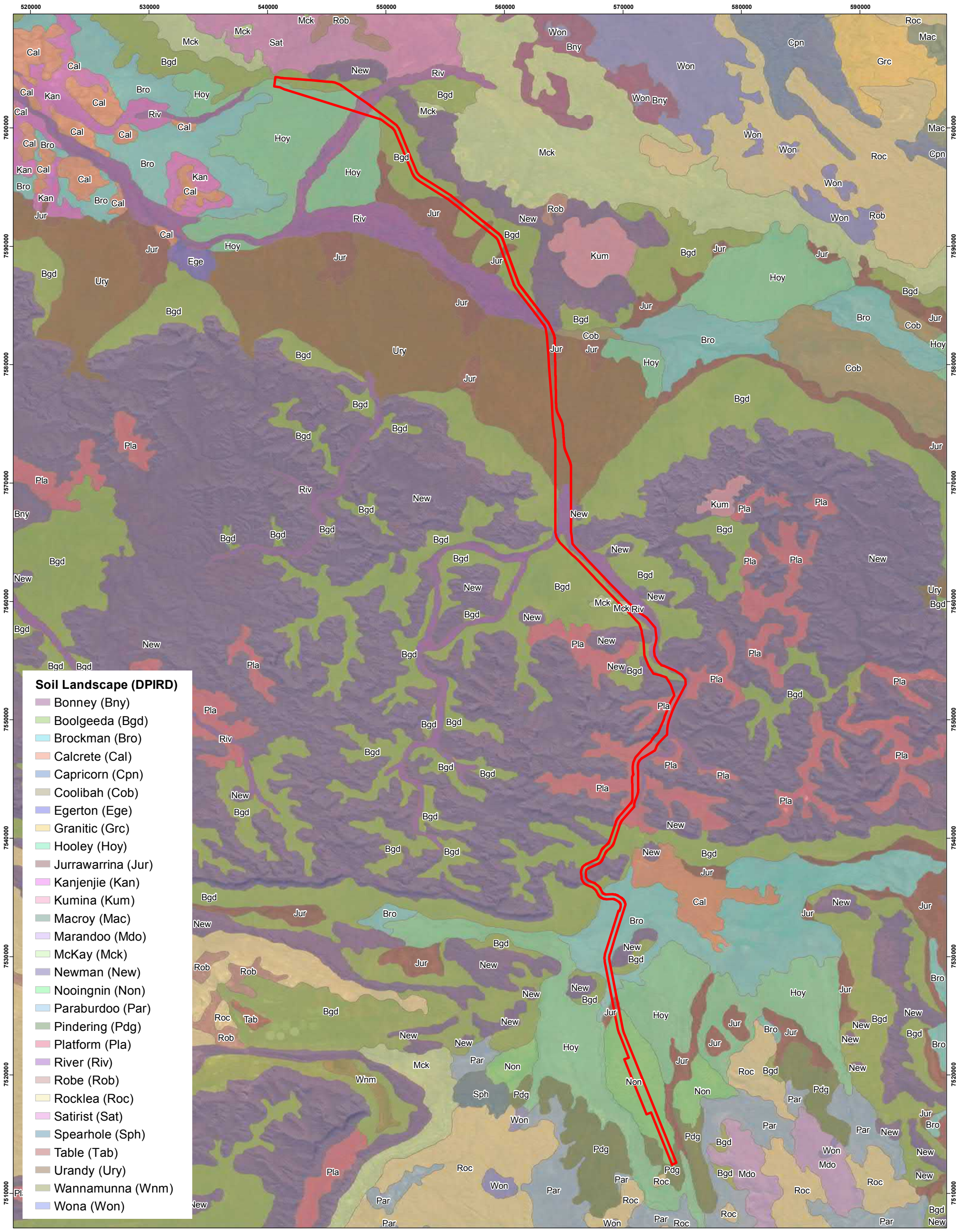

Figure 2-8: Land Systems

Legend

Karratha Tom Price Road Stage 4 Development Envelope

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2.6.6 Hydrology

Drinking water in the Pilbara is mainly sourced from groundwater with the Millstream Water Reserve servicing several key localities in the Pilbara region. The Development Envelope for the proposed change overlaps this water reserve, including areas listed partially as Priority 1 and Priority 2 drinking water source areas (see **Section 5.3.3.1**). Stage 3 of the Approved Proposal was also constructed through the Millstream Water Reserve.

The Fortescue River is the only major surface water feature overlapping the Development Envelope for the proposed change, however; there are a number of creeks and drainage lines within and adjacent to the Development Envelope (**Figure 5-3**). Notably, between 8 and 30 millimetres (mm) of rain is required to initiate runoff in the Pilbara and only 2-13% of mean annual rainfall becomes runoff (CSIRO, 2015). Due to large water flows during cyclonic events exceeding the amount of water that can be infiltrated during these events, streamflow exceeds recharge volumes by five to six times (CSIRO, 2015). Surface water hydrology specific to the Development Envelope for the proposed change is described in **Section 5.3.3.2**.

3. Stakeholder Consultation

Stakeholder consultation has been undertaken with regards to Stage 4 of the Manuwarra Red Dog Highway since 2019. Stakeholder consultation will continue through the Develop, Deliver and Operations Phases. A Community and Stakeholder Engagement Strategy (CSES) has been prepared to guide consultation for the project and will remain a live document as the project progresses. Objectives of the CSES are:

- generate awareness of and support (where possible) for the project;
- provide opportunity for stakeholders to input into the project, identifying stakeholder aspirations, opportunities and concerns with the project;
- use stakeholder input to guide project decision making; and
- obtain stakeholder buy-in to the design and construction methodology, ensuring where possible that the project addresses concerns, and if not, explain why not.

3.1 Stakeholder Identification

Stakeholders for the proposed change to Stage 4 of the Manuwarra Red Dog Highway have been identified through a review of the previous road stage upgrades, consultation with the project team and through a Preliminary Sustainability Stakeholder Workshop held in 2019. Key stakeholders identified to date are listed in **Table 3-1**.

Table 3-1: Key Stakeholders Identified for Stage 4 of the Manuwarra Red Dog Highway

Stakeholder	Relevance to Project
State Government Agencies ▪ Department of Transport (DoT) ▪ Department of Planning, Lands and Heritage (DPLH) ▪ Department of Biodiversity, Conservation and Attractions (DBCA) ▪ Department of Health (DoH) ▪ Department of Water and Environmental Regulation (DWER) ▪ Pilbara Development Commission (PDC) ▪ Department of Mines, Industry, and Safety (including Worksafe) (DMIRS) ▪ Water Corporation/Service providers	▪ Responsible for various elements of project ▪ Endorsement in line with existing and future planning requirements ▪ Approvals (i.e. DBCA) ▪ Millstream Water Protection – DWER ▪ DoH & DMIRS - Asbestos ▪ Cost implications (services relocation if required)
Federal Government Agencies Department of Agriculture, Water and the Environment (DAWE)	▪ Responsible for environmental approvals
Mining Companies ▪ Rio Tinto ▪ BBI ▪ Fortescue Metals Group (FMG)	▪ Future access/ construction impacts ▪ Rail maintenance track usage & rail arch ▪ Rail arch
Local Governments ▪ Shire of Ashburton ▪ City of Karratha	▪ Collaboration and engagement with Local Governments required around design development and communications ▪ Future access/ construction impacts

Stakeholder	Relevance to Project
	▪ Road ownership and maintenance
Road Users ▪ Residents within Karratha/Tom Price/Paraburdoo who may use the road ▪ Tourists/Visitors	▪ Future access/ construction impacts ▪ Detours and restricted access during construction
Environmental Groups	▪ Construction impacts
Pastoral Stations ▪ Coolawanyah Station ▪ Hamersley Station	▪ Future access/ construction impacts
Aboriginal Communities ▪ Wintawari Garuma Aboriginal Corporation (WGAC) ▪ Yindjibarndi Aboriginal Corporation (YAC)	▪ Future Access/ construction impacts ▪ Ethnographic and archaeological sites ▪ Construction opportunities

3.2 Stakeholder Engagement

A summary of the stakeholder engagement undertaken to date in relation to the proposed change is provided in **Table 3-2**.

Table 3-2: Stakeholder Consultation Undertaken for Stage 4 of the Manuwarra Red Dog Highway

Stakeholder	Date	Consultation Type	Consultation Topic/Outcome
Coolawanyah Station	18/06/2020	Email	Updates provided on heritage survey dates. Requested input on proposed corridors. Provided maps of 400 to 800 m wide corridor through Coolawanyah.
FMG	15/06/2020	Video Conference	Discussion of the corridor alignment and potential implications for tenure/FMG use of the sealed road. FMG requested files on proposed corridor to assess against future tenement considerations.
Shire of Ashburton	09/06/2020	Video Conference (Elected Members Forum)	Main Roads provided an update on the progress of Karratha Tom Price Stage 4.
Yindjibarndi Aboriginal Corporation	27/05/2020	Video Conference	Discussion on heritage survey access; project update; discussed potential development of an Indigenous Reference Group.
Rio Tinto	20/05/2020	Email	Main Roads contacted Rio Tinto Tenure Specialists to provide current corridor information and propose further discussions.
BBI	19/05/2020	Email	Main Roads contacted BBI to provide a project update, discussed traffic demand and the sharing of information.
Shire of Ashburton	19/05/2020	Meeting	Discussion of the term "Pilbara Proof" and its meaning to the Shire of Ashburton (e.g. impact

Stakeholder	Date	Consultation Type	Consultation Topic/Outcome
			on the road from cyclonic weather/flooding); the Shire's expectations for the design of the road and for ongoing communications / engagement with the council and wider community.
WGAC	08/05/2020	Video Conference	Discussion of a preferred Hamersley Homestead corridor alignment; heritage survey access; project update; potential development of an Indigenous Reference Group.
Coolawanyah Station	28/04/2020	Phone Conversation	Discussion of current corridor alignment, including key changes to the corridor and next phases of refining the alignment. An email with the current corridor alignment was provided as follow up.
FMG	24/04/2020	Video Conference	Discussion of FMG land tenure and any implications of the currently proposed corridors. Discussions regarding potential transport needs for FMG to provide context to the demand assessment report.
Balla Balla Infrastructure (BBI)	23/04/2020	Phone Conversation	Update that alignment corridor would be provided to stakeholder once approved. Stakeholder may then commence further discussion with Main Roads. Main Roads to investigate challenges of the stakeholder's confidentiality agreement.
Rio Tinto	20/04/2020	Meeting	Discussion of synergies with Rio Tinto's ongoing rail renewal project for potential sourcing of construction materials; and potential synergies with future quarries or borrow pits.
Chamber of Minerals and Energy (CME) Members	20/04/2020	Email	Email to CME Members providing an overview of the Karratha Tom Price Stage 4 Project and seeking input from CME Members.
Rio Tinto	17/04/2020	Meeting	Discussion of environmental surveys (location and schedule), geotechnical investigations and accommodation for local contractors; synergies in resources (e.g. ballast); traffic demand and crossing information.
PDC	17/04/2020	Video Conference	Project update provided and discussions on demand assessment considerations (i.e. current and future potential road users). Input provided by the PDC into the demand assessment for regional travel movements.
DWER (EPA Services)	26/03/2020	Video Conference	Briefed new EPA Services Officer on the project and seek advice /agreement on the approvals process for the project

Stakeholder	Date	Consultation Type	Consultation Topic/Outcome
DWER (EPA Services)	28/02/2020	Email	Email advising that the project should be referred as a 'Revised Proposal' (using section 38 referral form) for EPA consideration. The email provided some examples of other projects (e.g. Mesa A and H) that may offer guidance in relation to the referral, approval and characterisation of 'Revised Proposals' in a table.
WGAC and Eastern Guruma Traditional Owners	27/02/2020	Face to Face Meeting	Drive-through of alignment options and discussion of least impact option for Hamersley Station Homestead and Weelumurra Law Ground. Feedback received from stakeholders as to possible impacts and areas to be avoided. Further conversation required regarding alignment options at the next WGAC board meeting before decision made.
FMG	Dec 2019 – Feb 2020	Various Electronic Correspondence	Correspondence to achieve alignment on suitable locations and design for the future Karratha Tom Price Stage 4 intersection with FMG infrastructure; Eliwana rail arch (Bridge number 1870). FMG provided the 100% design report for this infrastructure to Main Roads.
WGAC	28/01/2020	Office-based Face to Face Meeting	Alignment options and concerns related to the Hamersley Station Homestead discussed. Focus on least impact option for the homestead. In-field walk-over of alignment options to the west of the homestead with Eastern Guruma Traditional Owners requested by WGAC.
DWER (EPA Services)	23/01/2020	Face to Face Meeting	Overview of the project and key environmental issues provided. Main Roads advised EPA it is of the view that the Project will require referral to the EPA (and Commonwealth Department of the Environment and Energy, now DAWE) for assessment. Main Roads advised to: ▪ demonstrate that the Proposal does not meet the criteria for a section 45c amendment to the existing Ministerial Statement; and ▪ then, should the Proposal not meet the criteria for a section 45c, it is most likely the Proposal would be assessed as a Revised Proposal.
Coolawanyah Station	05/01/2020	Email	Input received from Coolawanyah Station Owner and Manager Kim Parsons regarding specific concerns for the station.

Stakeholder	Date	Consultation Type	Consultation Topic/Outcome
▪ Rio Tinto ▪ Coolawanyah Station ▪ PDC ▪ DWER ▪ City of Karratha ▪ Karratha and Districts Chamber of Commerce and Industry (KDCCI) ▪ Shire of Ashburton ▪ Balla Balla Infrastructure (BBI)	10/12/2019	Face to Face Workshop (Karratha Tom Price Stage 4 Preliminary Sustainability Workshop)	A Preliminary Sustainability Workshop was held to define the main issues and opportunities associated with Stage 4 of the Manuwarra Red Dog Highway.
WGAC	14/11/2019	Face to Face Meeting	Discussion of options for the corridor alignment with regards to heritage issues. WGAC advised that: ▪ preferred option was a corridor to the east of the current railway; ▪ that the Weelumurra Creek is now a lodged site under the *Aboriginal Heritage Act 1972*; and ▪ expressed concerns regarding social impacts to the Hamersley Station Homestead. WGAC requested more information regarding alignment options around the homestead.
YAC	13/11/2019	Face to Face meeting	Discussion of options for the corridor alignment with regards to heritage issues. The YAC: ▪ advised Main Roads of the importance of Weelumurra Creek and asked for the least impact possible. ▪ discussed the importance of Millstream as a public drinking water source area. ▪ looks forward to a heritage survey over the proposed corridor to determine heritage issues more clearly.
DBCA	01/11/2019	Phone Conversation	Phone conversation to offer to brief DBCA on the proposed project. DBCA expressed a preference for a preliminary project meeting to be held in conjunction with the EPA Services team.
DWER (Water)	28/10/2019	Face to Face Meeting	Discussion of the project and expected approvals pathways. DWER advised Main Roads that:

Stakeholder	Date	Consultation Type	Consultation Topic/Outcome
			▪ the EPA is in same building as DWER and recommended early engagement and involvement with the EPA; ▪ there are four Water Quality Protection Notes (WQPNs) that should be referenced in the development of the project: WQPNs 44, 65, 83 and 84; ▪ that new roads are compatible activities in Priority (P) 1, P2 and P3 areas of public drinking water source areas, with conditions; ▪ beds and banks permits are required; and ▪ borrow pits must be free draining. Main Roads were advised that Justine Shailes (Program Manager in the Karratha Office) will be the main point of contact for the Project.
Coolawanyah Station	09/10/2019	Email	Email communication to station owner and Manager to introduce Main Roads Project Manager and invite consultation on the project for which alignment selection has now commenced.

4. Environmental Principles and Factors

4.1 Environmental Principles

The five core principles of environmental protection are embedded in the EP Act. These principles align with the principles of Ecologically Sustainable Development outlined in section 3A of the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth). **Table 4-1** describes how each of the five principles of the EP Act has been applied to the Revised Proposal.

Table 4-1: Principles of Environmental Protection

Principle	Consideration of Principle in the Revised Proposal
The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decision should be guided by: a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and b) an assessment of the risk-weighted consequences of various options.	A wide range of comprehensive desktop and field studies will be undertaken within the Development Envelope to assess the impact of the Revised Proposal. Studies will include: ▪ Flora and vegetation; ▪ Terrestrial fauna; ▪ Hydrology; and ▪ Heritage (Aboriginal and Historic). Impacts have been identified and described under each key environmental factor in the following sections. Information gathered during these studies will reduce the uncertainty surrounding prediction of impacts for the assessment. Preliminary mitigation and management measures have been proposed to ensure impacts are environmentally acceptable. These measures will be refined once the above listed studies have been completed.
The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The Revised Proposal will ensure the health, diversity and productivity of the environment is maintained through retaining as much habitat as possible and by taking into account the minimisation of environmental impacts where practicable during design and construction of the road.
The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Main Roads will seek to preserve as much of the biodiversity identified within the Development Envelope as possible by reducing clearing of native vegetation where practicable.

Principle	Consideration of Principle in the Revised Proposal
Principles relating to improved valuation, pricing and incentive mechanisms a) Environmental factors should be included in the valuation of assets and services. b) The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. c) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes. d) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.	Main Roads acknowledges the need for improved valuation, pricing and incentive mechanisms and endeavours to pursue these principles when appropriate. For example, environmental factors will determine the location of the road alignment within the Development Envelope and there will be a strong focus on reducing the direct and indirect clearing footprint. Impacts on flora, vegetation and terrestrial fauna will be assessed further once studies are completed and mitigation and management measures proposed in this document will also be further refined. Main Roads accepts that the cost of the Revised Proposal must include environmental impact mitigation, management and maintenance activities. These requirements will be incorporated into the overall Revised Proposal costs. The Revised Proposal will be subject to an Infrastructure Sustainability Council of Australia (ISCA) sustainability rating, which will assess the environmental, social and economic impacts of the Revised Proposal, including its waste stream and the resources utilised for construction. The ISCA rating scheme is designed such that goals are established for a proposal, then the proposal is assessed against the achievement of those goals. Main Roads have established a sustainability charter for the Revised Proposal, which includes commitments to use sustainability principles to guide decision-making throughout the project lifecycle, enhance biodiversity and maximise positive environmental outcomes and integrate sustainability into procurement, product life cycles and supply chains.
The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	The Revised Proposal will be subject to an ISCA sustainability rating, which will assess the environmental, social and economic impacts including waste minimisation and associated discharges. Where practicable, fill materials will be sourced from areas of cut along the road alignment to minimise the requirement to import additional material. Main Roads have established a sustainability charter for the Revised Proposal, which includes commitments to maximise the use of 'on alignment' materials/resources and promote circular economy to drive innovation in waste reduction.

4.2 Identification of Environmental Factors

Environmental factors are those parts of the environment that may be impacted by a Proposal (EPA, 2020). The EPA has 14 environmental factors, organised into five themes (Sea, Land, Water, Air and People) as detailed in **Table 4-2**, which allow for a systematic approach to organising environmental information for the purpose of impact assessment. Each of the 14 environmental factors has an associated objective which is used to determine whether the potential environmental impacts of a Proposal or scheme may be significant. The EPA environmental factors and objectives, and their relevance to the proposed changes, are summarised in **Table 4-2**.

Table 4-2: WA EPA Environmental Factors (EPA, 2020) and their Relevance to the Proposed Changes

Theme	Factor	Objective	Relevance to Proposed Change	Significant Environmental Factor?
Sea	Benthic Communities and Habitats	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.	The proposed change is not located in or near the marine environment	×
	Coastal Processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.		
	Marine Environmental Quality	To maintain the quality of water, sediment and biota so that environmental values are protected.		
	Marine Fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.		
Land	Flora and Vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	Construction requires vegetation clearing, including up to 75 ha of the *Themeda* Grasslands TEC.	✓
	Landforms	To maintain the variety and integrity of significant physical landforms so that environmental values are protected.	Distinctive, unique or important landforms are not present.	×
	Subterranean Fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.	No conservation significant subterranean fauna identified within the Development Envelope for the proposed change. The "Stygofaunal community of the Western Fortescue Plains freshwater aquifer" PEC occurs within the nearby Millstream-Chichester National Park. No impacts to this PEC are anticipated from the proposed change given the distance of the National Park from the Development Envelope and the limited interaction between the proposed change and groundwater.	×

Theme	Factor	Objective	Relevance to Proposed Change	Significant Environmental Factor?
	Terrestrial Environmental Quality	To maintain the quality of land and soils so that environmental values are protected.	Likelihood of Acid Sulfate Soils (ASS) is considered extremely low to low within the Development Envelope for the proposed change according to the ASRIS database.	×
	Terrestrial Fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	Construction will result in clearing of habitat for conservation significant fauna.	✓
Water	Inland Waters	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.	The Development Envelope for the proposed change crosses several watercourses, including the Fortescue River downstream of the Fortescue Marshes. The Development Envelope for the proposed change is partially located within the Millstream Water Reserve, in both Priority 1 and Priority 2 protection areas.	✓
Air	Air Quality	To maintain air quality and minimise emissions so that environmental values are protected.	Air emissions, largely in the form of dust, will be generated during construction. Given the remote location and low traffic volumes (less than 15,000 vehicles per day), air emissions are not expected to result in significant impacts.	×
	Greenhouse Gas (GHG) Emissions	To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change	Based on estimated GHG emissions from other recent Main Roads projects, Scope 1 GHG emissions associated with the proposed change are expected to be well below the 100,000 tonnes CO_2-equivalent per annum threshold defined in the Environmental Factor Guideline (EPA, 2020).	×
People	Social Surroundings	To protect social surroundings from significant harm.	Five registered Aboriginal heritage sites occur within the Development Envelope for the proposed change with a further 28 occurring within 2.5 km of the Development Envelope.	✓

Theme	Factor	Objective	Relevance to Proposed Change	Significant Environmental Factor?
	Human Health	To protect human health from significant harm.	No human health impacts expected. No radiation emissions will result from the proposed changes or the Revised Proposal.	×

5. Key Environmental Factors

The following subsection discuss the predicted impacts to the key environmental factors in relation to the proposed change only. The impacts predicted for Stages 2 and 3 remain as discussed in the CER.

5.1 Flora and Vegetation

5.1.1 EPA Objective

The WA EPA objective for the flora and vegetation environmental factor is 'To protect flora and vegetation so that biological diversity and ecological integrity are maintained'.

5.1.2 Policy and Guidance

The following EPA policies and guidelines have been considered for the proposed changes in order to meet the EPA's objective in relation to this factor:

- Statement of *Environmental Principles, Factors and Objectives* (EPA, 2020);
- *Environmental Factor Guideline – Flora and Vegetation* (EPA, 2016a); and
- *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b).

The Environmental Factor Guideline has been considered during the identification of flora and vegetation values within the Development Envelope for the proposed changes and the issues identified in the guideline considered in relation to potential impacts from the proposed changes.

Flora and vegetation surveys have been and will continue to be planned and executed in accordance with the EPA's technical guidance for this factor. Any survey limitations relative to the technical guidance will be noted in the flora and vegetation survey report.

5.1.3 Receiving Environment

5.1.3.1 Surveys and Studies

A number of surveys and investigations were undertaken to inform the CER. More recently, a weed survey has been completed over an area that includes the northern portion of the Development Envelope for the proposed changes (Ecologia Environment, 2018). The report for this survey is provided in **Appendix A**.

Further surveys are underway across the entire Development Envelope for the proposed changes to provide up to date and accurate information and enable effective prediction, quantification, assessment and management of potential impacts.

5.1.3.2 Vegetation

Overview

Vegetation within the Development Envelope for the proposed changes lies within the Beard (1975) Fortescue Botanical District (Pilbara Region), which is divided into the Fortescue River and Valley and Hamersley Plateau subdivisions. The characteristics of these vegetation associations are described below.

Fortescue River and Valley

The Fortescue River and Valley are located between the high points of the Chichester and Hamersley Ranges and Plateaux. The soil types found in the valley are predominantly Quaternary alluvial and colluvial deposits. The sand plain areas of the Fortescue Valley are mostly vegetated with Acacia shrubs of various species (*A.*

ancistrocarpa, *A. acradenia*, *A. inaequilatera* and *A. tumida/colei*) over Spinifex (*Triodia pungens* and/or *T. wiseana*).

Major drainage lines are wide and support River Gums (*Eucalyptus camaldulensis*) over Paperbarks (*Melaleuca glomerata* and *M. linophylla*) over small shrubs, herbs and grass species. The smaller drainage channels have scattered trees of *E. camaldulensis* and/or *E. victrix* (Coolibah) over a denser cover of *Acacia citrinoviridis* and a mixture of small shrubs, herb and grass species in the understorey.

Hamersley Plateau and Range to the intersection with the Nanutarra – Wittenoom Road

The vegetation of the Hamersley Ranges is characteristically *Eucalyptus leucophloia* (Snappy Gum) and *Corymbia hamersleyana* over Spinifex (*Triodia wiseana*). Small trees of *Eucalyptus gamophylla* and *Corymbia deserticola* are also present. The principal shrub species found on these areas are mostly of the Acacia genus; *A. inaequilatera*, *A. dictyophleba*, *A. monticola*, *A. tumida/colei*, *A. ancistrocarpa*, *A. pachyacra/tenuissima*, *A. adoxa*, *A. synchronicia* and *A. acradenia*.

Most of the valley plains support Mulga (*Acacia aneura*) low woodland, though some of the widest and flattest valley floors develop open grassland. Mulga is usually associated with another Acacia species, *Acacia pruinocarpa*, a small tree of about four to five metres. Some other small tree and shrub species found growing in alluvial soils characterised by Mulga woodlands are *Acacia xiphophylla* (in localised small patches only), *A. tetragonophylla*, *Psydrax latifolia*, *Eremophila fraseri*, *E. latrobei, E. longifolia* and *Grevillea stenobotrya*.

The major and minor drainage lines are vegetated with principally the same species, but in varying proportions depending on the width and depth of the channels and their area. The main tree species recorded in areas with seasonally flowing water are; *Corymbia hamersleyana*, *Eucalyptus camaldulensis* and *E. victrix*, over the shrub species *Gossypium robinsonii*, *G. australe*, *Acacia farnesiana*, and the grass species *Cymbopogon ambiguus* and *Cenchrus ciliaris* (an introduced pasture grass).

Grasslands in the northern part of Hamersley Station are dominated by *Themeda* sp. (Hamersley Station) (M.E. Trudgen 11431) (listed as Priority 3 by DBCA). This community has been endorsed by the State Minister for the Environment as a TEC. The DBCA listed Priority 1 PEC Brockman Iron cracking clay communities of the Hamersley Range is also found in the northern portion of Hamersley station. These communities are discussed further below.

Threatened Ecological Communities

The Development Envelope for the proposed changes traverses a known occurrence of the TEC 'Themeda Grasslands' (**Figure 5-1**). This vegetation type is described as areas of grassland plains, which are dominated by the perennial grass species *Themeda sp.* Hamersley Station (M.E. Trudgen 11431) and many annual herbs and grasses. There are also various other species of trees, shrubs, herbs and grasses found growing on the clay soils of this vegetation community. The vegetation community has been endorsed as a Vulnerable (Category A) TEC by the Minister for the Environment but is not listed under the EPBC Act. The DBCA records indicate that this community covers approximately 34,600 ha, of which approximately 202.5 ha is within the Development Envelope for the proposed changes.

Priority Ecological Communities

The Development Envelope also traverses a known occurrence of the PEC 'Brockman Iron cracking clay communities of the Hamersley Range'. Approximately 353 ha of this PEC is within the Development Envelope for the proposed changes and approximately 31,805 ha within 50 km of the Development Envelope, based on DBCA mapping. This PEC is found in association with and adjacent to the Themeda Grasslands TEC in this location. Three other PECs are within 50 km of the Development Envelope for the proposed changes. All four PECs are described below and shown on **Figure 5-1** (DBCA, 2020):

- **Brockman Iron cracking clay communities of the Hamersley Range - Priority 1**

  'Rare tussock grassland dominated by *Astrebla lappacea* (not every site has presence of *Astrebla*) in the Hamersley Range, on the Brockman land system. Tussock grassland on cracking clays- derived in valley floors, depositional floors. This is a rare community and is known from near West Angeles, Newman, Tom Price and boundary of Hamersley and Brockman Stations'.

- **Kanjenjie Land System – Priority 3**

  'Stony clay plains supporting snakewood shrublands with tussock grasses. Supports tall shrublands of mulga, snakewood and other acacias with understorey of low shrubs or perennial grasses. Some parts support tussock grasslands of Mitchell grass or Roebourne Plains grass with few shrubs'.

- **Kumina Land System – Priority 3**

  'Ferricrete duricrust plains, uplands and plateaux remnants, relief up to 15 m. Duricrust plains and plateau remnants support hard spinifex grasslands'.

- **Stygofaunal community of the Western Fortescue Plains freshwater aquifer – Priority 4**

  'A unique assemblage of subterranean invertebrate fauna associated with the Millstream freshwater aquifer'.

Vegetation Associations as per Beard (1975)

Eight vegetation associations as mapped by Beard (1975) occur within the Development Envelope for the proposed changes. These are detailed in **Table 5-1** along with the pre-European extent, current extent and percentage of the vegetation association remaining at difference scales (Statewide, IBRA Bioregion, IBRA Subregion and Local Government Area (LGA)).

The condition and assemblages of these vegetation associations within the Development Envelope for the proposed changes is to be confirmed by the field surveys currently being undertaken.

Table 5-1: Beard (1975) Vegetation Associations within the Development Envelope (Government of Western Australia, 2019).

Vegetation Association	Description	Scale	Pre-European Extent (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA Reserves
607	Hummock grasslands, low tree steppe; snappy gum and bloodwood over soft spinifex and *Triodia wiseana*.	Statewide	120, 789.19	120,599.81	99.84	12.84
		IBRA Bioregion[1]	120, 789.19	120,599.81	99.84	12.84
		IBRA Subregion - Chichester	119,022.15	118,832.76	99.84	13.03
		LGA[2]	120,789.19	120,599.81	99.84	12.84
646	Hummock grasslands, shrub steppe; snakewood over *Triodia basedowii*.	Statewide	47,555.98	47,555.98	100.00	2.34
		IBRA Bioregion	47,546.55	47,546.55	100.00	2.34
		IBRA Subregion - Chichester	18,625.13	18,625.13	100.00	1.45
		IBRA Subregion - Hamersley	13,907.39	13,907.39	100.00	*None within DBCA reserves*
		LGA	47,555.98	47,555.98	100.00	2.34
29	Sparse low woodland; mulga, discontinuous in scattered groups.	Statewide	7,903,991.45	7,898,973.24	99.94	0.29
		IBRA Bioregion	1,133,219.76	1,131,712.01	99.87	1.91
		IBRA Subregion - Chichester	62,506.95	62,506.95	100.00	*None within DBCA reserves*
		IBRA Subregion - Hamersley	172,082.57	170,747.58	99.22	11.21
		LGA	274,442.50	273,138.45	99.52	7.87
82	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*.	Statewide	2,565,901.28	2,553,206.19	99.51	10.25
		IBRA Bioregion	2,563,583.23	2,550,888.14	99.50	10.26
		IBRA Subregion - Chichester	360,666.90	360,322.69	99.90	*None within DBCA reserves*
		IBRA Subregion - Hamersley	2,177,573.90	2,165,224.21	99.43	12.04

[1] Pilbara Bioregion
[2] LGA = Local Government Area; Ashburton

Vegetation Association	Description	Scale	Pre-European Extent (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA Reserves
		LGA	1,537,076.71	1,533,313.95	99.76	17.11
175	Short bunch grassland - savanna/grass plain (Pilbara).	Statewide	526,957.95	524,640.18	99.56	4.21
		IBRA Bioregion	507,860.16	507,466.80	99.92	4.37
		IBRA Subregion - Chichester	230,987.86	230,952.43	99.98	9.61
		IBRA Subregion - Hamersley	93,039.76	92,751.05	99.69	*None within DBCA reserves*
		LGA	267,900.95	267,555.16	99.87	8.29
565	Hummock grasslands, low tree steppe; bloodwood over soft spinifex.	Statewide	143,438.92	143,427.36	99.99	*None within DBCA reserves*
		IBRA Bioregion	108,956.73	108,945.16	99.99	
		IBRA Subregion - Hamersley	108,956.73	108,945.16	99.99	
		LGA	108,956.73	108,945.16	99.99	
644	Hummock grasslands, open low tree steppe; mulga and snakewood over soft spinifex and *Triodia basedowii*.	Statewide	27,199.82	27,068.69	99.52	*None within DBCA reserves*
		IBRA Bioregion	27,199.82	27,068.69	99.52	
		IBRA Subregion - Hamersley	3.57	3.57	100.00	
		LGA	27,199.82	27,068.69	99.52	
645	Hummock grasslands, shrub steppe; kanji and snakewood over soft spinifex and *Triodia wiseana*.	Statewide	84,670.25	84,658.03	99.99	*None within DBCA reserves*
		IBRA Bioregion	84,670.25	84,658.03	99.99	
		IBRA Subregion - Hamersley	16,294.77	16,286.24	99.95	
		LGA	84,670.25	84,658.03	99.99	

5.1.3.3 Flora

A search of the Commonwealth Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) and review of the spatial distribution of Threatened and Priority flora records available from DBCA identified 22 Priority flora species known to occur within 50 km of the Development Envelope for the proposed changes (**Table 5-2**). None of these records are within the Development Envelope for the proposed changes.

Table 5-2: DBCA Flora Records of Listed Threatened or Priority Species within 50 km of the Development Envelope

Species	Conservation Status
Barbula ehrenbergii	Priority 1
Calotis squamigera	Priority 1
Indigofera ixocarpa	Priority 2
Paspalidium retiglume	Priority 2
Scaevola sp. Hamersley Range basalts (S. van Leeuwen 3675)	Priority 2
Acacia daweana	Priority 3
Acacia effusa	Priority 3
Astrebla lappacea	Priority 3
Dampiera anonyma	Priority 3
Eragrostis crateriformis	Priority 3
Eremophila magnifica subsp. *velutina*	Priority 3
Fimbristylis sieberiana	Priority 3
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	Priority 3
Olearia mucronata	Priority 3
Owenia acidula	Priority 3
Ptilotus subspinescens	Priority 3
Sida sp. Hamersley Range (K. Newbey 10692)	Priority 3
Stylidium weeliwolli	Priority 3
Acacia bromilowiana	Priority 4
Goodenia nuda	Priority 4
Lepidium catapycnon	Priority 4
Ptilotus trichocephalus	Priority 4

In addition, a survey by Rio Tinto found eight (8) records of a *Eulalia* sp. (Three Rivers Station B. Forsyth AQ6789133) (Biota, 2018) within and adjacent to the Development Envelope proposed changes. This species has not been formally described and is not currently recognised on FloraBase or Australia's Virtual Herbarium. A formal description of the species is currently underway. It is considered unlikely that this species will be listed as Threatened under the BC Act, though it may be listed as a Priority species by DBCA (Biota, 2018).

5.1.3.4 Weeds

The search of the DAWE PMST indicated that two invasive flora species may occur within the Development Envelope for the proposed changes, or the immediate surrounds; *Cenchrus ciliaris* (buffel-grass, black buffel-grass) and *Parkinsonia aculeata* (parkinsonia, Jerusalem thorn, jelly bean tree, horse bean) (**Appendix B**). *P. aculeata* is listed as a Weed of National Significance (WONS).

During the Ecologia Environment weed survey (Ecologia Environment, 2018) of the Karratha Tom Price Stage 4A (northern section) alignment, ten (10) weed species were recorded:

- *Aerva javanica* (kapok bush);
- *Bidens bipinnata* (bipinnate beggartick);
- *Cenchrus ciliaris* (buffel grass);
- *Cenchrus setiger* (birdwood grass);
- *Cenchrus* spp.;
- *Echinochloa colona* (awnless barnyard grass);
- *Flaveria trinervia* (speedy weed);
- *Malvastrum americanum* (spiked malvastrum);
- *Melochia pyramidata* (pyramid flower);
- *Passiflora foetida* var. *hispida* (stinking passion flower); and
- *Sonchus oleraceus* (common sowthistle).

None of these species are Declared Plants under the *Biosecurity and Agriculture Management Act 2007* or WONS.

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Tom Price Railway Rd

Roebourne-Wittenoom Rd

Coolawanyah Rd

Tom Price Railway Rd

Hamersley Rd

Nanutarra Rd

Hamersley-Mount Bruce Rd

Bingann Rd

Conservation Significant Flora

- *Astrebla lappacea*, P3
- *Dampiera anonyma*, P3
- *Eremophila magnifica* subsp. *velutina*, P3
- *Goodenia nuda*, P4
- *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727), P3
- *Lepidium catapycnon*, P4
- *Paspalidium retiglume*, P2
- *Ptilotus subspinescens*, P3
- *Scaevola* sp. Hamersley Range basalts (S. van Leeuwen 3675), P2
- *Sida* sp. Hamersley Range (K. Newbey 10692), P3

Vegetation Association (Beard, 1975)

- 18; Low woodland, open low woodland or sparse woodland
- 29; Low woodland, open low woodland or sparse woodland
- 82; Low tree-steppe
- 173; Shrub-steppe
- 175; Grasslands, short bunch-grass savanna
- 565; Low tree-steppe
- 567; Shrub-steppe
- 569; Low tree-steppe
- 587; Sparse low tree-steppe / Sparse shrub-steppe
- 607; Low tree-steppe
- 629; Short bunch-grass savanna / Grass-steppe
- 641; Woodland other
- 644; Low tree-steppe
- 645; Shrub-steppe
- 646; Shrub-steppe

Figure 5-1: DBCA Flora Records and Beard (1975) Vegetation Associations

Legend

- *Eualia* sp. Three Rivers Station (B. Forsyth AQ6789133)
- Development Envelope

Threatened Ecological Communities (DBCA)

- Threatened
- Priority

0 2.5 5 10

Kilometres

N

KARRATHA

TOM PRICE

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5.1.4 Potential Impacts

Potential direct and indirect impacts to flora and vegetation within the Development Envelope for the proposed changes may result from the following project activities:

- clearing for construction of the road and ongoing maintenance activities;
- clearing for associated construction activities such as site offices, laydown, side-tracks and so on;
- construction dewatering of the Fortescue River crossing and potential other watercourse crossings;
- abstraction of water for construction purposes;
- design of roadside drainage; and
- movement of construction vehicles and machinery around the site.

Potential impacts in relation to the proposed changes have been identified as:

- clearing of up to 800 ha native vegetation. Details on the extent of clearing by vegetation type is provided in **Table 5-3**. Of this total, 100 ha is temporary clearing that will be revegetated once construction is complete.
- clearing of up to 75 ha of the Themeda Grasslands TEC and up to 115 ha of the Brockman Iron PEC, based on mapping data obtained from DBCA. This clearing is included in the 800 ha of total clearing detailed above.
- clearing of Priority flora species, such as *Goodenia nuda* (Priority 4) and the undescribed *Eulalia* sp. (Three Rivers Station B. Forsyth AQ6789133), should they be found within the disturbance footprint.
- vehicle movements and earthmoving activities may result in the introduction of new or spread of existing weed species.
- should dewatering be required to construct the crossing at the Fortescue River or other watercourses, the resultant drawdown may indirectly impact groundwater dependent vegetation (GDEs) in the area. The dewatering and any associated impacts are anticipated to be temporary.
- changes to surface water flow as a result of the construction and presence of the road may result in indirect impacts to flora and vegetation.
- fragmentation of vegetation, in particular the Themeda Grasslands TEC.

Table 5-3: Estimated Clearing Area of Beard (1975) Vegetation Associations, TECs and PECs

Vegetation Description	Estimated Additional Clearing (ha)	Current Bioregional Extent Remaining (ha)
Beard (1975) Vegetation Associations		
29	Up to 41	1,131,712.0
82	Up to 75	2,550,888.1
175	Up to 155	507,466.8
565	Up to 195	108,945.2
607	Up to 175	120,599.8
644	Up to 70	27,068.7
645	Up to 12	84,658.0
646	Up to 25	47,546.6

Vegetation Description	Estimated Additional Clearing (ha)	Current Bioregional Extent Remaining (ha)
TEC		
Themeda Grasslands (within Vegetation Associations 82 and 175)	Up to 75[1]	34,600[2]
PEC		
Brockman Iron cracking clay communities of the Hamersley Range (within Vegetation Associations 82 and 175 and overlaps the TEC)	Up to 115[1]	Not known (31,805 ha[2] within 50 km of the Development Envelope)

Notes: 1 - The TEC and PEC occur within the Beard (1975) Vegetation Associations. As such, the area of clearing is a subset of the clearing stated for the corresponding Beard (1975) Vegetation Associations, that is, the estimated clearing for the TEC and PEC are not cumulative. 2 – extent remaining has been estimated from DBCA mapping.

5.1.5 Mitigation

The following measures have been proposed to manage and mitigate the potential environmental impacts from the proposed changes:

- the use of existing cleared areas where practicable (existing tracks and pits);
- avoidance of conservation significant flora where possible in designing/selecting the alignment;
- use of existing material pits;
- sourcing materials that don't require additional vegetation clearing, such as using materials from areas of cut in areas where fill is needed;
- the clearing area and any 'no-go zones' will be demarcated prior to ground disturbing activities commencing;
- where safe to do so, batters will be steepened to reduce the clearing footprint;
- safety barriers will be installed where practicable to allow roadside batters to be steepened;
- all vehicles arriving on site to be certified clean and free of soils or vegetative matter;
- weedy patches within the clearing footprint will be clearly marked prior to clearing and cleared separately to other patches of the alignment. Plant undertaking the clearing of weedy patches will be cleaned down prior to returning to non-weed infested sections;
- topsoil will be segregated according to its weed status as appropriate;
- creek crossings will be designed to minimise potential changes to surface water flows and design of road drainage to consider potential for drainage shadows or waterlogging;
- if dewatering is required, dewatering rates will be managed to minimise drawdown and potential impacts to GDEs; and
- residual impacts to TECs, PECs and conservation significant flora will be managed via offsetting as appropriate.

Project specific Environmental Management Plans (EMPs) will be developed to manage impacts to flora and vegetation associated with the Revised Proposal. The EMPs to be developed will include:

- Construction Environmental Management Plan (CEMP);
- Vegetation Protection and Rehabilitation Management Plan; and
- Weed Control and Management Plan.

5.1.6 Assessment of Impacts

An assessment of the potential impacts to flora and vegetation from the proposed changes, based on current knowledge, is provided in **Table 5-4**. As noted in **Section 5.1.3.1**, a flora and vegetation survey of the Development Envelope for the proposed changes is currently underway, which will further inform the assessment of potential impacts to flora and vegetation associated with the proposed changes.

Table 5-4: Assessment of Impacts to Flora and Vegetation from the Revised Proposal

Aspect	Assessment
Vegetation – Beard (1975) Vegetation Associations	**Table 5-3** details the expected approximate area of each Vegetation Association to be cleared for the proposed changes. These values comprise a very small percentage of the remaining pre-European extent within the LGA for each Vegetation Association (<0.22% in all cases), as well as at the regional and Statewide scales. Impacts to these Vegetation Associations at the Local and Regional scales as a result of clearing for the proposed changes are, therefore, not anticipated. The flora and vegetation survey currently underway will verify these records and enable a more informed assessment regarding the amount of each Vegetation Association present within the Development Envelope for the proposed changes and the extent that may be directly impacted by clearing.
Vegetation – TEC	Up to 75 ha of the Themeda Grasslands TEC is proposed to be cleared. DBCA records indicate that the TEC covers approximately 34,600 ha. The required clearing equates to 0.49% of this extent. As such the clearing is considered unlikely to result in regional scale impacts to this TEC. This TEC is mapped as overlapping part of the Development Envelope for the proposed changes (approximately 5 km of the proposed alignment) at one location. Clearing of this TEC along the alignment is unlikely to further fragment the ecological community, given the level of fragmentation already existing due the presence of the Rio Tinto railway. The railway and associated access roads sit within a 65 m corridor, resulting in the TEC being separated into an approximately 475 ha portion on the western side, with the remainder of the TEC to the east. Construction of Stage 4 will require clearing of a 40 m – 60 m corridor to the west of the railway, reducing the western portion of the TEC by about 75 ha. Construction of the Revised Proposal is unlikely to increase the level of fragmentation of the TEC or change the existing edge effect impacts experienced by the western portion of the TEC. The surveys currently underway will verify the presence and extent of the TEC within the Development Envelope for the proposed changes and allow a thorough assessment of potential impacts.
Vegetation - PECs	Only one PEC overlaps the Development Envelope for the proposed changes, the 'Brockman Iron cracking clay communities of the Hamersley Range'. The surveys currently underway will verify the occurrence and condition of this PEC within the Development Envelope.

Aspect	Assessment
	Clearing of this PEC along the alignment is unlikely to further fragment the ecological community as there is a level of fragmentation already existing due to the presence of the Rio Tinto railway. Construction of the Revised Proposal is therefore considered unlikely to increase the level of fragmentation of the PEC. The other PECs identified near to the Development Envelope for the proposed changes but not overlapping it are sufficiently far away that both direct and indirect impacts are considered unlikely.
Flora – Conservation Significant Species	Whilst there are a number of flora species of conservation significance within 50 km of the Development Envelope for the proposed changes, according to DBCA records, no records overlap the Development Envelope. Known records of the Priority 4 species *Goodenia nuda* are within 500 m of the Development Envelope for the proposed changes. As the Vegetation Associations and Land Systems this species is found in occur within the Development Envelope, habitat for this species is likely to occur within the Development Envelope and may be impacted by the proposed changes. It is acknowledged that there are eight (8) records of the currently undescribed species *Eulalia sp.* (Three Rivers Station B. Forsyth AQ6789133) that are within or in the immediate vicinity of the Development Envelope for the proposed changes (Biota, 2018). The significance of clearing of individuals is unknown as the species has not formally been described, though it is likely that it will be listed as a Priority species (Biota, 2018). Main Roads will consult with DBCA where clearing of the species may be required to identify the significance of this and appropriate management actions. Flora surveys currently being undertaken will contribute to further assessment of impacts to conservation significant flora and this species of *Eulalia*.
Weeds	As the Development Envelope for the proposed changes is primarily located within or adjacent to the existing Rio Tinto railway access road and largely within pastoral leases (i.e. already disturbed areas), it is likely that weed species, such as those identified by Ecologia Environment (2018), will be present. Management measures will be implemented to reduce the risk on introducing new weed species to the Development Envelope for the proposed changes or spreading those species already present.

Impacts resulting from the proposed changes against this environmental factor have largely been assessed based on desktop review of available data and literature. Once the results of the ecological surveys that are currently underway are known, the impact assessment will be revisited and refined.

5.1.7 Predicted Outcome

The clearing of up to 75 ha of the Themeda Grasslands TEC required for construction of the Revised Proposal represents a significant impact. As this will be a permanent loss of the TEC, the residual impact is also considered significant. The ecological surveys currently underway will define the extent and condition of the TEC within the Development Envelope for the proposed changes and assist in the development of management measures and design criteria to reduce the extent of clearing required. Residual impacts to the TEC will require offsetting.

Other potential impacts to flora and vegetation associated with the proposed changes will not be significant at the local or regional scale. With implementation of the management measures proposed, together with offsetting of the significant residual impacts to the TEC, the WA EPA's objective for flora and vegetation can be met.

5.2 Terrestrial Fauna

5.2.1 EPA Objective

The WA EPA objective for the Terrestrial Fauna environmental factor is 'To protect terrestrial fauna so that biological diversity and ecological integrity are maintained'.

5.2.2 Policy and Guidance

The following EPA policies and guidelines have been considered for the proposed changes in order to meet the EPA's objective in relation to this factor:

- Statement of *Environmental Principles, Factors and Objectives* (EPA, 2020);
- *Environmental Factor Guideline – Terrestrial Fauna* (EPA, 2016c); and
- *Technical Guidance – Terrestrial Fauna Surveys* (EPA, 2020).

The Environmental Factor Guideline has been considered during the identification of fauna values within the Development Envelope for the proposed changes and the issues identified in the guideline considered in relation to potential impacts from the proposed changes.

Fauna surveys have been and will continue to be planned and executed in accordance with the EPA's technical guidance for this factor. Any survey limitations relative to the technical guidance will be noted in the fauna survey report.

5.2.3 Receiving Environment

5.2.3.1 Surveys and Studies

A number of surveys and investigations were undertaken to inform the CER. More recently, a desktop and targeted field survey for the northern quoll (*Dasyurus hallucatus*) has been completed over an area that includes the northern portion of the Development Envelope for the proposed changes (GHD, 2017). The report for this survey is provided in **Appendix C**.

Further surveys are underway across the entire Development Envelope for the proposed changes to provide up to date and accurate information and enable effective prediction, quantification, assessment and management of potential impacts.

5.2.3.2 Fauna Species

Searches of the DAWE PMST and DBCA Threatened and Priority fauna database identified 10 species listed as threatened under the EPBC Act or BC Act, including one species listed under the BC Act as "Specially Protected Fauna", that may occur within the Development Envelope for the proposed changes (**Table 5-5**). The searches also identified 13 species listed as Priority species by DBCA (**Table 5 5**) and the following 15 migratory bird species that may occur within the Development Envelope for the proposed changes:

- Fork-tailed swift (*Apus pacificus*);
- Common sandpiper (*Actitis hypoleucos*);
- Sharp-tailed sandpiper (*Calidris acuminata*);
- Pectoral sandpiper (*Calidris melanotos*);
- Long-toed stint (*Calidris subminuta*);
- Oriental plover (*Charadrius veredus*);
- Swinhoe's snipe (*Gallinago megala*)

- Oriental pratincole (*Glareola maldivarum*).
- Barn swallow (*Hirundo rustica*);
- Grey wagtail (*Motacilla cinerea*);
- Yellow wagtail (*Motacilla flava*);
- Whimbrel (*Numenius phaeopus*)
- Osprey (*Pandion cristatus*);
- Glossy Ibis (*Plegadis falcinellus*); and
- Wood sandpiper (*Tringa glareola*).

These migratory species mostly use the East Asian – Australasian (EAA) Flyway during their seasonal migration between breeding and staging grounds. Within mainland WA, they are typically associated with coastal wading or intertidal habitats such as wetlands, estuaries, and sand and mudflats; although some species occur further inland within similar habitats. These species may occur in association with the Fortescue River and floodplain.

Table 5-5: Listed Threatened and Priority Fauna Species Potentially Occurring within the Development Envelope for the Proposed Changes

Species Name	Common Name	Listing under the BC Act	Listing under the EPBC Act	Likelihood of Occurrence[1]
Birds				
Calidris ferruginea	Curlew sandpiper	Critically Endangered	Critically Endangered, Migratory	**Unlikely** – suitable habitat not present
Pezoporus occidentalis	Night parrot	Critically Endangered	Endangered	**Possible** – suitable habitat present
Rostratula australis	Australian painted snipe	Endangered	Endangered	**Unlikely** – suitable habitat not present
Falco hypoleucos	Grey falcon	Vulnerable	Vulnerable	**Possible** – suitable habitat present
Falco peregrinus	Peregrine falcon	Other Specially Protected Fauna (OS)	Not listed.	**Possible** – suitable habitat present
Amytornis striatus	Striated grasswren (inland)	Priority 4	Not listed.	**Likely** – suitable habitat present
Mammals				
Dasyurus hallucatus	Northern quoll	Endangered	Endangered	**Likely** – suitable habitat present
Macroderma gigas	Ghost bat	Vulnerable	Vulnerable	**Likely** – suitable habitat present
Macrotis lagotis	Bilby	Vulnerable	Vulnerable	**Unlikely** – suitable habitat not present
Rhinonicteris aurantia (Pilbara form)	Pilbara leaf-nosed bat	Vulnerable	Vulnerable.	**Likely** – suitable habitat present
Lagorchestes conspicillatus leichardti	Spectacled hare-wallaby (mainland)	Priority 4	Not listed.	**Possible** – DBCA record close to the Development Envelope
Leggadina lakedownensis	Northern short-tailed mouse	Priority 4	Not listed.	**Possible** – suitable habitat present
Pseudomys chapmani	Western pebble-mound mouse	Priority 4	Not listed.	**Likely** – suitable habitat present and recent DBCA records from within 50 km of the Development Envelope
Sminthopsis longicaudata	Long-tailed dunnart	Priority 4	Not listed.	**Likely** – suitable habitat present and

Species Name	Common Name	Listing under the BC Act	Listing under the EPBC Act	Likelihood of Occurrence[1]
Reptiles				
Liasis olivaceus barroni	Olive python	Vulnerable	Vulnerable	**Likely** – suitable habitat present and recent records adjacent to the Development Envelope
Anilios ganei	Gane's blind snake (Pilbara)	Priority 1	Not listed.	**Possible** – within known distribution of the species
Ctenotus nigrilineatus	Pin-striped finesnout ctenotus	Priority 1	Not listed.	**Unlikely** – closest record is over 30 km south of the Development Envelope
Ctenotus uber johnstonei	Spotted ctenotus (northeast)	Priority 2	Not listed.	**Possible** – may occur near the Fortescue River
Underwoodisaurus seorsus	Pilbara barking gecko	Priority 2	Not listed.	**Possible** – species is known to occur within the Hamersley Ranges
Notoscincus butleri	Lined soil-crevice skink (Dampier)	Priority 4	Not listed.	**Possible** – species is known to occur within the Hamersley Ranges
Fish				
Leiopotherapon aheneus	Fortescue grunter	Priority 4	Not listed.	**Unlikely** - expected to be restricted to larger permanent water sources (rather than the ephemeral watercourse sand pools found within the Development Envelope).
Invertebrates				
Nososticta pilbara	Pilbara threadtail	Priority 2	Not listed.	**Unlikely** - expected to be restricted to larger permanent water sources (rather than the ephemeral watercourse sand pools found within the Development Envelope). Records are associated with the Millstream River about 33 km north of the Development Envelope.

Species Name	Common Name	Listing under the BC Act	Listing under the EPBC Act	Likelihood of Occurrence[1]
Antipodogomphus hodgkini	Pilbara dragonfly	Priority 3	Not listed.	**Unlikely** - expected to be restricted to larger permanent water sources (rather than the ephemeral watercourse sand pools found within the Development Envelope). Records are associated with the Millstream River about 33 km north of the Development Envelope.

Notes: 1 – the likelihood of occurrence assessment is based on available desktop information, such and land systems and Beard vegetation units, the habitat requirements for each species and the proximity of known records.

5.2.3.3 Introduced fauna

The PMST identified a number of invasive fauna species as potentially occurring within the Development Envelope for the proposed changes:

- Domestic pigeon (*Columbia liva*);
- Camel (*Camelus dromedarius*);
- Domestic dog (*Canis lupus familiaris*);
- Donkey (*Equus asinus*);
- Horse (*Equus caballus*);
- Domestic cat (*Felis catus*);
- House mouse (*Mus musculus*);
- Rabbit (*Oryctolagus cuniculus*);
- Black rat (*Rattus rattus*); and
- Fox (*Vulpes vulpes*).

These species commonly occur throughout the State and pose a threat to fauna and flora species and vegetation communities of conservation significance.

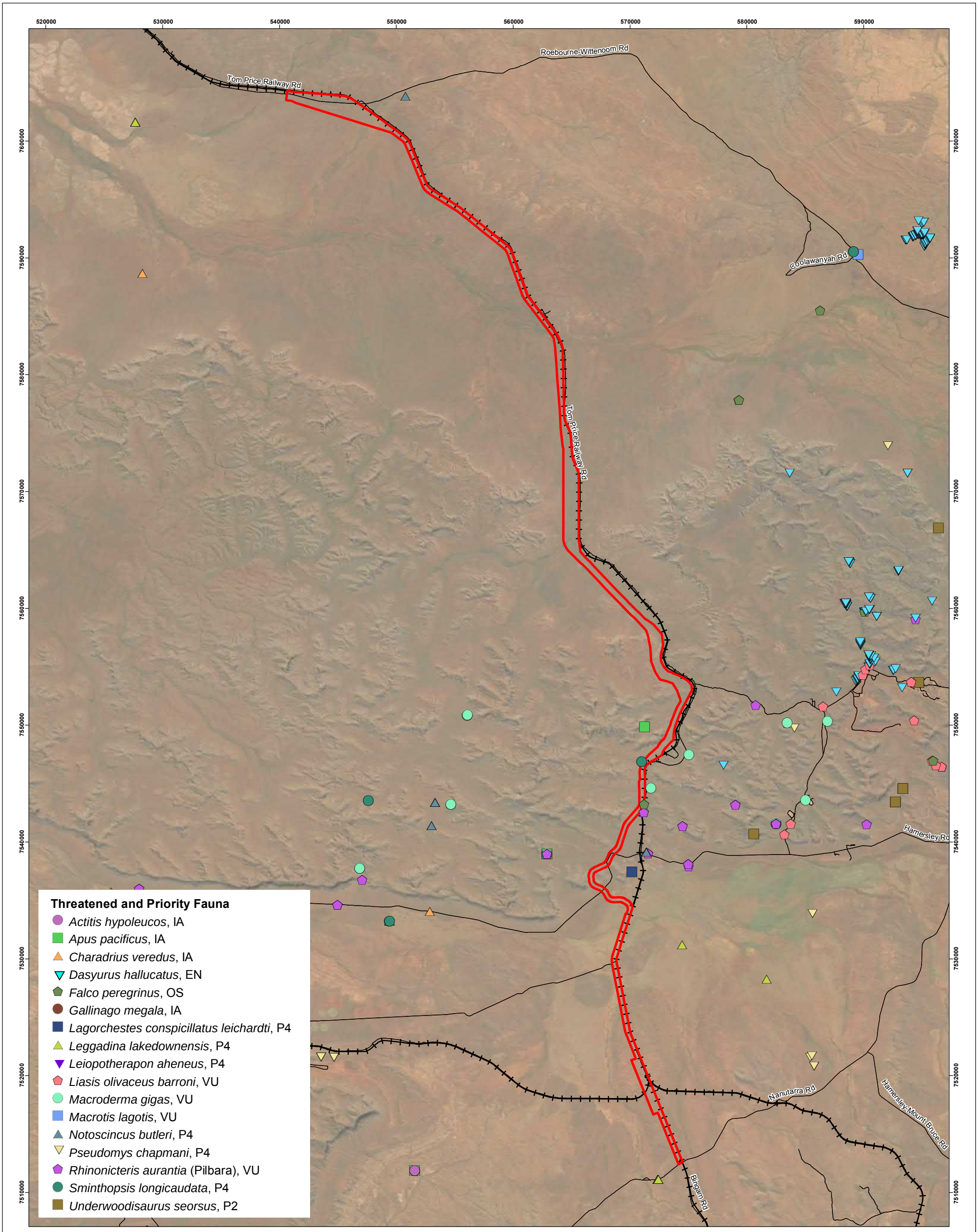

Figure 5-2: DBCA Fauna Records

Legend

Development Envelope

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5.2.4 Potential Impacts

Potential direct and indirect impacts to terrestrial fauna within the Development Envelope for the proposed changes may result from the following project activities:

- clearing for construction of the road and ongoing maintenance activities;
- clearing for associated construction activities such as site offices, laydown, side-tracks and so on; and
- movement of construction vehicles and machinery around the site.

Direct impacts to fauna habitat due to vegetation clearing required for the proposed changes include:

- loss of up to 530 ha of northern quoll habitat;
- loss of up to 530 ha of night parrot habitat;
- loss of up to 200 ha of Pilbara leaf-nosed bat habitat;
- loss of up to 200 ha of ghost bat habitat; and
- loss of up to 200 ha of olive python habitat.

These calculations are based on the DAWE mapped distributions for these species available on the DAWE Species Profile and Threats Database (SPRAT) Database (DAWE, 2020b). Surveys currently underway will verify the presence of suitable habitat for these species within the Development Envelope for the proposed changes and allow a more accurate estimate of the impacts to fauna habitat.

Other potential impacts to fauna habitat from the proposed changes include:

- fauna injury or mortality as a result of machinery and vehicles around site during construction;
- fauna mortality as a result of operational traffic movement;
- the presence of the road may impede the ability of species to disperse into new areas (for example, the dispersal of young following birth or maturity) or the ability of males to find and locate females during the mating season; and
- creation of new pathways for pest animals to access the Development Envelope.

5.2.5 Mitigation

The following measures are proposed to manage and mitigate the potential environmental impacts from the proposed changes:

- the use of existing cleared areas where practicable (existing tracks and pits);
- the clearing area and any 'no-go zones' will be demarcated prior to ground disturbing activities commencing;
- pre-construction fauna trapping and translocation or "shepherding" of fauna to avoid fauna fatalities during construction;
- speed limits on site during construction will be implemented and enforced;
- injured fauna will be reported to the site environmental officer who shall determine the appropriate actions to take depending on the circumstances;
- continuity of any fauna movement corridors identified during the ecological surveys will be maintained where practicable; and
- residual impacts to conservation significant fauna will be managed via offsetting as appropriate.

A Project specific CEMP will be developed to manage impacts to terrestrial fauna associated with the proposed changes.

5.2.6 Assessment of Impacts

The majority of recent records for the northern quoll have come from the Rocklea, Macroy and Robe land systems (Biota Environmental Services 2018; van Vreeswyk *et al*. 2004). The modelled distribution of the northern quoll shows the Development Envelope for the proposed changes is located in an area where the species is known or likely to occur. Clearing of critical habitat for the northern quoll is considered a significant impact. Up to 530 ha of potential northern quoll habitat, as defined by the modelled distribution, will be impacted by the proposed changes.

Records for the Pilbara leaf-nosed bat are spread throughout the Pilbara region, though it is generally encountered in rocky areas that provide opportunity for roosting in caves or disused underground mines (Armstrong 2001). The Hamersley Range is regarded as suitable habitat for the species with many records throughout the area. The modelled distribution of the Pilbara leaf-nosed bat shows the Development Envelope for the proposed changes is in an area where the species is known or likely to occur. Further survey is required to determine if any roosts are present within the Development Envelope for the proposed changes.

Ghost bat roost sites include caves, rock crevices and disused mine adits. In the Hamersley Range in the Pilbara, preferred roosting habitat appears to be caves beneath bluffs of low rounded hills composed of Marra Mamba geology, and larger hills of Brockman Iron Formation; in the eastern Pilbara (Armstrong & Anstee 2000). The Hamersley Range provides relatively protected habitats for many species including the ghost bat (DotEE, 2019), which the modelled distribution suggests may occur within the Development Envelope for the proposed changes. Further survey is required to determine if any roosts are present within the Development Envelope.

A 40 km section of the Development Envelope for the proposed changes is located in the Hamersley Ranges which is considered potential habitat for both the Pilbara leaf-nosed bat and the ghost bat. Up to 200 ha of this potential habitat will be impacted by the proposed changes.

The olive python (Pilbara subspecies) prefers escarpments, gorges and water holes in the ranges of the Pilbara region (Pearson 1993; Wilson & Swan 2003). Radio-telemetry has shown that individuals are usually in close proximity to water and rock outcrops that attract suitable sized prey species (Pearson 2003). The modelled distribution of the olive python indicates the Development Envelope for the proposed changes is in an area where the species is known or likely to occur. Potential habitat for the species overlaps with habitat for the two bat species discussed above.

Targeted fauna surveys are currently underway, the results of which will assist in better defining potential impacts to the northern quoll, Pilbara leaf-nosed bat, ghost bat and olive python from the proposed changes.

The night parrot (*Pezoporus occidentalis*) is a highly elusive nocturnal ground dwelling parrot found in the arid and semi-arid zones of Australia. Most habitat records are of *Triodia* (Spinifex) grasslands and/or chenopod shrublands (Garnett et. al., 2011) in the arid and semi-arid zones, and Higgins (1996) listed *Astrebla* spp. (Mitchell grass), shrubby samphire and chenopod associations, scattered trees and shrubs, *Acacia aneura* (Mulga) woodland, treeless areas and bare gibber as associated with sightings of the species. Accepted sightings of the night parrot have been recorded near Fortescue Marsh (approximately 60 km east of the Development Envelope for the proposed changes) in the Pilbara in 2005 and the modelled distribution for the species places the Development Envelope for the proposed changes in an area where habitat may be present (rather than likely to be present). Further information from the ecological surveys currently underway is required before an assessment of potential impacts to this species can made with confidence, including an assessment of potential habitat for the species.

5.2.7 Predicted Outcome

On the basis of currently available information, the proposed changes may result in significant impacts to the northern quoll, Pilbara leaf-nosed bat, ghost bat and olive python. Further information from the targeted surveys currently underway is required to make a full assessment of the likely impacts of the proposed changes on these species.

Additional information from the ecological surveys currently underway is required before potential impacts to the night parrot from the proposed changes can be determined and assessed.

Given the linear nature of the Revised Proposal, including the proposed changes, and the extensive area of habitat present for conservation significant fauna species in the region, potential impacts to terrestrial fauna can be managed such that the EPA's objective of maintaining biological diversity and ecological integrity can be achieved

5.3 Inland Waters

5.3.1 EPA Objective

The WA EPA objective for the Inland Waters environmental factor is 'To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected'.

Inland Waters are defined as 'The occurrence, distribution, connectivity, movement, and quantity (hydrological regimes) of inland water including its chemical, physical, biological and aesthetic characteristics (quality)' (EPA, 2016e). Inland waters include groundwater, such as superficial and confined aquifers, and surface water, such as waterways, wetlands and estuaries (EPA, 2016e).

5.3.2 Policy and Guidance

The following EPA policies and guidelines have been considered for the proposed changes in order to meet the EPA's objective in relation to this factor:

- *Statement of Environmental Principles, Factors and Objectives (EPA, 2020)*;
- *Environmental Factor Guideline – Inland Waters* (EPA, 2018);
- *Water Quality Protection Note no.25. Land use compatibility tables for public drinking water source areas* (DoW, 2016);
- *Millstream Water Reserve. Drinking water source protection plan* (DoW, 2010); and
- *Contaminated Sites Guidelines* (DWER, 2020).

The Environmental Factor Guideline has been considered during the identification of values within the Development Envelope for the proposed changes and the issues identified in the guideline considered in relation to potential impacts from the proposed changes. Specifically, the guidance requires a focus on the following aspects to ensure the objective of this Environmental Factor is met:

- the significant impacts the alteration of the hydrological regime will have on water dependent ecosystems and other environmental values;
- how the discharge of waste is minimised; and
- how any discharge of waste, or use of land or water, will significantly impact on water quality, the local hydrological regime, and the environmental values inland waters support.

5.3.3 Receiving Environment

5.3.3.1 Millstream Water Reserve

The Millstream wellfield is located approximately 100 km south of Karratha and, along with water from the Harding Dam Catchment Area and the Bungaroo Creek Water Reserve, it supplies the West Pilbara Water Supply Scheme. This scheme supplies water to Karratha, Dampier, Roebourne, Wickham, Point Samson, Cape Lambert and the Burrup Peninsula (DWER, 2018).

The Millstream wellfield and surrounding area is encompassed by a water reserve (the Millstream Water Reserve (West Pilbara) Public Drinking Water Resource Area [Millstream Water Reserve]) and associated Priority 1 and Priority 2 Groundwater Protection Areas. The Development Envelope for the proposed changes is located partially within both of these priority drinking water areas (see **Figure 5-3**).

The Millstream area is a complex system of permanent pools and wetlands, which is predominantly fed by groundwater discharge from the Millstream Dolomite, along with seasonal flows in the Fortescue River. The bores comprising the Millstream wellfield are situated in the Millstream Dolomite, which is an unconfined and highly transmissive aquifer, making the wellfield vulnerable to contamination from inappropriate land uses (DWER, 2018).

Groundwater aquifers within the Pilbara region are primarily recharged through large rainfall events via infiltration through streambeds (CSIRO, 2015). Significant groundwater supplies can be found with relative ease in the alluvium and colluvium found in the low-lying areas of the coastal plain, Fortescue River valley and the upper reaches of Weelumurra Creek to the south of Hamersley Station. Information from the then Water and Rivers Commission (now DWER) indicates that depths to water in these bores range from around four to 37 m.

At the time of writing, there were forty-eight licenced groundwater bores for six different users within the Millstream Water Reserve (DWER, 2018).

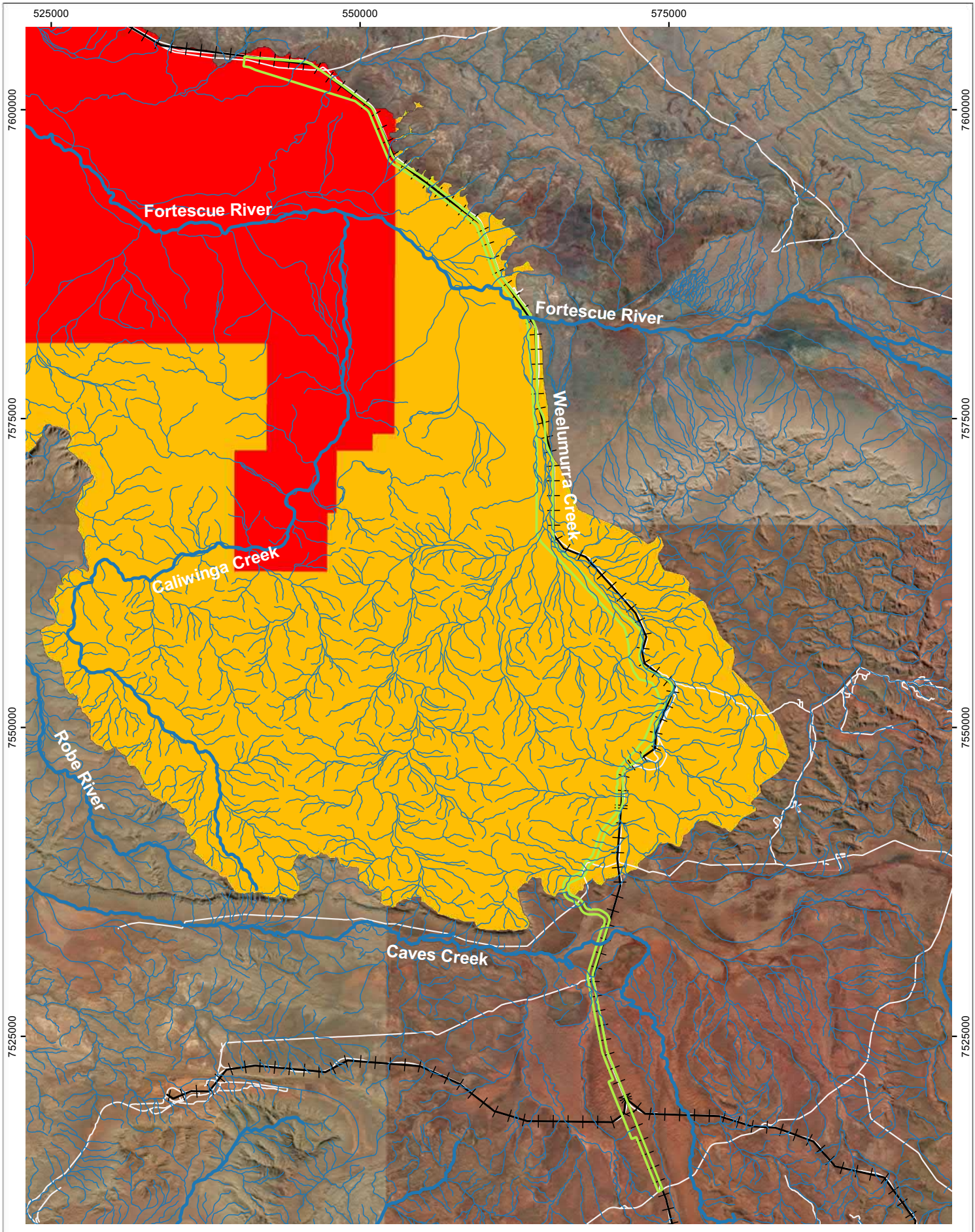

Figure 5-3: Surface Water Features and Priority Drinking Water Source Areas

Development Envelope **PDWSA**

Watercourses

Major

Minor

Infrastructure

Road

Railway

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5.3.3.2 Surface Water Hydrology

Between the Chichester and Hamersley Ranges, all surface drainage is directed to the Fortescue River across a wide plain. Flows tend westwards across the proposed road alignment. At the southern end of the plain, the braided channels of Weelumurra Creek run parallel to the road before joining the Fortescue River. Through the Hamersley Ranges, the rugged topography leads to small catchments drained by numerous, small channels. All drainage feeds into Weelumurra Creek, which runs along the proposed alignment. South of the Hamersley Ranges, the country is flat to undulating. Drainage may be in the form of sheet flow in places, with much of the sheet flow aligned parallel to the proposed road alignment.

Watercourses that cross the Development Envelope for the proposed changes include (**Figure 5-3**):

- the Fortescue River and associated tributaries – intersects the northern part of the Development Envelope;
- Weelumurra Creek (an ephemeral creek) – intersects the northern to central part of the Development Envelope; and
- Caves Creek - intersects the southern part of the Development Envelope.

There are also a large number of ephemeral drainage lines throughout the Development Envelope for the proposed changes, which are generally tributaries of one of the above-named watercourses.

5.3.3.3 Surveys and Studies

A hydrological assessment of the alignment options was undertaken for the CER, which has informed the understanding of surface water hydrology for the project. This assessment focussed on:

- identifying the catchment zones;
- recording the existing condition of the waterways, floodways and associated vegetation; and
- examining any impacts from the existing culverts and embankments of the Dampier to Paraburdoo railway.

Additional hydrological assessment will be undertaken during the design phase for Stage 4 in order to inform the impact assessment for the proposed changes.

5.3.4 Potential Impacts

Activities associated with the construction of the road (e.g. cut and fill and compaction activities) and associated infrastructure (e.g. culverts) have the potential to influence and/or alter existing hydrological processes within the Development Envelope for the proposed changes. This might include:

- changes to surface water flows due to the physical presence of the road;
- changes to infiltration from the creation of new hardstand areas (i.e. the road surface);
- temporary drawdown of groundwater should dewatering be required to construct watercourse crossings; and
- temporary drawdown of groundwater in the vicinity of bores supplying construction water.

Altered or impacted hydrological processes may in turn lead to flooding and/or erosion (e.g. the banks of water courses) and subsequent impacts to vegetation and flora lining embankments and waterways. The design of the road and alignment selection will be undertaken with the intent of minimising disruption to hydrological processes (as described below in **Section 5.3.5**).

Impacts to surface and/or groundwater quality in relation to the proposed changes may include:

- clearing and earthworks during construction and/or maintenance activities potentially resulting in a temporary increase to sediment loads entering watercourses (sedimentation was not identified as a

problem in channels and culverts over the surveyed alignment during the Hydrological Assessment undertaken for the CER);

- accidental contamination of surface and/or groundwater sources from:
  - accidental spills during construction and/or maintenance activities;
  - increased contamination loads in stormwater runoff due to greater traffic volume using the road once completed; and
  - spills from vehicle accidents (including hydrocarbons and other potentially hazardous materials from transport vehicles) during construction, maintenance and operations; and
- discharge of groundwater from dewatering (if required) potentially temporarily impacting surface water quality.

5.3.5 Mitigation

The following measures have been proposed to manage and mitigate the potential environmental impacts from the proposed changes:

- the road and drainage design will be developed to maintain the existing hydrological regime of the area. This will include:
  - hydrological assessments of major surface water crossing points to ensure that flooding is not exacerbated;
  - preventing water shadow effects where sheetflow occurs following rains by minimising the dam effect of the road formation
- development of a Surface Water Drainage Management Plan to maintain existing drainage patterns and prevent soil erosion and sedimentation caused by construction activity or new waterways structures. The plan will include:
  - confirmation of design requirements (waterways report) for all major waterways;
  - protection of embankments and waterway banks and beds;
  - protection of riparian vegetation;
  - the use of vegetation to promote filtering and slow run-off;
  - reinstatement or protection of creek banks as required to reduce the risk or erosion;
  - installation of silt curtains into watercourses when working over or in waterways to limit sedimentation impacts;
  - details for monitoring of waterway integrity and erosion risks during and following construction;
  - management and remediation of any impacts found during monitoring; and
  - measurement and evaluation of environmental performance.
- development of a CEMP:
  - only substances such as fuel, oil and bitumen will be used and works will adhere to Main Roads standard management actions and Safety Data Sheets;
  - spill kits will be employed for all works and stocked as appropriate to the risk;
  - bulk storage of chemicals and hydrocarbons will only occur at the construction compound. Temporary storage of minor quantities of chemicals required during construction activities will not occur within 100 m of a watercourse or within the 100-year Average Recurrence Interval (ARI) flood high water mark;
- the road design will incorporate the use of existing natural drainage features;

- water required for construction and dust management will be sourced from existing bores and potentially from new sources for the southern section. Should new bores be required, a 26D licence to construct or alter a well will be submitted along with a 5C licence to extract water; and
- any water abstraction required for construction of the Revised Proposal will be undertaken to minimise drawdown and potential impacts on vegetation or fauna.

The Millstream Water Reserve Drinking Water Source Protection Plan (DoW, 2010) specifically considered management of contamination associated with the Manuwarra Red Dog Highway and recommended protection strategies include:

- that road drainage be designed to prevent the spread of contaminants from spills of chemicals;
- that sumps and drains are utilised; and
- that a hydrological assessment would need to be conducted.

In addition, Main Roads will undertake consultation with DWER to develop a spill response strategy. These management and mitigation measures will be in place to prevent contamination of surface and groundwater sources.

Best practice in culvert and floodway design as identified in the Austroads (2020) Guide to Road Design – Part 5 will be implemented and recent experience in major road construction through similar country in Karijini National Park and of the previous Manuwarra Red Dog Highway stages will be incorporated.

5.3.6 Assessment of Impacts

As the Development Envelope for the proposed changes is located within the Millstream Water Reserve, there is a risk of contamination of this resource due to accidental spills of hazardous materials during construction, run-off from the road, and accidental release of hazardous martials due to unforeseen emergencies such as a truck roll over. The management measures outlined above, including those implemented during construction of Stage 3 and the recommendations of the Millstream Water Reserve Drinking Water Source Protection Plan will reduce the risk to the drinking water resource as a result of the proposed changes. As such, it is considered unlikely that contamination of the drinking water aquifer will occur due to the proposed changes.

Clearing of vegetation, construction earthworks and altered surface water regimes associate with the proposed changes have the potential, if unmanaged, to result in erosion and sedimentation of surrounding drainage infrastructure, vegetation, wetlands and waterways. Construction in the vicinity of watercourses will require clearing of riparian vegetation and works in proximity of the riverbanks, which could lead to erosion of the bed and banks. Erosion in these areas may result in increase in turbidity and consequent decrease water quality within the watercourses. The potential impacts from the proposed changes will be effectively managed through mitigation measures outline above and are therefore considered unlikely to be significant.

Should water abstraction, such as for dewatering, be required as part of the proposed changes, this will be temporary and of a short duration. Abstraction will be managed to minimise groundwater drawdown. Once abstraction activities have ceased groundwater is expected to recover to pre-impact level with no long-term effects on the environment.

Impacts against this environmental factor in relation to the proposed changes have largely been assessed based on desktop review of available data and literature. Further hydrological studies undertaken during detailed design will assist in refining the impact assessment and identifying any additional management measures or design criteria that may be required in relation to the proposed changes.

5.3.7 Predicted Outcome

By incorporating and implementing the management and mitigation measures outlined above, impacts to the Inland Waters Environmental Factor from the proposed changes are not expected to be significant. Specifically, the Millstream Water Reserve, groundwater reserves and surface waters which overlap or are situated near to the Development Envelope for the proposed changes are not anticipated to be significantly impacted by activities associated with the construction, maintenance or operation of the road; and the EPA's objective for Inland Waters can be met.

5.4 Social Surroundings

5.4.1 EPA Objective

The WA EPA objective for social surroundings is 'to protect social surroundings from significant harm'.

5.4.2 Policy and Guidance

The following EPA policies and guidelines have been considered for the proposed changes in order to meet the EPA's objective in relation to this factor:

- *Statement of Environmental Principles, Factors and Objectives* (EPA, 2020);
- *Environmental Factor Guideline – Social Surroundings* (EPA, 2016);
- Environmental Protection (Noise) Regulations 1997 (Noise Regulations);
- State Planning Policy 5.4 Road and Rail Noise; and
- *Aboriginal Heritage Act 1972* (AH Act).

5.4.3 Receiving Environment

The receiving environment in relation to social surroundings for the proposed changes is made of many elements including land tenure, historic and cultural features, tourism and recreational features, and amenity.

5.4.3.1 Aboriginal Heritage and Culture

The Development Envelope for the proposed changes is located within two Native Title areas. The northern portion of the Development Envelope sits within Yindjibarndi Country while the southern portion is within Eastern Guruma country. The Federal Court assessed the Native Title claims submitted by each group under the *Native Title Act 1993* and determined that Native Title does exist in the claim areas. These determinations were made in 2005 and 2007 respectively.

A search of the Department of Planning Lands and Heritage's Aboriginal Heritage Inquiry System (AHIS) database (DPLH, 2020) identified 32 registered sites within 2.5 km of the Development Envelope for the proposed changes (**Figure 5-4**). The following sites overlap the Development Envelope:

- Site ID 17332: Horseshoe Bore 02 – Artefacts/Scatter;
- Site ID 17335: Mt Margaret 96-1 (Hamersley Plateau) – Modified Tree;
- Site ID 18173: Weelamurra Creek Ceremonial Ground - Artefacts / Scatter, Ceremonial and Historical site;
- Site ID 37670: Narraminju (Caves Creek) – Mythological site associated with Caves Creek and its tributaries; and
- Site ID 38183: Weelamurra Wuntu (Willamarranha, Wilumarra and Wirlumarra) – a complex of Ceremonial, Mythological, and Water Sources associated with Weelamurra Creek.

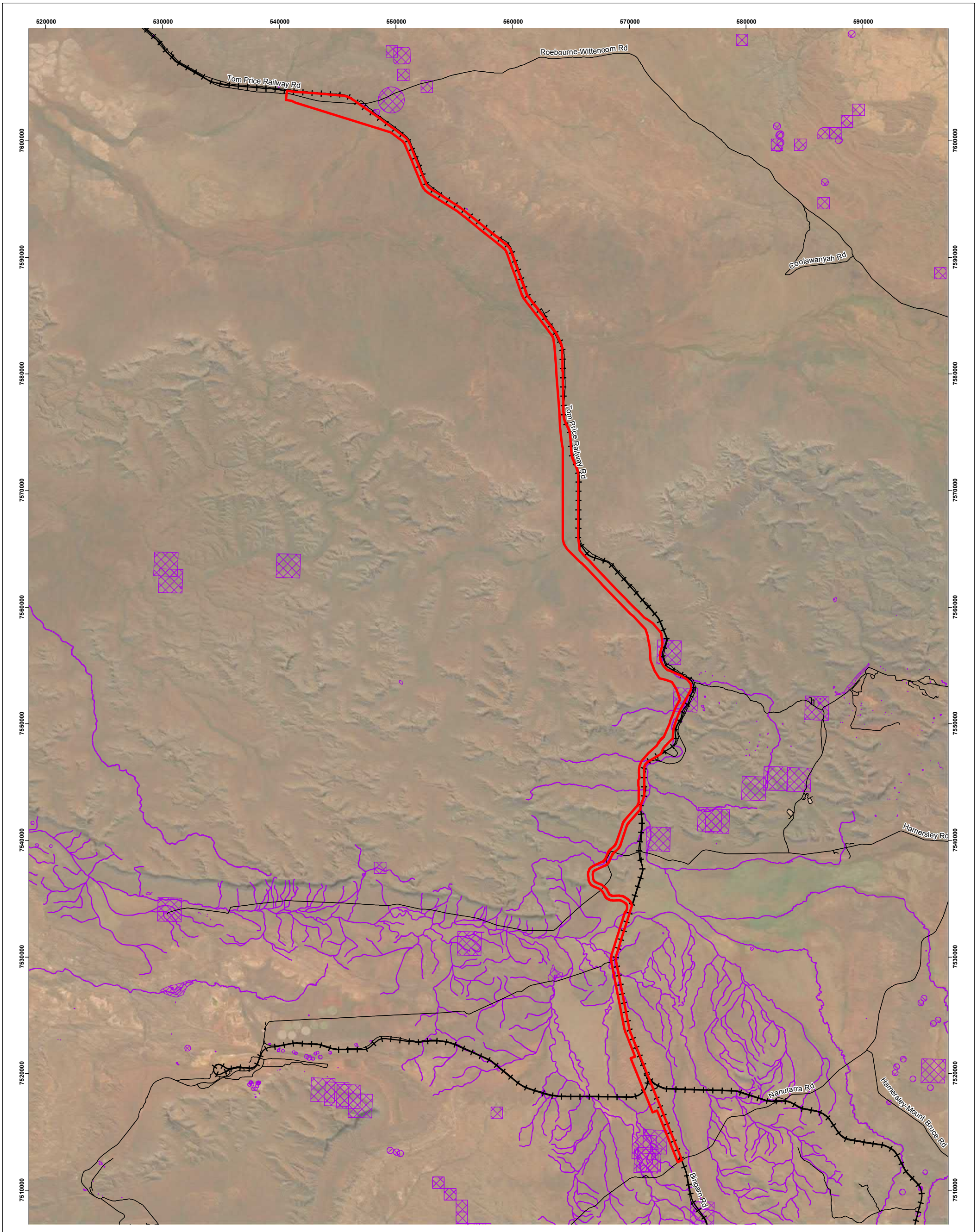

Figure 5-4: Registered Aboriginal Heritage Sites

Legend

- Karratha Tom Price Road Stage 4 Development Envelope
- Aboriginal Heritage Places (DPLH)

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Over 50 Aboriginal heritage surveys have been undertaken across the general area of the Revised Proposal since the 1970's. These have been undertaken for a range of proposed developments, including for the original Manuwarra Red Dog Highway proposal. Main Roads will undertake additional Aboriginal Heritage surveys of the Development Envelope for the proposed changes to adequately understand the cultural heritage of the area and to confirm the values present for the existing registered sites and identify any additional sites that may not have been found during previous surveys. The information gathered from this survey will be used to inform ongoing consultation with the Yindjibarndi and Eastern Guruma Traditional Owners.

5.4.3.2 Historic Heritage

There are no known historic heritage places listed on either the State Heritage List, National Heritage lists, or local Municipal heritage lists associated with the proposed changes.

5.4.3.3 Amenity

The Development Envelope for the proposed changes is located in a remote area and is not close to any towns or population centres. Hamersley Homestead is the closest residence to the Development Envelope at approximately 2 km to the east. The nearest recreational or tourism areas are Millstream-Chichester National Park and Karijini National Park, 14 km and 18 km from the Development Envelope for the proposed changes respectively.

5.4.4 Potential Impacts

Potential direct and indirect impacts to the Social Surrounds of the Development Envelope for the proposed changes may result from the following project activities:

- clearing for construction of the road and ongoing maintenance activities;
- clearing for associated construction activities such as site offices, laydown, side-tracks and so on;
- construction of watercourse crossings;
- earthworks and materials haulage; and
- movement of construction vehicles and machinery around the site.

Potential impacts to the social surrounds of the Development Envelope for the proposed changes include:

- physical damage to Aboriginal heritage sites; and
- impacts to anthropological values of heritage sites.

Impacts to amenity during construction or operation of the proposed changes are expected to be insignificant given the nearest residence is approximately 2 km from the Development Envelope and the nearest recreational or tourism areas are over 10 km away.

5.4.5 Mitigation

The alignment of the road near the Hamersley Homestead has been modified in order to avoid potential amenity impacts to the homestead. This realignment also reduces potential security risks from increased traffic passing by the homestead's driveway, within sight of the Homestead and associated station buildings and equipment. Consultation was undertaken with the residents of Hamersley Homestead to determine an appropriate alignment.

The following measures have been proposed to manage and mitigate the potential impacts to social surroundings from the proposed changes:

- construction noise will be managed in accordance with the Environmental Protection (Noise) Regulations 1997;

- additional Aboriginal heritage surveys (archaeological and ethnographic) to identify sites within the Development Envelope;
- consultation with Traditional Owners will be undertaken to understand the significance of the area and specific sites to the relevant Traditional Owners;
- heritage sites identified during surveys will be protected from disturbance during construction;
- where disturbance to Aboriginal heritage sites is unavoidable, approval under the *Aboriginal Heritage Act 1972* will be sought to disturb these sites; and
- a Cultural Heritage Management Plan will be developed for the specific requirements and cultural heritage environment of Stage 4.

5.4.6 Assessment of Impacts

Some impacts to Aboriginal heritage sites due to the proposed changes may be unavoidable. Consultation with Traditional Owners has been and will continue to be undertaken during the design of the proposed changes in order to understand the values present and to minimise impacts where practicable. Should complete avoidance of sites not be achievable a section 18 notice under the AH Act will be submitted. Initial consultation has resulted in changes to the alignment to avoid areas of particular significance to the Traditional Owners.

Given the remote location of the Development Envelope for the proposed changes, no significant impacts to amenity are anticipated. The proposed changes have been developed to take into account requests from the owners of Hamersley Station to have the road deviate from the Rio Tinto Railway alignment in order to reduce impacts such as unwanted visitation once the road is opened to traffic. This will also reduce the risk of temporary impacts to amenity at the homestead through noise and dust during construction.

Impacts against this environmental factor in relation to the proposed changes have largely been assessed based on desktop review of available data and literature. Further Aboriginal heritage surveys will be undertaken and will assist in refining the impact assessment for the proposed changes and identifying any management measures or design criteria that may be required to avoid or minimise impacts.

5.4.7 Predicted Outcome

While some impact may occur to Aboriginal heritage sites, the proposed changes have been designed, will continue to be designed, and will be managed to avoid and minimise impacts on the sites. Ongoing refinement of the route alignment will take into consideration the location of Aboriginal heritage sites and the outcomes of consultation with Traditional Owners. With the management measures proposed, including the development of a cultural heritage management plan, the EPA's objective for Social Surroundings in relation to Aboriginal heritage can be met for the proposed changes.

Little to no impact to amenity from the proposed changes is expected given the avoidance measures employed, the remoteness of the area, distance to tourism and recreational areas, presence of other infrastructure (such as the Rio Tinto Railway) and short-term duration of construction activities. The EPA's objective for Social Surroundings in relation to amenity can therefore be met. The Revised Proposal will bring a number of benefits including improved road safety and reduced travel times for local residents, and improved access to tourism and recreations sites.

6. Offsets

Main Roads recognises that offsets may be required due to potential significant residual impacts associated with the proposed changes. An assessment of the offsets required to mitigate impacts will be undertaken once ecological surveys have been completed and a more comprehensive understanding of impacts is attained. It is expected that a financial contribution to the Pilbara Environmental Offsets Fund will most likely be required to offset to the environmental impacts of the proposed changes.

7. Matters of National Environmental Significance

Main Roads submitted a referral under the EPBC Act to DAWE on 9 July 2020. On 3 September 2020, DAWE determine the proposed action was a controlled action with the controlling provisions being listed threatened species and communities. The level of assessment was set at Preliminary Documentation.

It was considered by DAWE that the Revised Proposal was likely to have significant impacts to the following matters of national environmental significance:

- Northern Quoll (*Dasyurus hallucatus*) – listed as Endangered under the EPBC Act;
- Ghost Bat (*Macroderma gigas*) – listed as Vulnerable under the EPBC Act;
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) – listed as Vulnerable under the EPBC Act;
- Olive Python (*Liasis olivaceus barroni*) – listed as Vulnerable under the EPBC Act;
- Night Parrot (*Pezoporus occidentalis*) – listed as Endangered under the EPBC Act; and
- Grey Falcon (*Falco hypoleucos*) – listed as Vulnerable under the EPBC Act.

7.1 Northern Quoll

The Northern Quoll is widely distributed through a range of habitats across northern Australia but is more abundant in rocky terrain and open Eucalypt forest within 150 km of the coast (Braithwaite and Begg, 2004). The majority of recent records in the Pilbara have come from the Rocklea (stony ridges, hills and plateaus), Macroy (stony plains dominated by hummock grasslands) and Robe (low plateaus, mesas and buttes) land systems (Biota Environmental Services 2018; van Vreeswyk et al. 2004).

The modelled distribution of the northern quoll indicates the Development Envelope of the proposed changes is located in an area where the species is known or likely to occur. Review of DBCA records for the species (**Figure 5-2**) suggests the northern quoll is likely to occur within the Development Envelope with numerous records to the east of the Development Envelope, the closest record being approximately 5 km east in the Hamersley Range.

Up to 530 ha of potential northern quoll habitat, as defined by the modelled distribution, will be cleared for the proposed changes. Targeted fauna surveys are currently underway, the results of which will define the extent of northern quoll habitat within the Development Envelope and enable the impact assessment for this species.

7.2 Ghost Bat

Ghost bat roost sites include caves, rock crevices and disused mine adits. In the Hamersley Range, preferred roosting habitat appears to be caves beneath bluffs of low rounded hills composed of Marra Mamba geology and larger hills of Brockman Iron Formation (Armstrong & Anstee 2000). Maternity (breeding) caves require high humidity, greater than 80%, and often have narrow entrances opening into larger chambers (Armstrong & Anstee 2000).

The modelled distribution of the ghost bat indicates the Development Envelope for the proposed changes is located in an area where the species is known or likely to occur. Review of DBCA records for the species (**Figure 5-2**) suggests the ghost bat is likely to occur within the Development Envelope where it passes through the Hammersley Ranges with records adjacent to and both west and east of the Development Envelope.

Up to 200 ha of potential habitat for the ghost bat, as defined by the modelled distribution, will be impacted by the proposed changes. Targeted fauna surveys are currently underway, the results of which will define the extent of ghost bat habitat within the Development Envelope and enable the impact assessment for this species.

7.3 Pilbara Leaf-nosed Bat

Records for the Pilbara leaf-nosed bat are spread throughout the Pilbara region, though it is generally encountered in rocky areas that provide opportunity for roosting in caves or disused underground mines (Armstrong 2001). The species is reliant on warm, humid roost microclimates in order to maintain their heat and water balance (Armstrong 2001) with critical habitat identified as permeant diurnal roosts, non-permeant breeding roosts and transitory diurnal roosts (TSSC 2016c).

The modelled distribution of the Pilbara leaf-nosed bat shows the Development Envelope for the proposed changes is in an area where the species is known or likely to occur. Review of DBCA records for the species (**Figure 5-2**) suggests the Pilbara leaf-nosed bat is likely to occur within the Development Envelope where it passes through the Hammersley Ranges with records adjacent to and both west and east of the Development Envelope.

Up to 200 ha of potential habitat for the Pilbara leaf-nosed bat, as defined by the modelled distribution, will be impacted by the proposed changes. Targeted fauna surveys are currently underway, the results of which will define the extent of the Pilbara leaf-nosed bat habitat within the Development Envelope and enable the impact assessment for this species.

7.4 Olive Python

The olive python (Pilbara subspecies) prefers escarpments, gorges and water holes in the ranges of the Pilbara region (Pearson 1993; Wilson & Swan 2003). Radio-telemetry has shown that individuals are usually in close proximity to water and rock outcrops that attract suitable sized prey species. The species is known from Tom Price and Millstream – Chichester National Park (Pearson 2003).

The modelled distribution for the species suggests the Development Envelope for the proposed changes is in an area where the species is known or likely to occur. A review of DBCA records (**Figure 5-2**) indicates the species is likely to occur within the Development Envelope with records both east and west of the Development Envelope through the Hamersley Ranges. The closest record being approximately 4 km west, where the alignment deviates around Hamersley Homestead. Targeted fauna surveys are currently underway, the results of which will define the extent of the olive python habitat within the Development Envelope for the proposed changes and enable the impact assessment for this species.

7.5 Night Parrot

The night parrot is a highly elusive, nocturnal ground dwelling parrot found in the arid and semi-arid zones of Australia. Though little is known of this species, preferred habitat is thought to be Triodia (Spinifex) grasslands and/or chenopod shrublands, *Astrebla* spp. (Mitchell grass), shrubby samphire and chenopod associations, scattered trees and shrubs, *Acacia aneura* (Mulga) woodland (Garnett et. al., 2011; Higgins 1996).

The modelled distribution for the species places the Development Envelope for the proposed changes in an area where habitat may be present (rather than likely to be present). There are no DBCA records for this species within 50 km of the Development Envelope (**Figure 5-2**). Targeted fauna surveys are currently underway, the results of which will define the extent of the potential night parrot habitat within the Development Envelope and enable the impact assessment for this species. The targeted surveys also include night time recordings to capture calls made by the species should it occur in the area.

7.6 Grey Falcon

The grey falcon is the rarest of the falcon species (genus Falco) found in Australia. It occurs in arid and semi-arid regions where rainfall is less than 500 mm annually (Marchant and Higgins 1993). This elusive species is known to frequent timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses, tussock grassland and open woodland, and has been observed hunting in treeless areas (Garnett et al.;

Schoenjahn 2018). Grey falcons typically nest in the tallest trees along watercourses, particularly River Red Gum (*Eucalyptus camaldulensis*), though they have also been known to nest in communications towers (Marchant and Higgins 1993).

The Development Envelope for the proposed changes is within the modelled distribution of the grey falcon, though there are no DBCA records of this species within 50 km of the Development Envelope (**Figure 5-2**). Based on the habitat preference of the species, grey falcons are more likely to be found along the Fortescue River valley and the section of the Development Envelope south of the Hamersley Range. Up to 450 ha of the disturbance footprint is within areas of potential habitat for the grey falcon. Targeted fauna surveys are currently underway, the results of which will define the extent of the grey falcon habitat within the Development Envelope for the proposed changes and enable the impact assessment for this species.

7.7 Potential Impacts

Potential impacts from the proposed changes to the species listed above includes:

- clearing of habitat;
- fauna injury or mortality as a result of machinery and vehicles around site during construction;
- fauna mortality as a result of operational traffic movement;
- the presence of the road may impede the ability of species to disperse into new areas (for example, the dispersal of young following birth or maturity) or the ability of males to find and locate females during the mating season; and
- creation of new pathways for pest animals to access the Development Envelope and surrounds.

7.8 Mitigation

The following measures are proposed to manage and mitigate the potential environmental impacts from the proposed changes:

- the use of existing cleared areas where practicable (existing tracks and pits);
- the clearing area and any 'no-go zones' will be demarcated prior to ground disturbing activities commencing;
- pre-construction fauna trapping and translocation or "shepherding" of fauna to avoid fauna fatalities during construction;
- speed limits on site during construction will be implemented and enforced;
- injured fauna will be reported to the site environmental officer who shall determine the appropriate actions to take depending on the circumstances;
- continuity of any fauna movement corridors identified during the ecological surveys will be maintained where practicable; and
- residual impacts to conservation significant fauna will be managed via offsetting as appropriate.

A Project specific CEMP will be developed to manage impacts to terrestrial fauna associated with the Revised Proposal.

Additional surveys are either underway or planned. These surveys will provide additional information that will allow for a detailed and full assessment of potential impacts related to the proposed changes and assist in developing additional management and mitigation measures to be implemented. The surveys will also assist in identifying significant residual impacts and any offset requirements related to these.

8. Holistic Impact Assessment and Conclusion

The proposed changes have the potential to adversely impact the environment and social values within the Development Envelope. In particular, the proposed changes are likely to impact the following environmental factors:

- Flora and Vegetation:
  - clearing of up to 800 ha native vegetation, of which 100 ha will be revegetated;
  - within the total clearing extent, clearing of up to 75 ha of the Themeda Grasslands TEC and up to 115 ha of the Brockman Iron PEC; and
  - Clearing of DBCA listed Priority flora species, should they be found to occur within the disturbance footprint.
- Terrestrial Fauna:
  - loss of habitat for conservation significant fauna species;
  - the presence of the road may present a barrier to fauna movement or impede the ability of species to disperse into new areas;
  - fauna injury or mortality as a result of machinery and vehicles around site during construction and operations traffic movement; and
  - creation of new pathways for pest animals to access the Development Envelope for the proposed changes.
- Inland Waters:
  - changes to surface water flows due to the physical presence of the road;
  - changes to infiltration from the creation of new hardstand areas (i.e. the road surface);
  - temporary drawdown of groundwater should dewatering be required to construct watercourse crossings or in the vicinity of bores supplying construction water; and
- Social Surroundings:
  - physical damage to Aboriginal heritage sites or impacts to the anthropological values of heritage sites.

A number of connections and interactions occur between the key environmental factors. Changes to surface water flows may impact on flora and vegetation that are dependent on these flows. Similarly, groundwater abstraction may impact on groundwater dependent vegetation if not managed appropriately. Clearing of native vegetation correlates to loss of habitat for conservation significant fauna, though the extent to which these are linked is determined by the vegetation type, vegetation structure and terrain.

Additional surveys and investigations are either underway or planned. These surveys and investigations will provide additional information that will allow for a detailed and full assessment of potential impacts related to the proposed changes and assist in developing additional management and mitigation measures to be implemented.

On the basis of the current information and the mitigation proposed, the proposed changes are likely to result in the following significant residual impacts:

- loss of up to 75 ha of the Themeda Grasslands TEC; and
- loss of habitat for conservation significant fauna species.

Should these residual impacts be confirmed for the proposed changes, following the receipt of additional ecological surveys and updated impact assessment, appropriate offsets will be proposed, such as a financial contribution to the Pilbara Environmental Offsets Fund.

Through the mitigation measures proposed, together with offsetting of residual impacts where required, it is considered that the proposed changes can meet the EPA's objectives for the key environmental factors.

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Appendix A. Weed Survey (Ecologia Environment 2018)

Appendix B. Protected Matters Search Tool (PMST) Report

Appendix C. Northern Quoll Survey (GHD 2017)