



# EPA Referral Document

Miralga Creek DSO Project

180-LAH-EN-REP-0002

Revision 0



## Authorisation

Rev	Reason for Issue	Prepared	Checked	Authorised	Date
A	Internal review	Felicity Jones	David Morley	Monica Goggin	27/03/2020
B	Internal review	Felicity Jones	David Morley	Monica Goggin	02/04/2020
0	Submission to EPA	David Morley	David Morley	Monica Goggin	06/04/2020

*Handwritten signatures:* Two signatures for David Morley (Prepared and Checked) and one signature for Monica Goggin (Authorised) are present under the Revision 0 row.

*Signatures are required for Revision 0 and above*

© Atlas Iron Pty Ltd

Atlas Iron  
PO Box 7071  
Cloisters Square Perth WA 6850  
Australia  
T: + 61 8 6228 8000  
F: + 61 8 6228 8999  
E: atlas@atlasiron.com.au  
W: www.atlasiron.com.au



# Contents

Abbreviations	vii
Executive Summary	ix
1. Introduction	1
1.1 Purpose and Scope	1
1.2 Proponent	1
1.3 Environmental Impact Assessment Process	4
1.4 Other Approvals and Regulation	4
2. Proposal Description	7
2.1 Background	7
2.2 Justification	7
2.3 Key Proposal Characteristics	7
2.3.1 Mining	18
2.3.2 Processing	18
2.3.3 Haulage	18
2.3.4 Waste Rock Management	18
2.3.5 Water Supply	19
2.3.6 Additional Infrastructure and Support Facilities	20
2.4 Local and Regional Context	20
3. Stakeholder Engagement	25
3.1 Key Stakeholders	25
3.2 Stakeholder Engagement Process	26
3.3 Stakeholder Consultation	26
3.3.1 Targeted Community and Engagement Strategy	27
3.3.2 Ongoing Community and Stakeholder Engagement	35
4. Environmental Principles and Factors	36
4.1 EPA Principles	36
4.2 Environmental Factors	39
4.2.1 Preliminary Key Environmental Factors	40
4.2.2 Other Environmental Factors	40
5. Flora and Vegetation	42
5.1 Receiving Environment	42
5.1.1 Environmental Studies	42
5.1.2 Regional Vegetation	44
5.1.3 Local Vegetation	49
5.1.4 Flora	59
5.1.5 Groundwater Dependent Vegetation and Surface Water Flows	65
5.2 Potential Impacts	69



5.3	Assessment of Impacts	69
5.3.1	Clearing of Flora and Vegetation	69
5.3.2	Weeds	73
5.3.3	Dust	74
5.3.4	Altered Hydrological Regimes	74
5.3.5	Groundwater Drawdown	75
5.4	Mitigation	76
5.5	Predicted Outcome	77
5.6	Flora and Vegetation Summary	78
6.	Terrestrial Fauna	82
6.1	Receiving Environment	82
6.1.1	Environmental Studies	82
6.1.2	Fauna Habitat	83
6.1.3	Habitat Features	88
6.1.4	Vertebrate Fauna Assemblage	97
6.1.5	Conservation Significant Vertebrate Fauna	98
6.1.6	Short-range Endemic Fauna	116
6.1.7	Introduced Fauna	121
6.2	Potential Impacts	121
6.3	Assessment of Potential Impacts	121
6.3.1	Removal, Fragmentation and/or Modification of Fauna Habitat	121
6.3.2	Impacts to Habitat Features	124
6.3.3	Indirect Impacts	125
6.3.4	Conservation Significant Species	128
6.4	Mitigation	132
6.5	Predicted Outcome	135
6.6	Terrestrial Fauna Summary	136
7.	Other Environmental Factors	141
8.	Offsets	156
9.	Matters of National Environmental Significance (MNES)	157
10.	Holistic Impact Assessment	158
11.	References	165





## List of tables

Table 1.1 – Other Approvals.....	5
Table 2.1 – Indicative Mined Tonnages, Life of Mine.....	8
Table 2.2 – Summary of the Proposal .....	9
Table 2.3 – Location and Proposed Extent of Physical and Operational Elements.....	9
Table 2.4 – Indicative Development Schedule.....	10
Table 2.5 – Preliminary Mine Waste Inventory .....	19
Table 3.1 – Proposal Stakeholders.....	25
Table 3.2 – Stakeholder Engagement Summary .....	28
Table 4.1 – EP Act Principles .....	36
Table 5.2 – Flora and Vegetation Studies.....	42
Table 5.3 – Land Systems Within the Study Area.....	45
Table 5.4 – Vegetation System Associations Intersecting the Study Area .....	46
Table 5.5 – Vegetation Types within Study Area .....	49
Table 5.6 – Vegetation Condition .....	51
Table 5.7 – Broad Functional Units and Riparian Vegetation Units.....	66
Table 5.8 – Potential Impact to Vegetation Types in the Indicative Disturbance Footprint ....	70
Table 5.9 – Locations of Priority Flora in the Development Envelope and Indicative Disturbance Footprint .....	71
Table 5.10 – Mitigation of Impacts to Flora and Vegetation .....	76
Table 5.1 – Flora and Vegetation Summary .....	78
Table 6.2 – Terrestrial Fauna Studies.....	82
Table 6.3 – Broad Fauna Habitat.....	84
Table 6.4 – Caves Recorded in the Study Area.....	88
Table 6.5 – Native Vertebrate Fauna Assemblage .....	97
Table 6.6 – Conservation Significant Fauna in the Study Area .....	100
Table 6.7 – Summary of Northern Quoll Occurrence and Habitat in Study Area.....	103
Table 6.8 – Ghost Bat Caves Recorded in the Study Area .....	107
Table 6.9 – SRE Categorisation used by WAM Taxonomists .....	116
Table 6.10 – Impacts to Vertebrate Fauna Habitats.....	122
Table 6.11 – Impacts to Invertebrate Fauna Habitats .....	122
Table 6.12 – Mitigation of Risks to Terrestrial Fauna.....	133
Table 6.12 – Terrestrial Fauna Summary .....	136
Table 7.1 – Other Environmental Factors .....	141
Table 10.1 – Holistic Impact Assessment Summary .....	159



## List of figures

Figure 1.1 – Site Location.....	3
Figure 2.1 – Site Layout – Overall .....	11
Figure 2.2 – Site Layout – Miralga East.....	12
Figure 2.3 – Site Layout – Miralga West.....	13
Figure 2.4 – Site Layout – Sandtrax .....	14
Figure 2.5 – Site Layout – Haul Road.....	15
Figure 2.6 – Site Layout – Stockyards .....	16
Figure 2.7 – Abydos Infrastructure .....	17
Figure 2.8 – Climate Data Marble Bar Station (004106) 2000–2019.....	20
Figure 2.9 – Hydrology .....	22
Figure 2.10 – Surrounding Land Use.....	23
Figure 2.11 – Heritage.....	24
Figure 4.1 – Study Areas.....	41
Figure 5.1 – Land Systems.....	47
Figure 5.2 – Regional Vegetation .....	48
Figure 5.3 – Vegetation Types.....	52
Figure 5.4 – Vegetation Condition .....	56
Figure 5.5 – Conservation Significant Flora.....	62
Figure 5.6 – Weeds .....	63
Figure 5.7 – <i>Polymeria</i> sp. Realignment.....	64
Figure 5.8 – Detailed Mapping of GDV .....	68
Figure 6.1 – Vertebrate Fauna Habitats.....	86
Figure 6.2 – Invertebrate Fauna Habitats .....	87
Figure 6.3 – Caves .....	90
Figure 6.4 – Waterholes .....	95
Figure 6.5 – Northern Quoll Records.....	104
Figure 6.6 – Pilbara Leaf Nosed Bat and Ghost Bat Records .....	108
Figure 6.7 – Pilbara Olive Python .....	112
Figure 6.8 – Grey Falcon and Peregrine Falcon Records.....	113
Figure 6.9 – Northern Brushtail Possum Records.....	115
Figure 6.10 – SRE Fauna Records and Habitat Type.....	119
Figure 6.11 – Extrapolation of Potential SRE Habitat .....	120

## List of plates

Plate 6.1 – Conceptual Layout of Pits, Ramps and Caves at Miralga East .....	91
Plate 6.2 – Aerial View Looking East Along the Escarpment Showing Locations of Caves...	91
Plate 6.3 – Cross-section of Cave CMRC-13 (Category 4) and Miralga East Pit 2.....	92
Plate 6.4 – Cross-section of Cave CMRC-14 (Category 3) and Miralga East Pit 2.....	92
Plate 6.5 – Cross-section of Cave CMRC-15 (Category 2) and Miralga East Pit 2.....	93



## Appendices

Appendix A	Detailed Flora and Vegetation Assessment
Appendix B	Groundwater Dependent Vegetation Desktop Review
Appendix C	Groundwater Dependent Vegetation Field Assessment
Appendix D	Summary of Local Waterholes
Appendix E	Level 2 Vertebrate and SRE Invertebrate Fauna Assessment
Appendix F	Ghost Bat Review
Appendix G	Geotechnical Investigation
Appendix H	Blast Impact Assessment
Appendix I	Vertebrate Fauna Impact Assessment
Appendix J	Invertebrate Fauna Impact Assessment
Appendix K	Significant Species Management Plan
Appendix L	Subterranean Fauna Assessment
Appendix M	Baseline Soil and Landform Assessment
Appendix N	Mine Waste Characterisation
Appendix O	Water Management Assessment
Appendix P	Noise and Vibration Assessment



## Abbreviations

ALARP	as low as reasonably practicable
ALRE	Abydos Link Road
BC Act	<i>Biodiversity Conservation Act 2016</i>
BIF	banded iron formation
DBCA	Department of Biodiversity, Conservation and Attractions
DEE	(former) Department of the Environment and Energy
DAWE	Department of Agriculture, Water and the Environment
DMIRS	Department of Mines, Industry Regulation and Safety
DSO	direct shipping ore
DWER	Department of Water and Environmental Regulation
EIA	environmental impact assessment
EMP	Environmental Management Plan
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EP Act	<i>Environmental Protection Act 1986</i>
EPA	Environmental Protection Authority
GDP	Ground Disturbance Permit
GDV	groundwater dependent vegetation
GL	gigalitre
GLpa	gigalitre per annum
GST	Goods and Services Tax
ha	hectare
HSEMS	Health, Safety and Environmental Management System
km	kilometre
LOM	life of mine
m	metre
mbgl	metres below ground level
MCP	Mine Closure Plan
MNES	Matter of National Environmental Significance
MSDS	Material Safety Data Sheet
Mt	megatonne



Mtpa	megatonnes per annum
NA	not applicable
NAF	non-acid-forming
RIWI Act	<i>Rights in Water and Irrigation Act 1914</i>
ROM	run of Mine
SRE	short-range endemic
SSMP	Significant Species Management Plan
VT	Vegetation Type
WAM	Western Australian Museum
WMT	wet metric tonne



## Executive Summary

Atlas Iron Pty Ltd (Atlas Iron) is seeking approval to develop the Miralga Creek Direct Shipping Ore (DSO) Project (the Proposal). The Proposal is an iron ore mine located in the Pilbara region of Western Australia (WA), approximately 100 km south-east of Port Hedland, along the Marble Bar Road (Figure 1.1). Atlas Iron is referring this Proposal under Section 38 of the *Environmental Protection Act 1986* (EP Act) due to its potential to have a significant effect on a number of the environmental factors defined by the Environmental Protection Authority (EPA). This document serves to provide supplementary information in support of the Section 38 referral under the EP Act.

Atlas Iron is an Australian iron ore company, mining and exporting DSO from its operations in the northern Pilbara region of WA. Its current operations are at Mt Webber, with a new project to commence shortly at Corunna Downs. In developing new projects, Atlas Iron leverages its considerable experience with its previous iron ore DSO operations at Pardoo, Wodgina, Mt Dove and Abydos, the latter of which is in the vicinity of this Proposal. The Abydos operation ran successfully from 2011 to 2016 at an annualised production rate of approximately 3 Mtpa. This Proposal is immediately (approximately 30 km) along strike from Abydos and will utilise existing infrastructure that was constructed for and used during Abydos operations. The Proposal's five pits are 'satellite' pits to the Abydos operation. This Proposal and Abydos share a similar project scope, terrain and geology.

Atlas Iron has met with the EPA and the Department of Agriculture, Water and the Environment (DAWE, formerly Department of the Environment and Energy) on several occasions to discuss the Proposal and impact assessment. Impacts to the key EPA factors of Flora and Vegetation and Terrestrial Fauna (vertebrates) are considered by Atlas Iron to be the key environmental factors relevant to the Proposal. A referral was submitted under the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC Act) in December 2019 (EPBC 2019/8601) for potential impacts to two Matters of National Environmental Significance (MNES). An outcome is pending. The EPA can undertake an 'Accredited Assessment' under the EPBC Act, for final approval by DAWE, if the Proposal is considered to be a Controlled Action under the EPBC Act. The Proposal will be subject to a number of other approval processes and regulation by the Department of Mines, Industry Regulation and Safety and the Department of Water and Environmental Regulation after the EPA process is completed, specifically a Mining Proposal and Part V approvals and licencing.

The Proposal comprises the mining of iron ore from five satellite pits within three discrete mining areas, spread over 30 km, as follows (Tables ES1 and ES2):

1. **Miralga East** (3 pits), 35 km north-east of the now closed Abydos Mine, with the three pits located along an east to west trending ridge.
2. **Miralga West** (1 large pit), 22 km north-east of Abydos, with the pit on a north-east to southwest trending ridge.
3. **Sandtrax** (1 small pit), 7 km north-east of Abydos, with the pit along an east-west ridge.

The pits will be mined in a staged manner by a small, mobile mining fleet. A new haul road will be constructed between Miralga West and Miralga East. The crushing plant will be established at a stockyard south of the Marble Bar Road and other typical support infrastructure will be installed where needed (e.g. laydown areas, administration and fuel



storage). The existing Abydos Link haul road will be used, along with existing licensed borefields and camp facilities. It is expected that approximately 8 Mt of iron ore will be mined above the groundwater table over approximately 4 to 5 years with an average strip ratio of 0.8:1 (waste:ore).

**Table ES1 – Summary of the Proposal**

<b>Proposal Title</b>	Miralga Creek DSO Project
<b>Proponent Name</b>	Atlas Iron Pty Ltd
<b>Short Description</b>	<p>The proposal is to develop above water table mining of iron ore from three areas referred to as Sandtrax, Miralga West and Miralga East, approximately 100 km south-east of Port Hedland, along the Marble Bar Road (Figure 1.1, Figure 2.1).</p> <p>The proposal includes the development of mine pits and associated infrastructure including but not limited to processing facilities, waste landforms and access roads. The proposal will utilise some existing ancillary infrastructure from the nearby Abydos DSO Project.</p>

**Table ES2 – Location and Proposed Extent of Physical and Operational Elements**

Element	Location	Proposed Extent
<b>Physical Elements</b>		
Pits	<ul style="list-style-type: none"> <li>Three at Miralga East (Figure 2.2)</li> <li>One at Miralga West (Figure 2.3)</li> <li>One at Sandtrax (Figure 2.4)</li> </ul>	Clearing of no more than 284.9 ha of native vegetation within the 621.1 ha Development Envelope.
Waste dumps	<ul style="list-style-type: none"> <li>Miralga East (Figure 2.2)</li> <li>Miralga West (Figure 2.3)</li> <li>Sandtrax (Figure 2.4)</li> </ul>	
Supporting Infrastructure: <ul style="list-style-type: none"> <li>Access roads</li> <li>Mine Operation Centre</li> <li>Laydown areas</li> <li>Administration areas</li> <li>Explosives magazine</li> <li>Fuel storage area</li> <li>Haulage route</li> <li>ROM stockyard</li> </ul>	Various locations	
<b>Operational Elements</b>		
Groundwater abstraction	Existing borefields	Abstraction of no more than 0.9 GLpa of groundwater.
Processing of ore (mobile crushing and screening plant)	Within the Development Envelope	Crushing and screening throughput of 2 Megatonnes per annum (Mtpa).



Atlas Iron has conducted desktop assessments and field studies at local and regional scales to investigate potential risks to the Environmental Factors potentially relevant to the Proposal:

- Land:
  - Flora and Vegetation
  - Landforms
  - Subterranean Fauna
  - Terrestrial Environmental Quality
  - Terrestrial Fauna
- Inland Waters
- Air Quality
- Social Surroundings.

Atlas Iron has sought to address scientific uncertainty and information gaps through additional investigations and specialist advice targeted at providing more certainty, e.g. around impacts of blasting on a Ghost Bat roosting cave at Miralga East. Conservative approaches have been taken when assessing risk.

On the basis of the EPA's Factors and Objectives guidance (Environmental Protection Authority, 2018a), the following preliminary key environmental factors have been identified for the Proposal:

- Flora and Vegetation
- Terrestrial Fauna.

Summaries of Atlas Iron's impact assessment and proposed management of these factors are provided in Tables ES3 and ES4.

**Table ES3 – Summary of Flora and Vegetation**

Factor	Flora and Vegetation Summary
<b>EPA Objective</b>	To protect flora and vegetation so that biological diversity and ecological integrity are maintained (Environmental Protection Authority, 2018a).
<b>Policy and Guidance</b>	<ul style="list-style-type: none"> <li>• Environmental Factor Guideline: Flora and Vegetation (Environmental Protection Authority, 2016a).</li> <li>• Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (Environmental Protection Authority, 2016b).</li> </ul>
<b>Receiving Environment</b>	<p>12 vegetation types (VTs) were mapped, with 80% of vegetation being considered to be in Excellent condition. The 12 VTs were broadly grouped into:</p> <ul style="list-style-type: none"> <li>• Granite and dolomite hills and ranges</li> <li>• Hills and steep slopes on ironstone</li> <li>• Rivers and claypans on alluvial sediments</li> <li>• Minor drainage lines and sheet flow on flood plains</li> <li>• Sandy and stony plains.</li> </ul>





Factor	Flora and Vegetation Summary
	<p>None of the VTs were considered to represent Threatened or Priority Ecological Communities. The only VTs considered to be of local significance were:</p> <ul style="list-style-type: none"> <li>• VT 2: occurs in shallow gorge/creek areas and provides habitat for significant flora taxa</li> <li>• VT 6: is mapped on a claypan, which is a limited habitat and supports significant flora taxa, it also has limited representation in the Study Area</li> <li>• VT 9: has an unknown regional extent and has limited representation in the Study Area</li> <li>• VT 11: has an unknown regional extent and has limited representation in the Study Area.</li> </ul> <p>No Threatened Flora taxa listed under the BC Act or EPBC Act, were recorded within the Study Area. Eight DBCA classified Priority Flora taxa were recorded within the Study Area:</p> <ul style="list-style-type: none"> <li>• <i>Corchorus</i> sp. Yarrie (J. Bull &amp; D. Roberts CAL 01.05) (P1)</li> <li>• <i>Eragrostis crateriformis</i> (P3)</li> <li>• <i>Euphorbia clementii</i> (P3)</li> <li>• <i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i> (P2)</li> <li>• <i>Goodenia nuda</i> (P4)</li> <li>• <i>Oldenlandia</i> sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3)</li> <li>• <i>Triodia basitricha</i> (P3)</li> <li>• <i>Triodia chichesterensis</i> (P3).</li> </ul> <p>A further eight species were considered significant for other reasons:</p> <ul style="list-style-type: none"> <li>• Taxa having anomalous features, and therefore potentially being undescribed: <ul style="list-style-type: none"> <li>– <i>Abutilon</i> aff. <i>hannii</i></li> <li>– <i>Polymeria</i> sp.</li> </ul> </li> <li>• Records representing a range extension or outlier of the main range: <ul style="list-style-type: none"> <li>– <i>Cyperus microcephalus</i> subsp. <i>saxicola</i></li> <li>– <i>Desmodium campylocaulon</i></li> <li>– <i>Dodonaea petiolaris</i></li> <li>– <i>Fimbristylis nuda</i></li> <li>– <i>Ophioglossum lusitanicum</i></li> <li>– <i>Scleria rugosa</i>.</li> </ul> </li> </ul>
<b>Potential Impacts</b>	<p>Potential impacts to flora and vegetation from the Proposal include:</p> <ul style="list-style-type: none"> <li>• Direct clearing of flora and vegetation resulting in a change to the local or regional representation of vegetation communities and flora species.</li> <li>• Changes to vegetation composition, condition and/or health resulting from the following indirect impacts: <ul style="list-style-type: none"> <li>– Introduction and/or spread of weeds</li> <li>– Dust deposition</li> <li>– Altered hydrological regimes (i.e., drainage shadowing and ponding).</li> <li>– Groundwater drawdown.</li> </ul> </li> </ul>
<b>Avoidance</b>	The Development Envelope was designed through several revisions to:



Factor	Flora and Vegetation Summary
	<ul style="list-style-type: none"> <li>• Avoid impact to VT 6 and VT 9, both of which are considered by Atlas Iron to be of conservation interest as they support conservation significant flora species.</li> <li>• Avoid known locations of priority flora including:               <ul style="list-style-type: none"> <li>– Both known locations of <i>Polymeria</i> sp. (potentially undescribed)</li> <li>– 5 out of 7 locations of <i>Eragrostis crateriformis</i> (P3)</li> <li>– 23 out of 28 locations of <i>Euphorbia clementii</i> (P3)</li> <li>– 29 out of 31 locations of <i>Triodia basitricha</i> (P3)</li> </ul> </li> </ul> <p>The Proposal has avoided the need to clear additional vegetation by using existing camp, haul road and borefield infrastructure at Atlas Iron's Abydos Project.</p>
<b>Minimisation</b>	<p>The following plans and procedures will be implemented to assist in minimising impacts to flora and vegetation:</p> <ul style="list-style-type: none"> <li>• Ground Disturbance Permit (GDP) Procedure (950-HSE-EN-PRO-0001).</li> <li>• Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).</li> <li>• Flora Management Procedure (950-HSE-EN-PRO-0010).</li> <li>• Weed Hygiene Procedure (950-HSE-EN-PRO-0002).</li> <li>• Dust Management Procedure (950-HSE-EN-PRO-0026).</li> <li>• Water Management Plan and Site Water Operating Plan (<i>in preparation</i>).</li> </ul> <p>Key management measures contained in these plans include:</p> <ul style="list-style-type: none"> <li>• No more than 284.9 ha of vegetation/habitat within the 621.1 ha Development Envelope will be cleared/disturbed.</li> <li>• Restricting clearing to the minimum necessary for safe construction and operation of the Proposal and to within approved areas through GDP Procedure.</li> <li>• Accurate delineation of the GDP boundary in the field prior to any works commencing, including all buffers and values to be avoided and weed infested areas.</li> <li>• Prohibition of off-road driving unless otherwise authorised by Senior Management.</li> <li>• Weed hygiene inspections and certification to ensure all mobile equipment arriving on site is clean and free of material.</li> <li>• Weeds and weed contaminated topsoil will be cleared, handled and stockpiled separately to native vegetation and 'clean' topsoil.</li> <li>• Regular and targeted weed control (e.g. by spraying, physical removal) will be undertaken as appropriate (during all stages of operation including care and maintenance).</li> <li>• Standard dust suppression techniques shall be used on roads, stockpiles and infrastructure areas (e.g., water carts, sprinklers) as required.</li> <li>• Road train trailers will be fitted with covers during product transport to port.</li> <li>• Atlas Iron will abstract water in accordance with 5C Licences to take groundwater, a Water Management Plan and Site Water Operating Plan in accordance with the Department of Water and Environmental Regulations requirements.</li> </ul> <p>Design of river crossings over Miralga Creek and the Shaw River:</p> <ul style="list-style-type: none"> <li>• The river crossing at Shaw River will be designed and constructed to over-top during periods of major stream flow. This will enable water flow past the crossing points and prevent significant amounts of water ponding up-stream, as well as prevent water shadow effects downstream.</li> </ul>



Factor	Flora and Vegetation Summary
	<ul style="list-style-type: none"> <li>The haul road crossing at Miralga Creek will be designed and constructed to enable water flow past the crossing point and prevent significant amounts of water ponding up-stream, as well as prevent water shadow effects downstream. This will be enabled through an over-topping design, or the installation of appropriate under-road drainage.</li> </ul>
<b>Rehabilitation</b>	<ul style="list-style-type: none"> <li>The removal and stockpiling of all vegetative matter during clearing for future use in rehabilitation.</li> <li>All areas of the Indicative Disturbance Footprint (except for open pits) will be progressively rehabilitated as soon as practicable and as required by the MCP. Rehabilitation works are expected to return disturbed areas to a stable and vegetated state</li> <li>A MCP will be updated triennially or as required when significant changes are made to the Proposal. A detailed MCP, which will contain further information on rehabilitation works, will be prepared approximately one year to six months prior to the cessation of mining.</li> </ul>
<b>Offset</b>	A contribution to the Pilbara Environmental Offset Fund is expected to be made, for clearing of vegetation in good or better condition in the Chichester subregion.
<b>Predicted Outcome</b>	<ul style="list-style-type: none"> <li>No impact to Threatened Flora, TECs or PECs.</li> <li>Removal of a maximum of 284.9 ha of native vegetation within the 621.1 ha of Development Envelope.</li> <li>Removal of up to 26% of VT 11 which had a limited distribution within the Study Area (Woodman Environmental, 2019a).</li> <li>No loss of the potentially undescribed <i>Polymeria</i> sp. due to revised Development Envelope and Indicative Disturbance Footprint.</li> </ul>

Table ES4 – Summary of Terrestrial Fauna

Factor	Terrestrial Fauna Summary
<b>EPA Objective</b>	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
<b>Policy and Guidance</b>	<p>The EPA has published a number of guidelines for the Terrestrial Fauna factor. Guidance relevant to the Proposal includes:</p> <ul style="list-style-type: none"> <li>Environmental Factor Guideline: Terrestrial Fauna</li> <li>Technical Guidance: Sampling methods for terrestrial vertebrate fauna (Environmental Protection Authority, 2010).</li> <li>Technical Guidance: Terrestrial Fauna Surveys (Environmental Protection Authority, 2004).</li> <li>Technical Guidance: Sampling of short range endemic invertebrate fauna (Environmental Protection Authority, 2009).</li> </ul> <p>Several guidelines published by the DAWE, DBCA and their predecessors are also of relevance for species listed under the EPBC Act, including:</p> <ul style="list-style-type: none"> <li>Survey Guidelines for Australia's Threatened Bats (DEWHA, 2010a).</li> <li>Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010b).</li> <li>Survey Guidelines for Australia's Threatened Mammals (DSEWPAC, 2011a).</li> </ul>



Factor	Terrestrial Fauna Summary
	<ul style="list-style-type: none"> <li>• Survey Guidelines for Australia's Threatened Reptiles (DSEWPAC, 2011b).</li> <li>• EPBC Act referral guideline for the endangered northern quoll <i>Dasyurus hallucatus</i> (Department of the Environment, 2016).</li> <li>• Interim guideline for preliminary surveys of night parrot (<i>Pezoporus occidentalis</i>) in Western Australia (Department of Parks and Wildlife, 2017).</li> <li>• Conservation Advice, <i>Macroderma gigas</i>, Ghost bat (Threatened Species Scientific Communittee, 2016).</li> </ul>
<b>Receiving Environment</b>	<p>Six fauna habitat types mapped, being Hillcrest/ Hillslope, Low Stony Hills, Major Drainage Line, Sand Plain, Stony Plain and Gorge/ Gully.</p> <p>Sixteen caves known to support the Ghost Bat and/or Pilbara Leaf-nosed Bat, including potential Ghost Bat maternity roost CMRC-15.</p> <p>No perennial waterholes of value for fauna.</p> <p>Seven conservation significant fauna were confirmed present including the Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Peregrine Falcon, Northern Brush-tailed Possum and Grey Falcon.</p>
<b>Potential Impacts</b>	<ul style="list-style-type: none"> <li>• Loss and/or degradation of fauna habitat, particularly for conservation significant fauna.</li> <li>• Loss and/or degradation of terrestrial fauna habitat due to increased presence of weed species.</li> <li>• Injuries to and mortalities of fauna caused by interactions with vehicles, infrastructure, machinery and the workforce.</li> <li>• Reduced diversity or abundance of foraging resources due to altered hydrological regimes.</li> <li>• Alteration in behaviour of fauna due to noise, vibration, artificial light emissions and dust.</li> <li>• Increased presence of non-indigenous fauna species.</li> <li>• Alteration to fire regimes.</li> </ul>
<b>Mitigation</b>	<p><b>Avoidance:</b></p> <ul style="list-style-type: none"> <li>• The Proposal has avoided the need to clear additional fauna habitat by using the existing camp, Abydos Link Road (haul road; ALRE) and borefield infrastructure associated with Atlas Iron's Abydos Project.</li> <li>• The Proposal has been designed to avoid direct impacts to 15 out of the 16 caves in the Study Area, as well as the significant Lalla Rookh maternity cave which lies 3 km outside of the Development Envelope.</li> <li>• The Development Envelope has been designed to avoid the majority of mapped area of fauna habitats of most significance: <ul style="list-style-type: none"> <li>– In relation to the three most significant habitat types for vertebrate fauna: Approximately 99% of Gorge/ Gully habitat, 90% of Hillcrest/ Hillslope habitat and 96% of Major Drainage Line will be retained outside of the Development Envelope. It is likely that additional parts of these habitat types will be retained in the final layout of the Disturbance Footprint.</li> <li>– In relation to the two most significant habitat types for invertebrate fauna: Approximately 10 ha of Gorge/ Gully habitat and 696 ha of Hillcrest/ Hillslope habitat will be retained outside of the Development Envelope. It is likely that additional parts of these habitat types will be retained in the final layout of the Disturbance Footprint.</li> </ul> </li> </ul>



Factor	Terrestrial Fauna Summary
	<ul style="list-style-type: none"> <li>- All known permanent waterholes are outside of the Development Envelope.</li> </ul> <p><b>Minimisation and management:</b></p> <p>The following plans and procedures will be implemented to assist in minimising impacts to fauna and fauna habitat:</p> <ul style="list-style-type: none"> <li>• GDP Procedure (950-HSE-EN-PRO-0001).</li> <li>• Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).</li> <li>• Fauna Management Procedure (950-HSE-EN-PRO-0012).</li> <li>• Landfill Management Procedure (950-HSE-EN-PRO-0020).</li> <li>• Waste Management Procedure (950-HSE-EN-PRO-0023).</li> <li>• Introduced Fauna / Pest Control Procedure (950-HSE-EN-PRO-0022).</li> <li>• Significant Species Management Plan (Appendix K).</li> <li>• Water Management Plan and Site Water Operating Plan (<i>in preparation</i>).</li> </ul> <p>Key management measures contained in these plans include:</p> <ul style="list-style-type: none"> <li>• No more than 284.9 ha of vegetation/habitat within the 621.1 ha Development Envelope will be cleared/disturbed.</li> <li>• Clearing in/ of sensitive habitats including caves, gorges and drainage lines will be kept to the minimum necessary for safe construction and operation of the Proposal.</li> <li>• Speed limits will be enforced across the site.</li> <li>• Off-road driving will be prohibited unless otherwise authorised by senior management to minimise potential vehicle strikes.</li> <li>• Night-time vehicle movements will be restricted where possible to minimise potential vehicle strikes.</li> <li>• All bins storing putrescible waste will have tightly secured lids to avoid fauna attraction and entry.</li> <li>• The landfill will be operated and managed in accordance with the Environmental Protection (Rural Landfill) Regulations 2002. This will include fencing to reduce the potential for attracting fauna.</li> <li>• Blasting operations will be limited to daytime only to limit disturbance to fauna including bats.</li> <li>• Noise, dust and light emissions will be controlled where possible to avoid excessive disturbance to native fauna, including directing lights to working areas, shielding lights to reduce glow, and using conventional dust suppression techniques (i.e. water trucks).</li> <li>• Clearing will occur in accordance with Atlas Iron's Ground Disturbance Permit Procedure. No clearing will occur without prior authorisation from Atlas Iron's Ground Disturbance Permitting System. This will ensure that clearing does not occur outside the Development Envelope or exceed 284.9 ha.</li> <li>• Atlas Iron will abstract water in accordance with 5C Licences to take groundwater, a Water Management Plan and Site Water Operating Plan in accordance with the Department of Water and Environmental Regulations requirements.</li> </ul> <p>Specific to the management of cave CMRC-15:</p> <ul style="list-style-type: none"> <li>• Blasting will be undertaken in accordance with the recommendations contained in Blast It Global (2020) and detailed in the SSMP. Key measures include: <ul style="list-style-type: none"> <li>- Design blasts to perform to the blast criteria (i.e. limit to 100 mm/s but design to achieve 85 mm/s) using the reference values set out in Blast It Global (2020).</li> </ul> </li> </ul>



Factor	Terrestrial Fauna Summary
	<ul style="list-style-type: none"> <li>- Establish vibration monitors in caves CMRC-13, -14 and -15 for blasting at Miralga East pits 2 and 3.</li> <li>- Avoid blasting within 100 m of a cave until the results of monitoring validate predictions with a reasonable degree of confidence.</li> <li>- If vibration exceeds 100 mm/s, blasting should cease until the cause has been determined and steps to prevent a reoccurrence have been taken. A cave inspection is required to assess any impacts.</li> <li>- Periodically inspect caves to confirm the vibration limits are fit for purpose.</li> </ul> <ul style="list-style-type: none"> <li>• Recommendations provided in Bat Call WA (2020) will be followed and included in the SSMP.</li> </ul> <p><b>Rehabilitation:</b></p> <ul style="list-style-type: none"> <li>• All areas of the Indicative Disturbance Footprint (except for open pits) will be progressively rehabilitated as soon as practicable and as required by the MCP.</li> <li>• A MCP will be updated triennially or as required when significant changes are made to the Proposal. A detailed MCP, which will contain further information on rehabilitation works, will be prepared approximately one year to six months prior to the cessation of mining as stated in the MCP.</li> <li>• Rehabilitation works are expected to return disturbed areas (other than pits) to a stable and vegetated state. Revegetation is expected to provide some value for fauna although it is acknowledged that fauna habitats will not be restored to their pre-disturbance state.</li> </ul> <p><b>Offset:</b></p> <ul style="list-style-type: none"> <li>• A contribution to the Pilbara Environmental Offset Fund is expected to be made based on the number of hectares of clearing in the Chichester subregion as detailed in Chapter 8.</li> </ul>
<b>Predicted Outcome</b>	<ul style="list-style-type: none"> <li>• Potential clearing of up to 59.6 ha of high quality denning and foraging habitat for the Northern Quoll (Gorge/ Gully and Hillcrest/ Hill Slope habitat mapped within the Development Envelope).</li> <li>• Potential clearing of up to 59.6 ha roosting habitat for the Ghost Bat (Gorge/ Gully and Hillcrest/ Hill Slope habitat mapped within the Development Envelope).</li> <li>• Loss of one occasional nocturnal roost for the Ghost Bat (cave CMRC-02).</li> <li>• Potential temporary abandonment of caves close to the mining areas by Ghost Bat.</li> <li>• Increased reliance by Ghost Bat on Lalla Rookh and other nearby roosts as refuges during mining.</li> <li>• Retention of 15 of 16 known caves post-mining, including the category 2 potential maternity roost CMRC-15.</li> <li>• No direct impact to any permanent waterholes within or directly adjacent to the Development Envelope.</li> <li>• No significant impact to SRE fauna or habitat.</li> </ul>

In summary, the Proposal is not expected to have a significant impact on any environmental factor and is therefore expected to meet the EPA's environmental objectives. While there is a possibility of impacts to Terrestrial Fauna, Atlas Iron believes the EPA's objective for this factor can be met with the implementation of the Significant Species Management Plan (SSMP), EMP, Atlas' commitments in this referral document and execution of an appropriate offset package which is anticipated to result in positive environmental outcomes.



# 1. Introduction

## 1.1 Purpose and Scope

Atlas Iron Limited (Atlas Iron) is seeking approval to develop the Miralga Creek Direct Shipping Ore (DSO) Project (the Proposal). The Proposal is an iron ore mine located in the Pilbara region of Western Australia (WA), approximately 100 km south-east of Port Hedland, along the Marble Bar Road (Figure 1.1). Atlas Iron is referring this Proposal under Section 38 of the *Environmental Protection Act 1986* (EP Act) due to its potential to have a significant effect on a number of the environmental factors defined by the Environmental Protection Authority (EPA). This document serves to provide supplementary information in support of the Section 38 referral under the EP Act.

The referral form and this supporting document have been prepared in accordance with the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual* (Environmental Protection Authority, 2018) and consider the following:

- Instructions on how to prepare an Environmental Review Document (Environmental Protection Authority, 2018).
- Instructions for the referral of a Proposal to the Environmental Protection Authority under Section 38 of the Environmental Protection Act 1986 (Environmental Protection Authority, 2018).
- Instruction on how to define the key characteristics of a proposal (Environmental Protection Authority, undated).

Other relevant guidance material from the EPA and other regulators consulted in the development of the Proposal and in undertaking the environmental impact assessment are summarised where they are relevant in the remainder of the document.

This supporting document describes Atlas Iron's environmental impact assessment (EIA) process to date.

## 1.2 Proponent

Atlas Iron Pty Ltd (ACN 110 396 168) is the Proponent of this Proposal. Atlas Iron was acquired by Hancock Prospecting Pty Ltd in 2018, at which time it was de-listed from the Australian Securities Exchange (ASX).

Atlas Iron is an Australian iron ore company, mining and exporting DSO from its operations in the northern Pilbara region of WA. Its current operations are at Mount Webber, with a new project to commence shortly at Corunna Downs. It has previously operated mines at Pardoo, Wodgina, Mt Dove and Abydos. Atlas Iron is able to leverage its environmental experience at these previous sites, in particular from Abydos, which has a similar environmental setting and similar significant environmental values such as Pilbara Leaf-nosed Bat, Ghost Bat, Northern Quoll and their habitats.

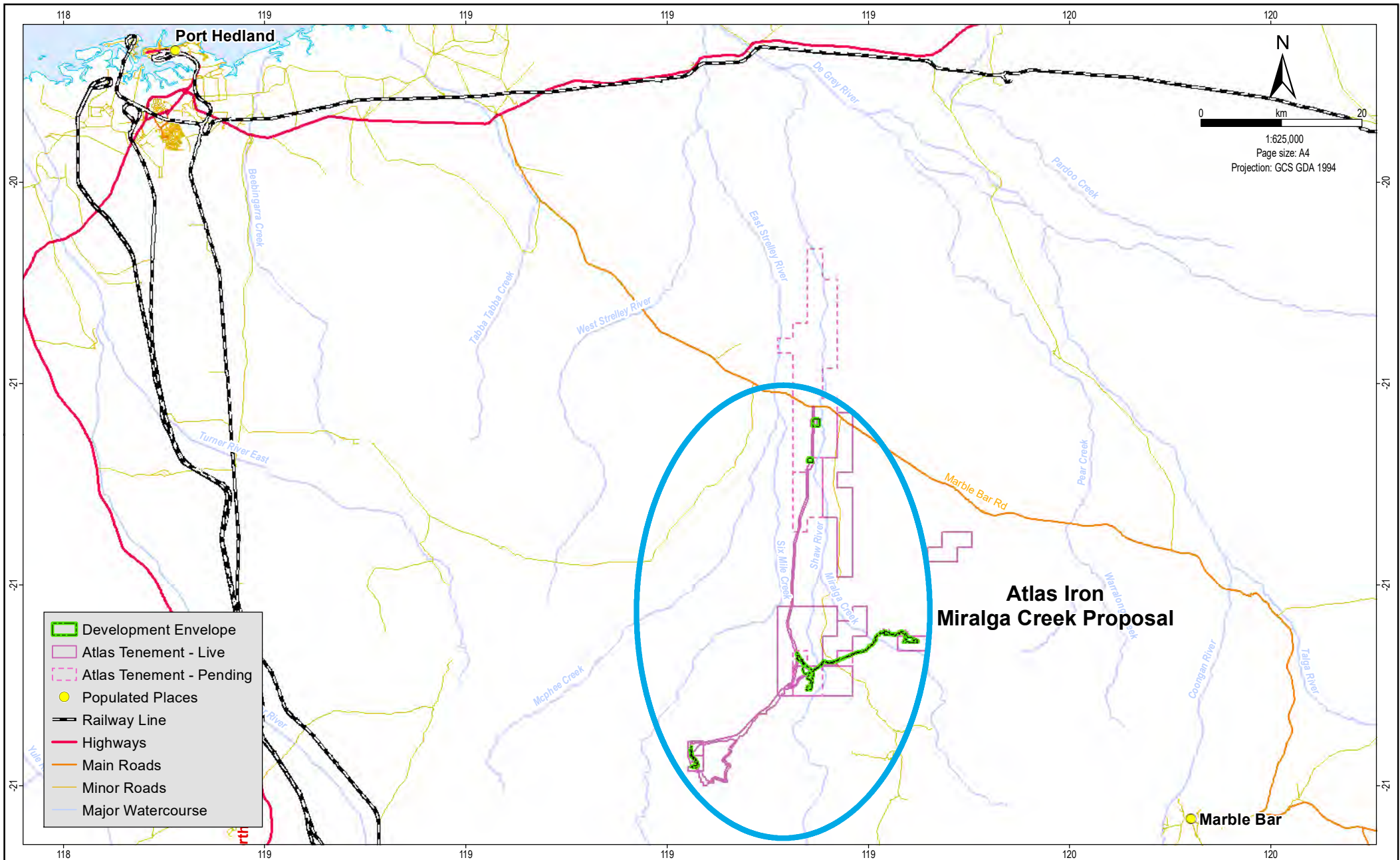




Atlas Iron is located at Level 17, Raine Square, 300 Murray St, Perth, WA. All correspondence regarding the Proposal should be forwarded to the key contact:

David Morley  
Senior Advisor – Approvals  
Email: [David.Morley@atlasiron.com.au](mailto:David.Morley@atlasiron.com.au)  
Phone: (08) 6228 8000





File Name: GIS\_2707\_MIR\_S38\_Fig1\_1 SiteLocFig.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes

**Site Location**

Figure No:  
**1-1**



### 1.3 Environmental Impact Assessment Process

One of the EPA's key roles is to provide the Western Australian Government with advice on the environmental acceptability of development proposals such as this Proposal. Proponents, and in some cases government departments and third parties, can refer their proposal to the EPA for consideration under Part IV of the EP Act. The EPA considers these referrals and decides whether or not they require formal environmental impact assessment and, if so, at what level. Alternatively, the EPA may determine that the Proposal can be adequately managed under another regulatory framework such as Part V of the EP Act (e.g. a Native Vegetation Clearing Permit, or a Works Approval and Licence).

Atlas Iron met with the DWER on 18 November 2019 to discuss this Proposal. The EPA recommended referring to EPA based on potential impacts. Subsequent studies and proposed management measures indicate that the EPA objectives for these factors can be met.

After consulting further with DWER, Atlas Iron anticipates the EPA will determine that the Proposal can be adequately managed under Part V of the EP Act and will make a 'Not Assessed' decision.

Atlas Iron referred the Proposal under the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC Act) in December 2019 (EPBC 2019/8601) for potential impacts to five terrestrial fauna species considered Matters of National Environmental Significance (MNES), two of which have been determined by Atlas Iron to be at risk of significant impact, pre-mitigation (Northern Quoll and Ghost Bat). If the Proposal is considered to be a Controlled Action under the EPBC Act, the EPA can undertake an 'Accredited Assessment' under the EPBC Act, on behalf of and for final approval by DAWE. However, anticipating a 'Not Assessed' by EPA, the federal approval process would then progress independently. In this instance, Atlas would submit the proposal under a Native Vegetation Clearing Permit application to the Department of Mines, Industry Regulation and Safety (DMIRS).

Atlas Iron anticipates both EPBC Act and EP Act approval well in advance of Q4 2020.

### 1.4 Other Approvals and Regulation

Beyond the EP Act Part IV process and EPBC Act process, Atlas Iron is undertaking additional EIA of the Proposal via the following permitting and approval processes:

- Mining Proposal and Mine Closure Plan approval under the *Mining Act 1978* (Mining Act) from DMIRS.
- Works Approval under Part V of the EP Act, regulated by the Department of Water and Environmental Regulation (DWER). This approval supports the Proposal's prescribed premises, specifically the crushing and screening facility (Category 5).
- Operating Licence under Part V of the EP Act, regulated by DWER, to operate the prescribed premises following construction and commissioning, once approved.
- Dangerous Goods License under the *Dangerous Goods Safety Act 2004* to store fuel and/or chemicals above prescribed volumes.



- *Rights in Water and Irrigation Act 1914* (RIWI Act) licensing is managed by DWER. The borefield to supply the Proposal has already been constructed and allocation licences have previously been granted for adequate volumes to support the Project. Minor amendment to these existing licences is required to include the Proposal as a recipient of the licensed water. This is currently in progress.
- Based on the surveys undertaken to date, a Section 18 approval under the *Aboriginal Heritage Act 1972* will not be required. However, Atlas Iron will reconsider this requirement should new heritage sites be identified over the course of the Proposal's implementation, for sites that cannot be avoided.

These are described further in Table 1.1.

Note that as the Proposal is making use of existing and previously permitted facilities at the Abydos mine, some approvals that would typically be discussed in a Section 38 referral for a mine have been excluded, as follows:

- Atlas Iron has already developed a borefield from which dust suppression water will be abstracted for the implementation of the Proposal. This borefield is discussed in this document only in relation to its interaction with sensitive receptors in a cumulative sense (e.g. groundwater dependent vegetation).
- The existing Abydos camp will be utilised to house the workforce during construction and operations, so typical camp requirements such as sewage and landfill are not considered in this EIA.
- The Proposal will make use of the existing Abydos Link Road (ALRE) and linkage to the Utah Point port facility in Port Hedland.

Atlas Iron has considered the impacts of the Miralga Creek proposal on the above external components and is satisfied they do not need to be included as there are no additional impacts expected beyond the existing approvals.

**Table 1.1 – Other Approvals**

Proposal Activities	Land Tenure/ Access	Type of Approval	Legislation Regulating the Activity
Clearing and mining	<p>The following tenure is relevant to the Proposal:</p> <ul style="list-style-type: none"> <li>• M45/1280</li> <li>• M45/1281</li> <li>• M45/1282</li> <li>• L45/525</li> <li>• L45/538</li> <li>• L45/369</li> </ul>	<p>Referral of the Proposal to the former DEE (now DAWE) occurred in December 2019 and close consultation has occurred since then. Based on current advice, a Not a Controlled Action decision is considered likely.</p>	EPBC Act
Clearing	<ul style="list-style-type: none"> <li>• L45/405</li> <li>• G45/340</li> <li>• G45/343.</li> </ul> <p>Atlas Iron has or is progressing Access</p>	<p>Assuming the EPA comes to a Not Assessed decision following this referral, a Native Vegetation Clearing Permit will be pursued through DMIRS</p>	Part V of the EP Act



Proposal Activities	Land Tenure/ Access	Type of Approval	Legislation Regulating the Activity
Crushing plant	<p>Agreements with relevant parties for any pending/ overlapping tenure.</p> <p>Appropriate tenure will be obtained prior to works commencing.</p>	Works Approval and Licence	Part V of the EP Act
Mining, including supporting activities and infrastructure		Mining Proposal Mine Closure Plan	<i>Mining Act 1978</i>
Mining, including supporting activities and infrastructure		Atlas Iron has an existing claim-wide Native Title Agreement with Njamal that covers both Claim #1 and #10. However, now that claim #1 has been determined (September 2019) Atlas and Njamal are updating this agreement accordingly.	<i>Native Title Act 1993</i>
Storage handling of dangerous goods		Licence to store fuel and chemicals on site	<i>Dangerous Goods Safety Act 2004</i>
Abstraction of groundwater		Amendment to existing licences	<i>Rights in Water and Irrigation Act 1914</i>



## 2. Proposal Description

### 2.1 Background

Atlas Iron met with the EPA on 4 April and 18 November 2019 and the former Department of the Environment and Energy (DEE) on 14 November 2019 to discuss commencing environmental impact assessment and approval of the Proposal. On the basis of completed environmental surveys at the time, it was determined that there could be potentially significant impacts to the Terrestrial Fauna environmental factor as defined by the EPA (Environmental Protection Authority, 2018a) and species recognised as MNES by the DEE, due to risk of impact to cave CMRC-15 at Miralga East. A referral was submitted to the DEE in December 2019 (EPBC 2019/8601). This document supports a referral to the EPA under Section 38 of the EP Act.

### 2.2 Justification

The Proposal will be Atlas Iron's second mine development since Mt Webber, and the first since the recently approved Corunna Downs Project. The Proposal is located approximately 100 km south of Port Hedland and is nearby the existing Abydos mine, which concluded operations in 2016. The greenfields project will however utilise the existing Abydos mine infrastructure to mine small satellite ore bodies at three small open pit mining areas – Miralga West, Miralga East and Sandtrax – using conventional drill and blast, load and haul methods.

Atlas Iron is currently operating the Mt Webber operation at a 7.8 Mtpa to 8.5 Mtpa (wet metric tonnes, WMT) rate producing a lump and fines product and pending market conditions a value fines product. Mt Webber is currently expected to finish operations in November 2022. To achieve a sustaining production profile of 6.0 Mtpa to 7.0 Mtpa (WMT), Atlas Iron will progress a ramp down of Mt Webber tonnes, as Corunna Downs ramps up followed by tonnage from Miralga Creek. This will enable a consistent uniform blended product available for sale until early 2027, when both the Corunna Downs and Miralga Creek orebodies have been exploited.

In the absence of the Corunna Downs and Miralga Creek developments, Mt Webber will conclude operations in April 2022. Once Mt Webber has concluded operations, the Miralga Creek development is required to ensure a consistent uniform blended product is achieved in combination with ore from Corunna Downs.

### 2.3 Key Proposal Characteristics

The Proposal comprises the mining of iron ore from five satellite pits within three discrete mining areas, spread over 30 km, as follows (Figure 2.1):

1. **Miralga East** (3 pits), 35 km north-east of the now closed Abydos Mine, with the three pits located along an east to west trending ridge (Figure 2.2)
2. **Miralga West** (1 large pit), 22 km north-east of Abydos, with the pit on a north-east to southwest trending ridge (Figure 2.3)
3. **Sandtrax** (1 small pit), 7 km north-east of Abydos, with the pit along an east–west ridge (Figure 2.4).





The pits will be mined in a staged manner by a small mobile mining fleet. Yearly predicted tonnages are provided in Table 2.1. A typical fleet for this size of operation may include<sup>1</sup>:

- Three Cat777 haul trucks.
- One bulldozer.
- 1 excavator.
- 1 front end loader.

**Table 2.1 – Indicative Mined Tonnages, Life of Mine**

Mine	Pit	Material	Year 1	Year 2	Year 3	Year 4	Year 5
Miralga East	Pit 1	Ore	179,568	502,486	345,087	–	–
		Waste	81,679	247,013	212,580	–	–
	Pit 2	Ore	41,126	267,147	393,571	361,379	156,524
		Waste	250,190	250,505	437,666	223,526	22,373
	Pit 3	Ore	–	216,044	135,882	–	–
		Waste	–	240,196	139,202	–	–
Miralga West	Ore	2,190	741,896	900,679	1,216,820	749,662	
	Waste	71,124	759,757	728,052	1,274,775	374,034	
Sandtrax	Ore	–	87,105	133,014	369,096	–	
	Waste	–	8,351	28,308	154,494	–	
<b>Totals</b>	<b>Ore</b>	<b>222,884</b>	<b>1,814,678</b>	<b>1,908,233</b>	<b>1,947,295</b>	<b>906,186</b>	
	<b>Waste</b>	<b>402,993</b>	<b>1,505,822</b>	<b>1,545,808</b>	<b>1,652,795</b>	<b>396,407</b>	

A new haul road will be constructed between Miralga East and Miralga West (Figure 2.5), and the crushing plant will be established within one of the stockyards presented in Figure 2.6, or another suitable location within the Development Envelope.

Table 2.2 and Table 2.3 below summarise the key characteristics for the Miralga DSO Proposal. The following sections provide a description of the key characteristics of the Proposal.

Atlas Iron is aiming to develop the Proposal to commence mining in the third quarter of 2021, as presented in Table 2.4.

<sup>1</sup> This list of equipment is not definitive; it is provided only to give context to the small size of the operation.

**Table 2.2 – Summary of the Proposal**

<b>Proposal Title</b>	Miralga Creek DSO Project
<b>Proponent Name</b>	Atlas Iron Pty Ltd
<b>Short Description</b>	<p>The proposal is to develop above water table mining of iron ore from three areas referred to as Sandtrax, Miralga West and Miralga East, approximately 100 km south-east of Port Hedland, along the Marble Bar Road (Figure 1.1, Figure 2.1).</p> <p>The proposal includes the development of mine pits and associated infrastructure including but not limited to processing facilities, waste landforms and access roads. The proposal will utilise some existing ancillary infrastructure from the nearby Abydos DSO Project.</p>

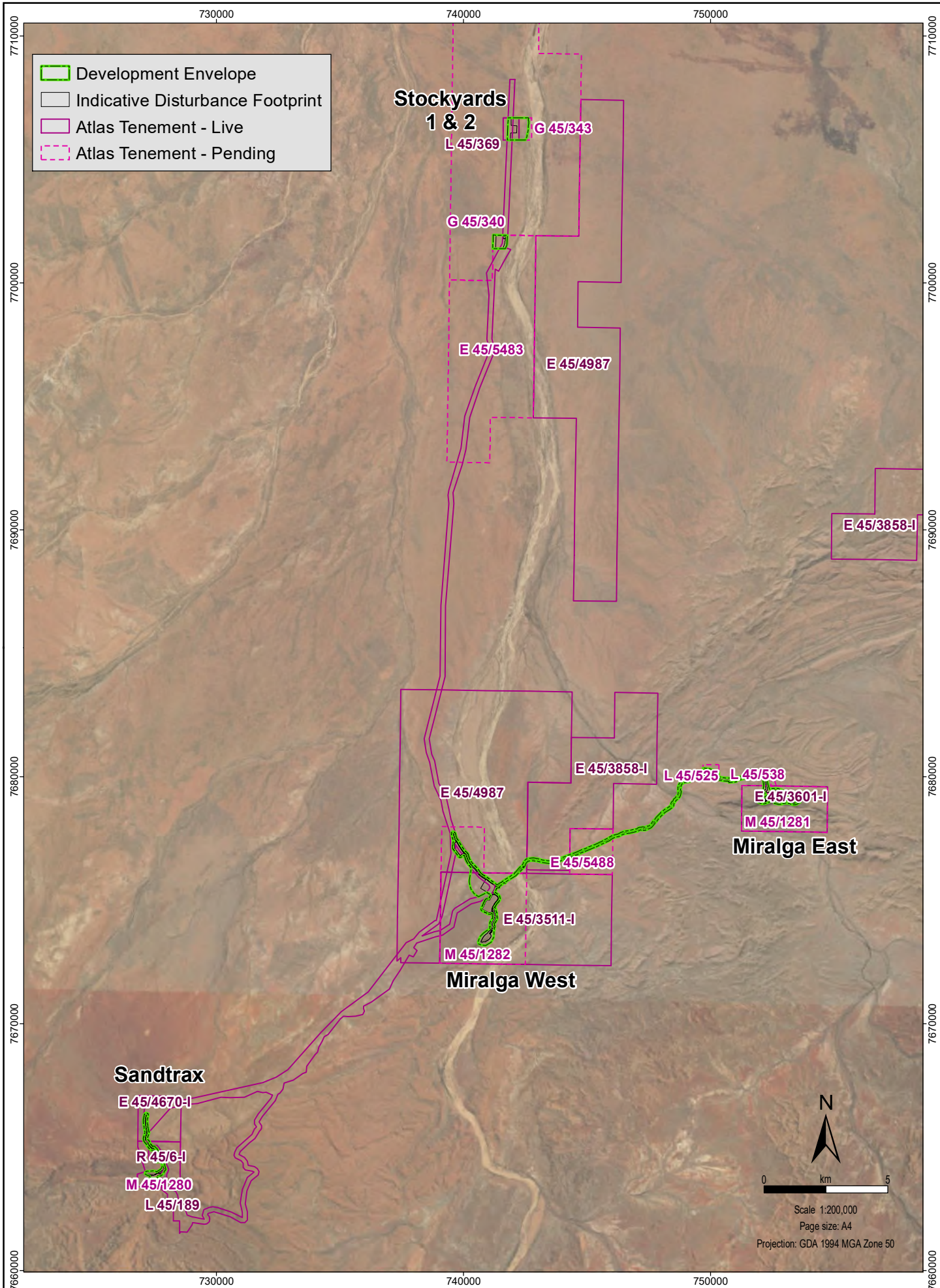
**Table 2.3 – Location and Proposed Extent of Physical and Operational Elements**

Element	Location	Proposed Extent
<b>Physical Elements</b>		
Pits	<ul style="list-style-type: none"> <li>• Three at Miralga East (Figure 2.2)</li> <li>• One at Miralga West (Figure 2.3)</li> <li>• One at Sandtrax (Figure 2.4)</li> </ul>	Clearing of no more than 284.9 ha of native vegetation within the 621.1 ha Development Envelope.
Waste dumps	<ul style="list-style-type: none"> <li>• Miralga East (Figure 2.2)</li> <li>• Miralga West (Figure 2.3)</li> <li>• Sandtrax (Figure 2.4)</li> </ul>	
Supporting Infrastructure: <ul style="list-style-type: none"> <li>• Access roads</li> <li>• Mine Operation Centre</li> <li>• Laydown areas</li> <li>• Administration areas</li> <li>• Explosives magazine</li> <li>• Fuel storage area</li> <li>• Haulage route</li> <li>• ROM stockyard</li> </ul>	Various locations	
<b>Operational Elements</b>		
Groundwater abstraction	Existing borefields	Abstraction of no more than 0.9 GLpa of groundwater.
Processing of ore (mobile crushing and screening plant)	Within the Development Envelope	Crushing and screening throughput of 2 Mtpa.

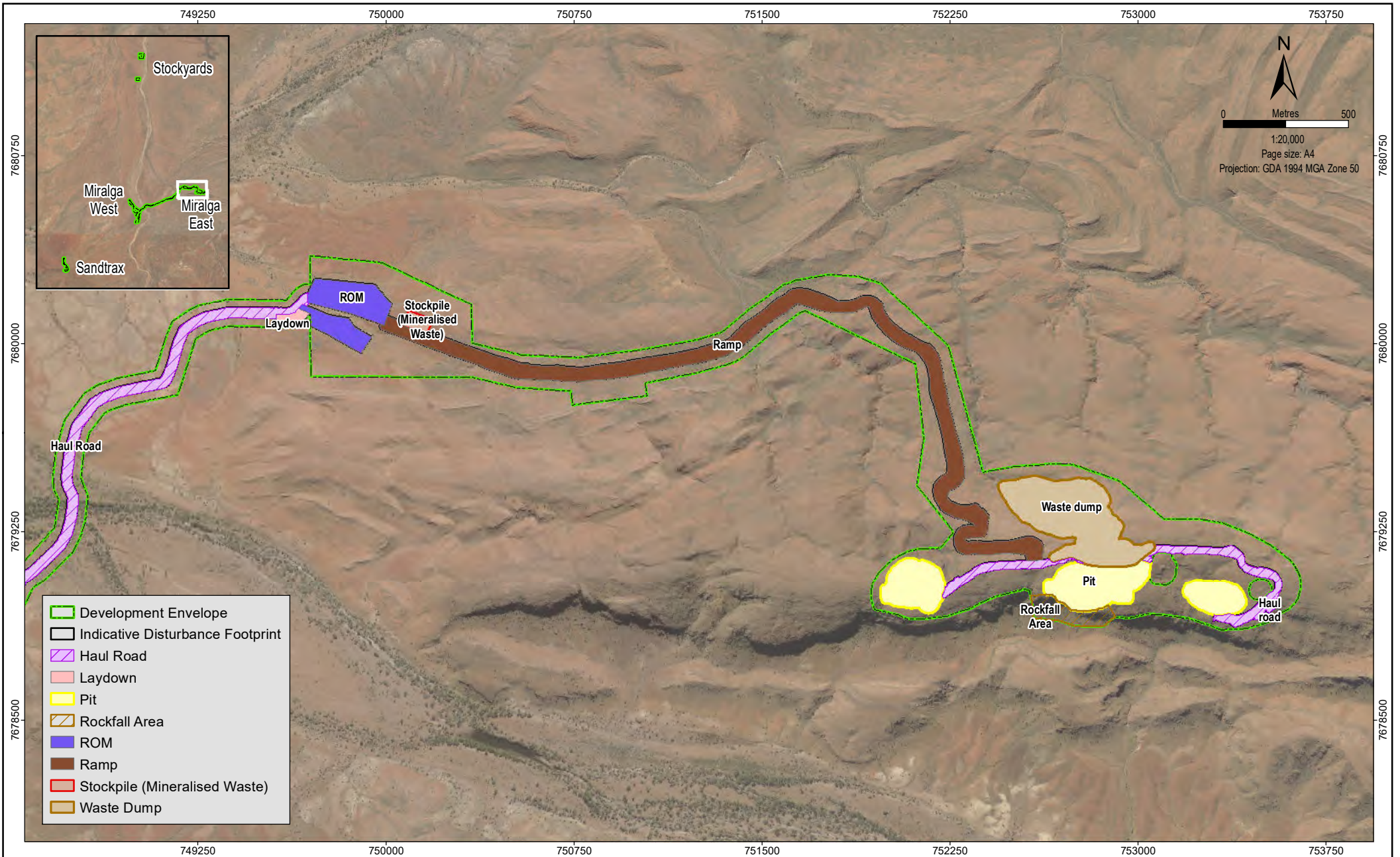
**Table 2.4 – Indicative Development Schedule**


<b>Development Stage</b>	<b>Indicative Timing</b>
Obtain key environmental and mining approvals	Q3 2020
Commence site construction	Q1 2021
Commence mining	Q3 2021
Commence shipping	Q2 2022
Mining ceases	Q3 2026
Decommissioning and closure	Q3 2027









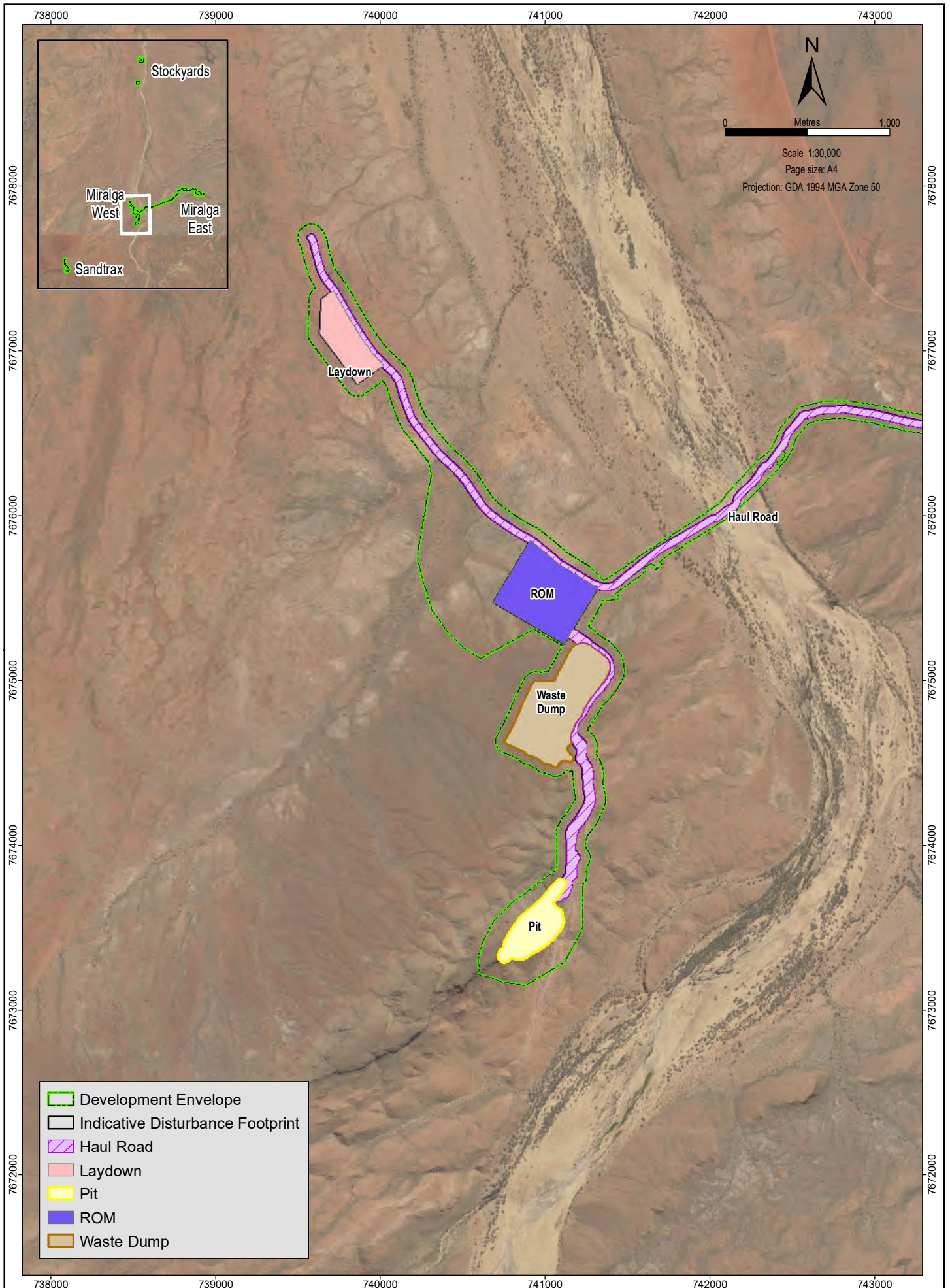

 File Name: GIS\_2713\_MIR\_S38\_Fig2\_2\_SiteLayoutMirEast.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:

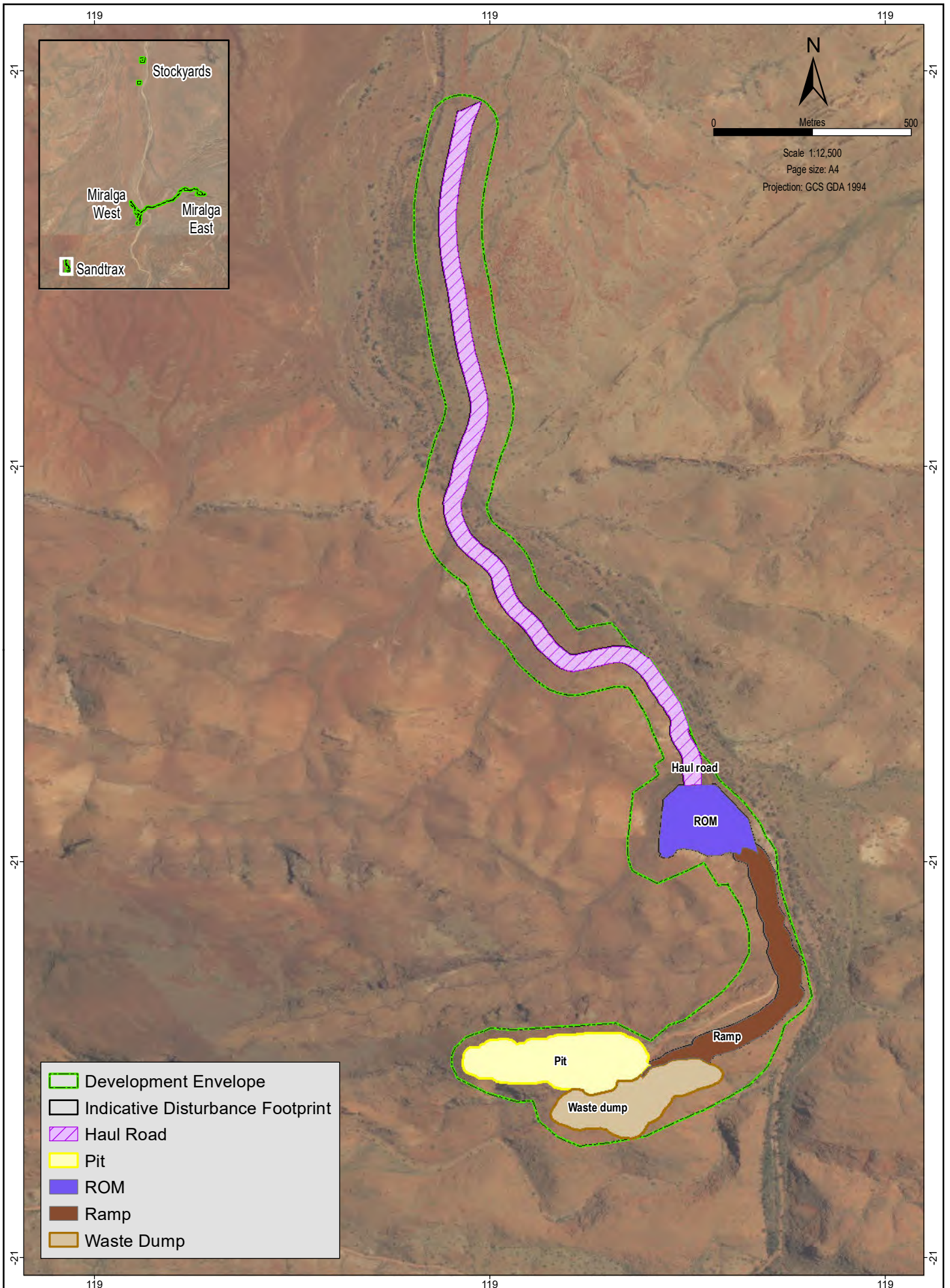
**Site Layout - Miralga East**

Figure No:  
**2-2**









-  Development Envelope
-  Indicative Disturbance Footprint
-  Haul Road
-  Pit
-  ROM
-  Ramp
-  Waste Dump



File Name: GIS\_2711\_MIR\_S38\_Fig2\_4\_SiteLayoutSandtrax.mxd  
 Date: 1/04/2020  
 Author: Heath.Maconachie

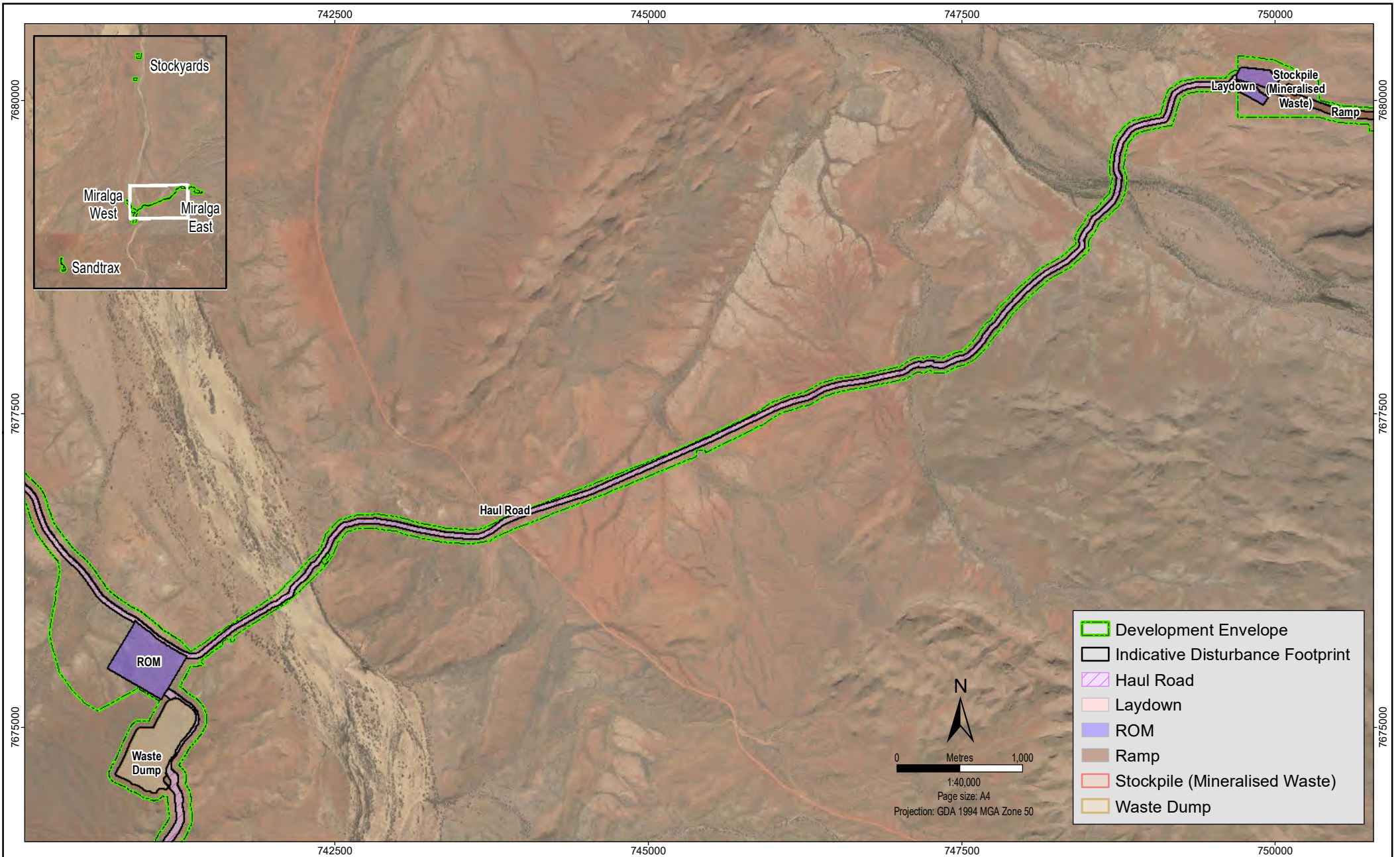
Source & Notes:

### Site Layout - Sandtrax

Figure No:

**2-4**





	Development Envelope
	Indicative Disturbance Footprint
	Haul Road
	Laydown
	ROM
	Ramp
	Stockpile (Mineralised Waste)
	Waste Dump

N

0      Metres      1,000

1:40,000  
Page size: A4  
Projection: GDA 1994 MGA Zone 50

	File Name: GIS_2714_MIR_S38_Fig2_5_HaulRoad.mxd
	Date: 2/04/2020
	Author: Heath.Maconachie

Source & Notes:

## Site Layout - Haul Road

Figure No:  
**2-5**





File Name: GIS\_2715\_MIR\_S38\_Fig2\_6\_SiteLayoutStockyards.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

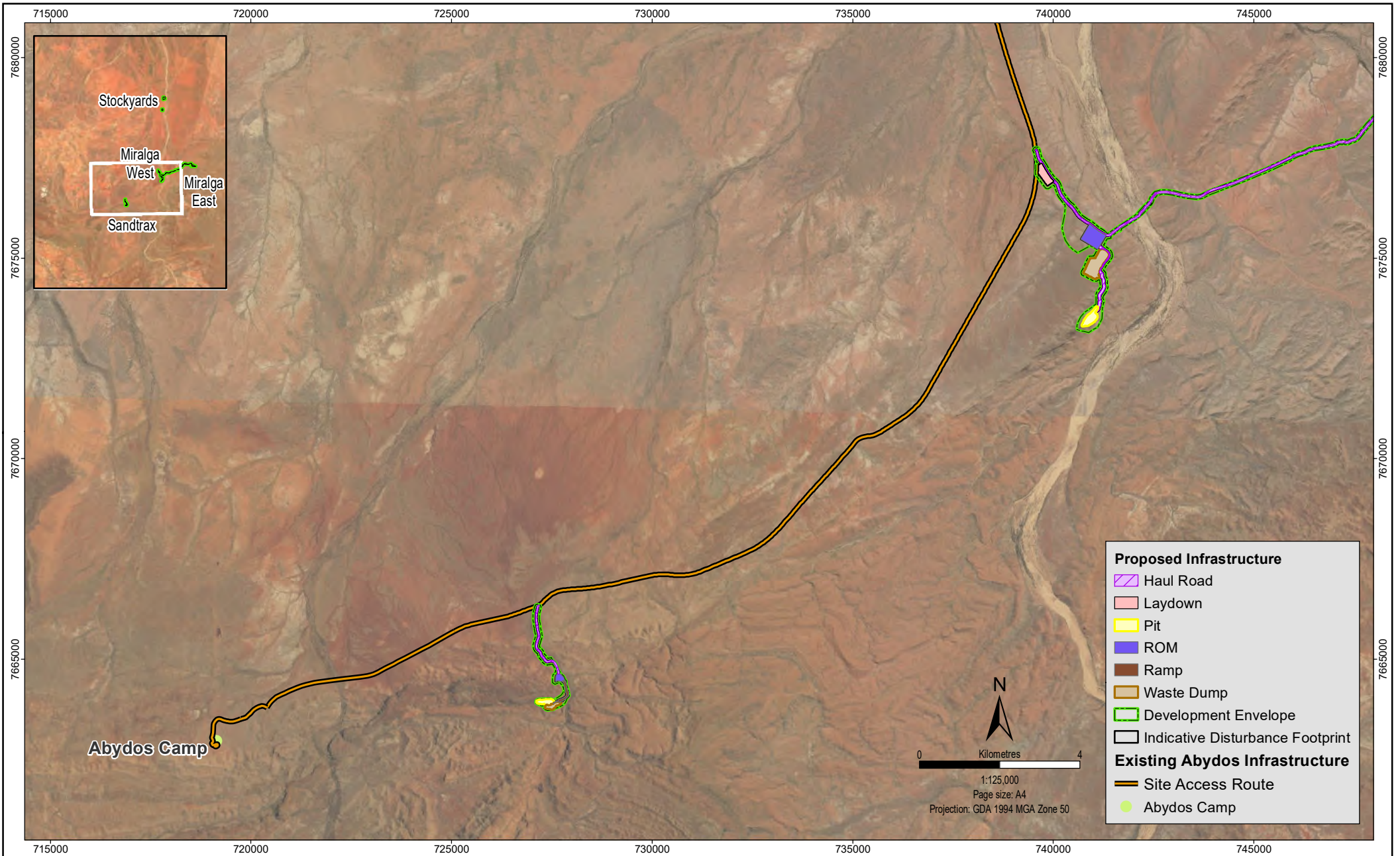
Source & Notes:


## Site Layout - Stockyards

Figure No:

**2-6**






 File Name: GIS\_2716\_MIR\_S38\_Fig2\_7\_ToABY.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:

**Abydos Infrastructure**

Figure No:  
**2-7**



### **2.3.1 Mining**

Mining will be conventional drill and blast, load, and haul methods. It is expected that approximately 8 Mt of iron ore will be mined above the groundwater table over approximately 4 to 5 years with an average strip ratio of 0.8:1 (waste:ore). The proposal is to maintain approximately 2 Mtpa ore supply with a mobile mining fleet, on a day shift only basis for seven days a week. New infrastructure in addition to the existing Abydos operation will include open pits, waste rock dumps, extension to haul roads and run of mine (ROM) pads. Topsoil and vegetation will be removed, where possible, during early development and stockpiled in adjacent well-drained areas. The orebodies crop out at surface and do not require pre-stripping. Topsoil stockpiles will be managed appropriately and the materials will be used during rehabilitation.

### **2.3.2 Processing**

Once blasted, broken ore and waste rock will be loaded separately into haul trucks. Ore will be transported via the haul road network to the ROM intermine pad at the base of each mining area. Processing will be undertaken using a small mobile dry crushing and screening facility located on one of the stockyard locations shown within the Development Envelope, adjacent to Marble Bar Road (Figure 2.1). The plant will comprise a primary crusher and screening plant, secondary cone crusher, samples station and product stackers. The plant will produce both lump (40 mm–6.3 mm) and fines (<6.3 mm) for 100% recovery. No tailings or waste product will be produced.

### **2.3.3 Haulage**

Ore will be transported by truck to the Utah Point port facility in Port Hedland via the existing Abydos Link Road (haul road; ALRE), to Marble Bar Road and the North West Coastal Highway. Road haulage will generally be on a 12 hour (day-time) basis. A new haul road will be constructed between Miralga West and Miralga East.

### **2.3.4 Waste Rock Management**

Approximately 5.5 Mt of waste rock will be mined throughout the life of the Proposal. Waste rock will initially be used to construct mine site infrastructure (e.g., access ramps, drainage structures and safety bunds) and then transported and disposed of in above ground waste rock dumps (Figure 2.2, Figure 2.3, Figure 2.4). Waste types are summarised in Table 2.5.



**Table 2.5 – Preliminary Mine Waste Inventory**

Lithology	Miralga East pit 1	Miralga East pit 2	Miralga East pit 3	Miralga West	Sandtrax
Banded Iron Formation (BIF)	94.7%	98.7%	94.8%	83.7%	100%
Chert	5.3%	1.3%	5.2%	0.2%	–
Shale	–	–	–	2.1%	–
Sandstone	–	–	–	13.9%	–
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Source: Mine Earth (2020)

Mine Earth was commissioned by Atlas Iron to assess the geochemical and physical characteristics of mine waste expected to be produced from the Miralga East, Miralga West and Sandtrax deposits (Mine Earth, 2020). Assay information across all deposits was both comprehensive and spatially representative for all rock types. The key mine waste lithology types expected to be produced from the open pits are banded iron formation (BIF), chert, shale and sandstone:

- All mine waste types within the planned pit shells and within a 10 m buffer outside of the pit shells, were classified as non-acid-forming (NAF).
- No significant enrichment in any element was identified from multi-element and water extraction testwork. All mine waste types from all deposits are expected to release negligible metals/metalloids during weathering.

An assessment of the physical characteristics and erosion stability of mine waste showed that:

- BIFs, cherts and sandstones will be the dominant waste rock lithology types from each deposit (>95%) and these are likely to display moderate-high erosion stability.
- Shales will only represent a minor proportion (2.1%) of the total waste rock volume from the Miralga West pit and are likely to display low erosion stability. These will be buried within the waste rock dumps rather than deposited on the surface of the final landform.

### 2.3.5 Water Supply

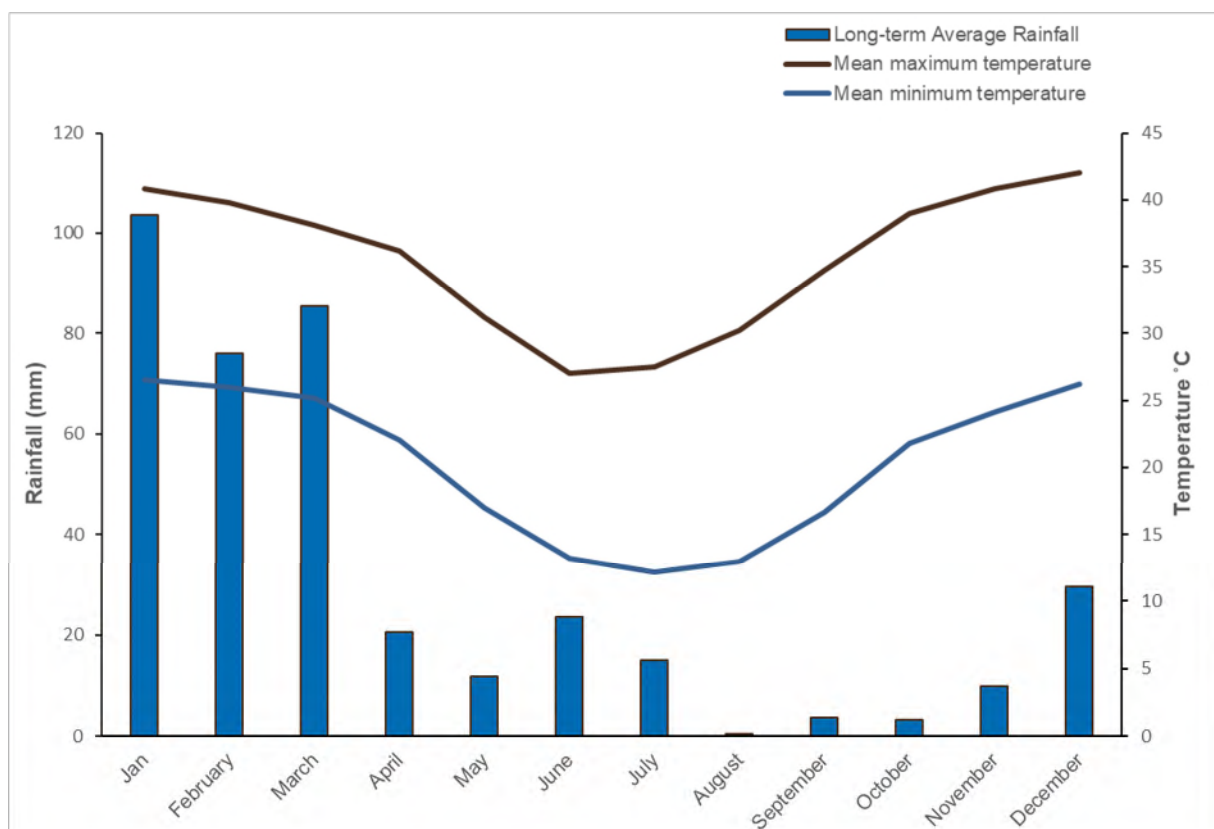
The Proposal's water supply includes existing groundwater and production bores and an existing ground water licence associated with Atlas Iron's Abydos Project and the ALRE. New production bores are not anticipated to be required (Atlas Iron Pty Ltd, 2020) (Appendix O). The Proposal requires up to approximately 0.9 GL per annum, with water demand anticipated to be approximately 60,000 to 80,000 kL per month (Atlas Iron Pty Ltd, 2020). The existing ALRE groundwater licence is for 1,198,368 kL per annum and is valid until 29 July 2025, and there is additional capacity in the Venturex borefield (near Sandtrax). Atlas Iron has an existing agreement with Venturex to take water from this borefield. Water licensing is managed by DWER under the RIWI Act. As bores and water approvals are already in place, their use is only being considered here in terms of the potential to impact local GDV, which is discussed in more detail in Chapter 5. The bores themselves do not form part of this Proposal to be considered by the EPA, and they do not all lie within the Development Envelope.

### 2.3.6 Additional Infrastructure and Support Facilities

Mobile crib rooms and workshops will be required for the Proposal, with the existing Abydos infrastructure used where appropriate (ALRE and borefield, the camp may be used as well). The use of existing infrastructure, where appropriate, is a significant mitigation in avoiding new impacts through the implementation of the Proposal, assisting Atlas Iron to meet the EPA's principles for this Proposal.

## 2.4 Local and Regional Context

The Proposal is located 100 km south-east of Port Hedland, along the Marble Bar Road and approximately 40 km (at its nearest point) to Marble Bar. The region has a semi-desert to tropical climate with highly variable, mostly summer rainfall (McKenzie, 2002; Leighton, 2004). The Pilbara climate is significantly influenced by tropical cyclones that develop over the Indian Ocean in Australia's north (Leighton, 2004), with typical average annual rainfall occurring predominantly from January to March. The closest official Bureau of Meteorology weather station in operation is located at Marble Bar, located approximately 40 km south-east of the Proposal. The average annual rainfall and average monthly minimum and maximum temperatures are provided in Figure 2.8.



Source: (Bureau of Meteorology, 2020)

**Figure 2.8 – Climate Data Marble Bar Station (004106) 2000–2019**

The northern stockyard lies within the Roebourne subregion of the Pilbara Bioregion, with the remainder of the Proposal lying in the Chichester sub-region of the Pilbara bioregion (Department of Sustainability, Environment, Water, Population and Communities, 2012). The Chichester subregion is characterised by undulating granite and basalt plains with significant



areas of basaltic ranges. The plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* (spinifex) hummock grasslands and the ranges support *Eucalyptus leucophloia* tree steppes (Kendrick P. &, 2001). The Roebourne subregion is characterised by coastal and subcoastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia*. Uplands are dominated by *Triodia* hummock grasslands.

Miralga East is located in the Miralga Creek catchment, a sub-component of the larger Shaw River Catchment (approximately 790,000 ha) (Figure 2.9). Miralga West and both stockyards are located in the Shaw River Catchment. Sandtrax lies within the separate Strelley River catchment (approximately 280,000 ha). No perennial streams occur in the immediate vicinity of the Proposal (Figure 2.9). The Proposal is located in the Proclaimed Pilbara Groundwater Area. Groundwater in the area is available in the following primary aquifers (MWH, 2012):

- Alluvial Aquifers
- Fractured Rock Aquifers.

The Chichester subregion has 6.56% of its land surface reserved under some form of conservation tenure, including Mungaroona Range Nature Reserve (100 km southwest of the Development Envelope) (Kendrick P. &, 2001). The Roebourne subregion has 9.56% of its land surface reserved under some kind of conservation tenure (Kendrick P. &, 2002).

The majority of the Development Envelope lies within pastoral tenure, in particular Strelley Station (42.1% of the Development Envelope) and Panorama Station (37.6% of the Development Envelope) (Figure 2.10):

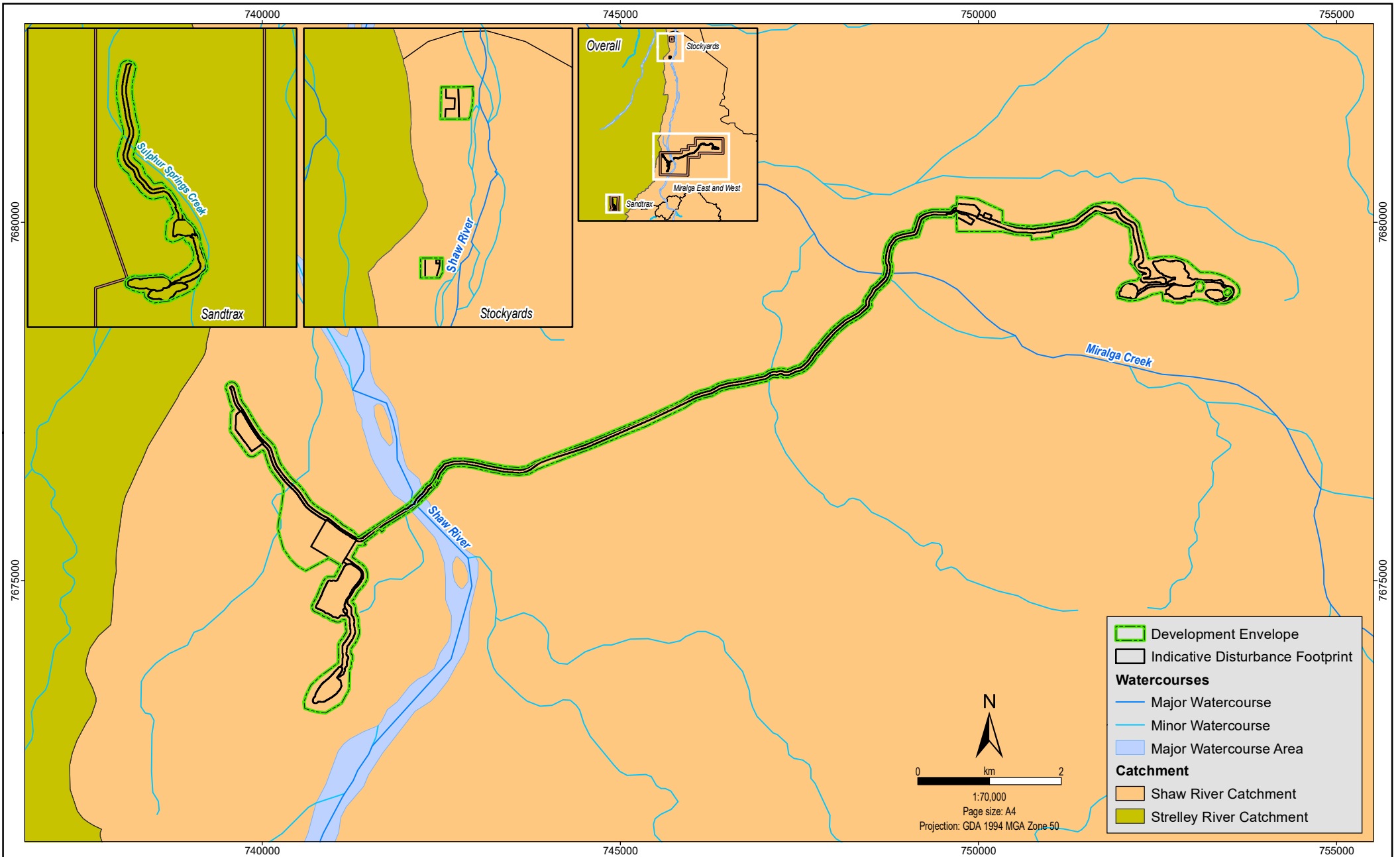
- Stockyards – Coongan Station and Strelley Station
- Sandtrax – Panorama Station and Unallocated Crown Land
- Miralga East – Panorama Station
- Miralga West – Panorama Station and Strelley Station
- New haul road between Miralga West and East and West - Panorama Station and Strelley Station.


The Development Envelope lies within two Native Title areas (Figure 2.11):

- Nyamal People #1 (WCD2019/010) across Sandtrax, Miralga East and the southernmost portion of Miralga West including the eastern portion of the new haul road. This is now a determined claim as at 24 September 2019.
- Nyamal People #10 (WCD2019/011) across the stockyards, the majority of Miralga West the western portion of the new haul road.

Atlas Iron has a claim-wide agreement with Njamal and has conducted exploration activities on site in accordance with this agreement and in regular consultation with the Njamal people and their representatives.

Atlas Iron has been in further consultation with Barlbimbinya Aboriginal Corporation (BAC) as the Registered Body Corporate, to revise the existing agreement appropriately since the Njamal People #1 claim was determined. This is currently in progress.

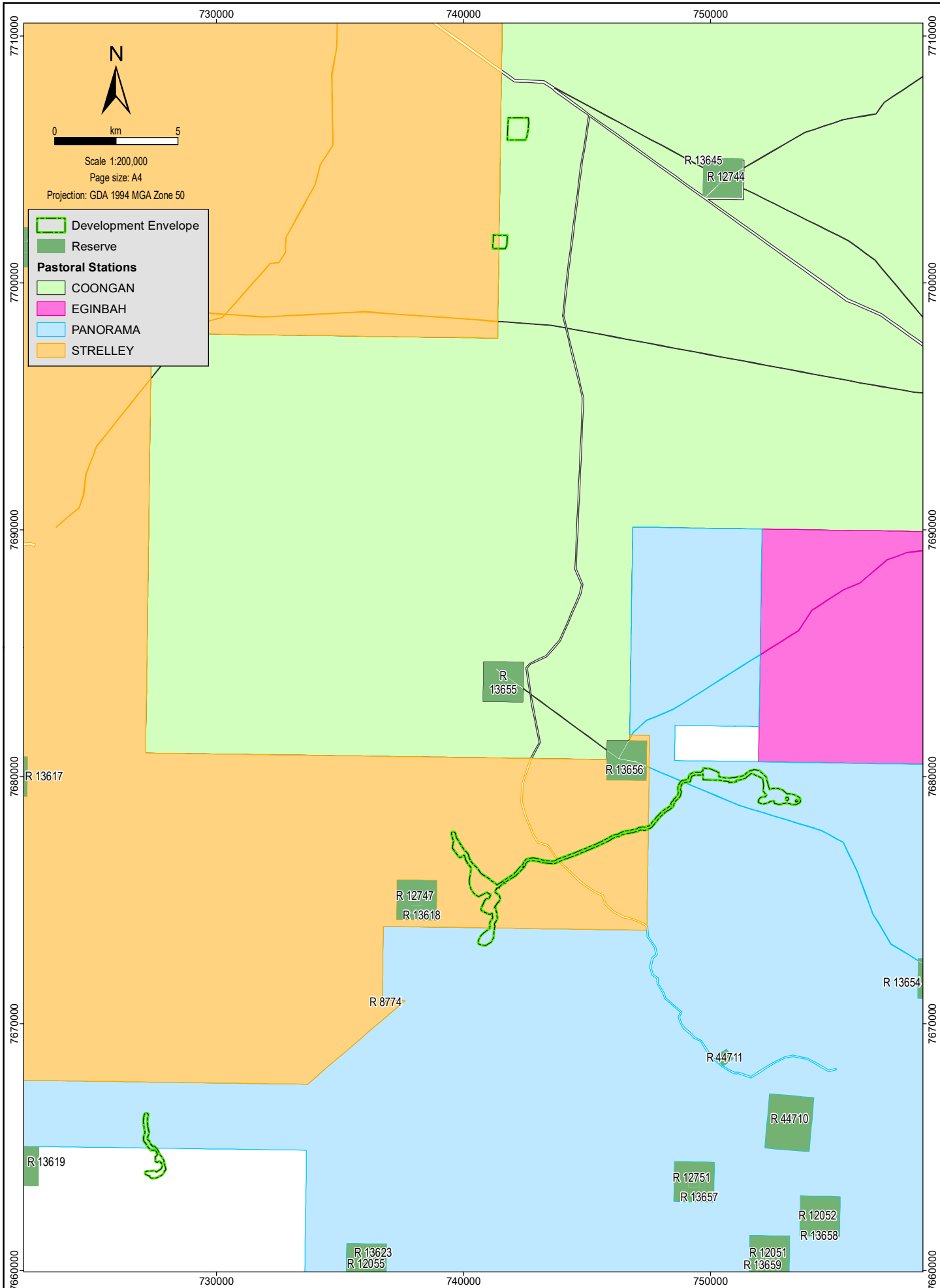



 GIS\_2723\_MIR\_S38\_Fig2\_9\_Hydrology.mxd  
 Date: 3/04/2020  
 Author: Heath.Maconachie

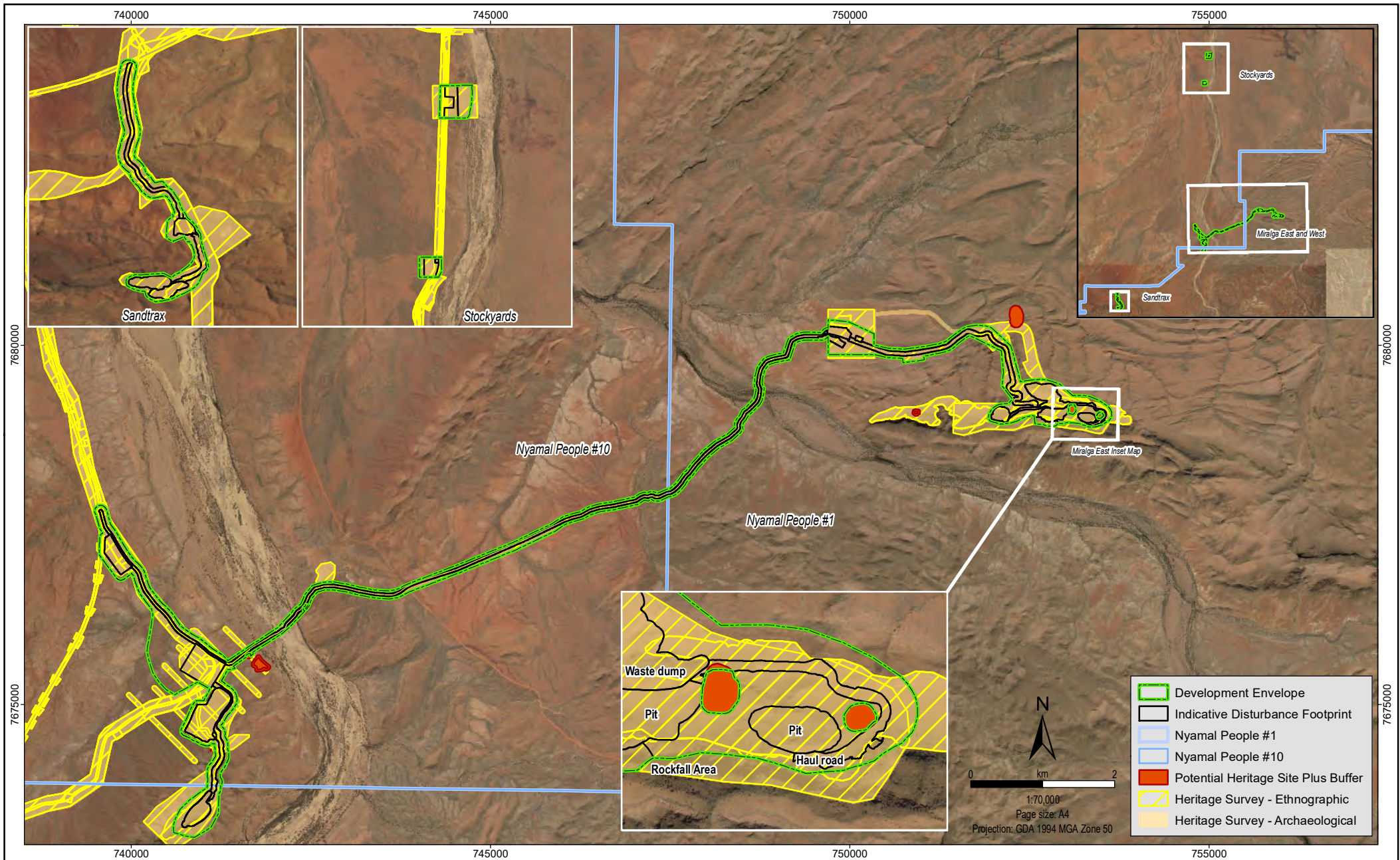
Source & Notes:


**Hydrology**

Figure No:  
**2-9**








 GIS\_2766\_MIR\_S38\_Fig2\_11\_Heritage.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:

## Heritage

Figure No:

**2-11**



### 3. Stakeholder Engagement

Atlas Iron has had ongoing consultation with relevant stakeholders throughout the development of this Proposal. Two of Atlas Iron's core values are to 'Do the Right Thing' and 'Think Win-Win'. With these in mind, the principal objectives of stakeholder consultation have been to:

- Identify interested and potentially affected individuals and groups and to understand the nature of stakeholders' interest in the Proposal.
- Ensure that stakeholders are properly informed about the Proposal and that there are adequate and timely opportunities for stakeholders to provide input and raise issues.
- Ensure that any stakeholder issues or concerns are managed with respect, are given due consideration and are responded to in a timely manner.
- Meet the relevant regulatory requirements with regard to appropriate stakeholder input to the impact assessment and approvals process.

#### 3.1 Key Stakeholders

Atlas Iron undertook an assessment to determine all stakeholders with an interest in the Proposal and has proactively consulted with key stakeholders during the exploration, design and planning phases of the Proposal.

Table 3.1 provides a list of key stakeholders and groups that may have interest in the Proposal.

**Table 3.1 – Proposal Stakeholders**

Interest Group	Stakeholder
Pastoral Stations	Strelley Station (Strelley Pastoral Co Pty Ltd)
	Hillside-Panorama Station (Hillside Station (WA) Pty Ltd)
	Coongan Station (Coongan Aboriginal Corporation)
Mining Tenure Holders	Whim Creek Mining Pty Ltd
	Fastfield Pty Ltd
	Venturex Sulphur Springs Pty Ltd
	Le Aussie
Native Title Groups	Nyamal People #1 and Nyamal People #10 Native Title Groups
Shires and Local Governments	Shire of East Pilbara
	Town of Port Hedland
State Government Agencies	Department of Mines, Industry Regulation and Safety
	Department of Water and Environmental Regulation
	Department of Biodiversity, Conservation and Attractions



Interest Group	Stakeholder
	Pilbara Ports Authority
	Main Roads Western Australia
	Department of Planning, Lands and Heritage
	Department of Primary Industries and Regional Development
Australian Government Agencies	Department of Agriculture, Water and the Environment
Local and Regional Groups	Marble Bar and Nullagine Community Resource Centre
	Marble Bar Progress Association

### 3.2 Stakeholder Engagement Process

Atlas believes in early and thorough stakeholder consultation. To this effect, Atlas introduced the Proposal at the concept level to all stakeholders, in particular the following key stakeholders:

- EPA (DWER)
- DAWE
- DMIRS
- Njamal Aboriginal Corporation (NAC), now Barlbinbinya Aboriginal Corporation (BAC)
- Shire of East Pilbara
- Venturex Resources Ltd.

For transparency, Atlas has continued to provide project updates to all stakeholders appropriately throughout the process as the project has become better defined and as we have gained further detailed knowledge regarding our potential environmental impacts.

A plan was provided to the EPA, DEE and DMIRS in late 2019 which identified gaps in Atlas Iron's knowledge, how the gaps would be filled via specific and specialist investigations, and a commitment to update all regulators as these studies were completed.

### 3.3 Stakeholder Consultation

Core consultation for this project has revolved around the following:

- Identifying all relevant stakeholders
- Potential environmental impacts
- Management and mitigation of potential environmental impacts
- Level of assessment
- Relevant approvals and approvals timeframes.

The result of baseline studies has been communicated to the relevant regulators as this impact assessment has progressed. Consultation has determined the key potential





environmental impact for the Proposal is the State and Federally protected Ghost Bat. A category 1 cave<sup>2</sup> was already known from the area, located at the abandoned gold mine referred to as Lalla Rookh, between Sandtrax and Miralga West. Baseline studies determined the presence of two category 2 caves with one being in close proximity to one pit at Miralga East (cave CMRC-15). On its own, CMRC-15 has value to the local Ghost Bat population, however that value is increased by the nearby location of caves CMRC-13 (category 4) and CMRC-14 (category 3), which form an 'apartment block' complex. Atlas Iron became aware of this cave in 2019 and immediately commenced additional, previously unplanned investigations to help better understand this cave specifically to tailor management and mitigation. This has involved close consultation with Bat Call WA, who has been engaged to guide the scoping of additional studies by geotechnical and blasting consultants to ensure the protectability of CMRC-15.

This has been a key topic discussed with EPA and DAWE to date.

### **3.3.1 Targeted Community and Engagement Strategy**

Atlas undertook targeted and proactive stakeholder engagement through early and transparent discussions with all parties specified in Table 3.2.

This table is not exhaustive but is consistent with EPA guidance.

---

<sup>2</sup> Cave categories are more fully described in Section 6.1.5.2. Briefly, category 1 caves are the most important to a population's persistence in an area, while category 4 caves are the least important.



Table 3.2 – Stakeholder Engagement Summary

Stakeholder	Atlas Representative	Date	Method	Topics/ Issues Raised	Key Outcomes/ Action Items Raised	Resolution of Action	Stakeholder Response
<b>Government Agencies</b>							
DMIRS – Melissa Harrison and Matt Boardman	Monica Goggin, David Morley and Sofie Springer	19/03/20	Phone call	Teleconference meeting to discuss shared infrastructure for Abydos and Miralga Creek. MP and MCP consultation and stakeholder engagement.	DMIRS suggested there was no reason to group these projects together if the project areas are completely separate. They indicated it was Atlas' decision how they decide to do this.	Miralga Creek to be a stand-alone project, not a satellite project to Abydos.  Atlas intends to draft the Mining Proposal and MCP, keeping Miralga Creek as an entirely separate project to Abydos	Acceptable
DMIRS – Danielle Risbey	Monica Goggin	08/03/20	Phone call	Requested extension to the Abydos MCP due to its ties to MIR Project	Abydos MCP due in July 2020. No extension required.	No action required.	Acceptable.
DMIRS – Melissa Harrison and Jacob King	Monica Goggin	08/03/20	Phone call	Meeting request	Meeting confirmed for 17 March 2020 to discuss MP and MCP closure consultation	MP and MCP in preparation.	Acceptable.



Stakeholder	Atlas Representative	Date	Method	Topics/ Issues Raised	Key Outcomes/ Action Items Raised	Resolution of Action	Stakeholder Response
DAWE – Parash Subedi	Monica Goggin, David Morley	06/03/20	Phone call	Processing of Referral via Gateway team.	Atlas to provide additional information to achieve a Not Assessed outcome with the EPBC Referral	Additional information drafted and submitted.	Acceptable.
DAWE Gateway Team – Lisa Hogan	Monica Goggin	06/03/20	Phone call	Processing of Referral via Gateway team.	Atlas to check items in the referral and resubmit via the online portal	Action agreed.	Acceptable.
Liesl Rohl	Monica Goggin, David Morley	05/03/20	Meeting	EPA referral of project	Felicity Jones (360 Environmental) presented overview of project and key issues. DWER advised unlikely to decide 'not assessed' if DAWE make a 'Controlled Action' decision under EPBC Act.	Atlas to send additional bat cave information to DAWE.	Acceptable
Liesl Rohl	Monica Goggin	28/02/20	Phone call	EPA Referral, Conflict of Interest, Liesl Rohl being acting Manager.	Meeting set with LR for Thursday 5th March to re-introduce the project, discuss outcomes of all studies to date and Level of Assessment.	Meeting 5 March 2020	Acceptable.



Stakeholder	Atlas Representative	Date	Method	Topics/ Issues Raised	Key Outcomes/ Action Items Raised	Resolution of Action	Stakeholder Response
EPA – Peter Tapsell	Monica Goggin	28/02/20	Phone call	EPA Referral	Following left phone messages Peter Tapsell kindly returned Atlas' calls and notified Atlas that he would no longer be associated with the Miralga Creek Project due to a conflict of interest. He advised that the project had been passed to Liesl Rohl.	Atlas Iron contacted Liesl Rohl and arranged an introduction to the Proposal.	Acceptable
EPA – Anthony Sutton, Peter Tapsell	Sanjiv Manchanda, Brendan Bow	4/04/19	Meeting	Update on Atlas Iron Pty Ltd - current operations, Hancock ownership, Corunna Downs and Miralga Creek prospects.	EPA noted good rehabilitation at Pardoo during recent fly-over. Atlas Iron should consider one approval if commonality between proposals (e.g. all ore processed at Roy Hill). Any bat issues likely warrant referral. >500 ha clearing usually trigger for referral (depending on veg condition etc.).	NA	NA
DMIRS – Phil Gorey, Rick Rogerson, Jeff Haworth, Karen Caple, Andrew Chaplyn	Sanjiv Manchanda, Brendan Bow	22/05/19	Meeting	Update on Atlas Iron Pty Ltd - current operations, Hancock ownership, Corunna Downs and Miralga Creek prospects.	Brief update on future projects. No actions.	NA	NA



Stakeholder	Atlas Representative	Date	Method	Topics/ Issues Raised	Key Outcomes/ Action Items Raised	Resolution of Action	Stakeholder Response
Shire East Pilbara – Oliver Schaer	Brendan Bow	28/03/19	Email	Update on Miralga Creek Project - North Pole Rd crossing to support 190 t quad road trains (frequency ~26 loaded movements per 24/hrs for approx. 12m).	Shire doesn't have any concerns with this Proposal at this stage given limited existing public use of this road.  Atlas Iron to mark/peg out proposed intersection point for Shire to examine/visit. Atlas Iron to provide road design to Shire.	In progress.	NA
EPA – Peter Tapsell	Monica Goggin, Natassja Bell	18/11/19	Meeting	Assessment and approvals process for the Project. Information requirements for assessment documentation.	Atlas to submit an EPA referral in 2020, expecting either an ARI or a 'Not Assessed'.	Atlas to submit EPA referral in 2020 following submission of the EPBC referral.	Atlas and the EPA aligned.
<b>Mining Tenure / Mining Companies</b>							
Venturex Resources: James Guy, Brad Walker, Alex Biggs	Brendan Bow, Stacey Brown, Bronwyn Kerr	9/07/19	Meeting	Update on Miralga Creek project - specifically Venturex's objection to Atlas mining lease application over the Sandtrax deposit.	Atlas to provide Miralga PM details in coming weeks and the two companies to keep open communication as both our projects develop.	Ongoing communication.	Acceptable.
Venturex Resources: Brad Walker	Monica Goggin	27/08/19	Email	Requested access to 7 bores on Venturex tenure for subterranean fauna sampling and offered data exchange between companies to support approvals.	Brad confirmed consent for Atlas to access their bores. Requested a copy of the results. Advised Biological and Heritage data would be shared.	Phone call	NA



Stakeholder	Atlas Representative	Date	Method	Topics/ Issues Raised	Key Outcomes/ Action Items Raised	Resolution of Action	Stakeholder Response
					Requested phone call to discuss further.		
<b>Pastoralists</b>							
Strelley Coongan Station	Commenced by Cara Librizzi	Q2 2019 - Present	Phone call/ meeting/ email	Tenure applications, objection and resolutions via an agreement.	Atlas and Strelley Station have been in communication since first applying for tenure across the project area. Objections were resolved and final Agreements are pending.	Land Access Agreement	Acceptable.
Hillside - Panorama Station	Commenced by Cara Librizzi	Q2 2019 – Present	Phone call/ meeting/ email	Tenure applications, objection and resolutions via an agreement.	Atlas and Panorama Station have been in communication since first applying for tenure across the project area. Final Agreement pending.	In Progress.	Acceptable.
Hillside-Panorama Pastoral Lease – Brent Smooth	Bronwyn Kerr, Alison Llewellyn	5/02/20	Meeting	Update on Miralga Creek Project and Hillside Objection in Wardens Court to Mining Leases. Discussion of potential options re operations affecting cattle	Atlas to provide a map. Brent to provide details of estimates of costs to set up alternate stockyard, fencing. Atlas to consider compensation agreement terms	In Progress.	In Progress.
<b>Native Title &amp; Heritage</b>							
Barlbinbinya Aboriginal Corporation	Brendan Bow, Monica Goggin	May 2019	Email/	A1160 survey and reporting to support approvals.	Miralga Creek survey and reporting.	Report May 2019, Asharlon Morison and	Acceptable, Atlas in very



Stakeholder	Atlas Representative	Date	Method	Topics/ Issues Raised	Key Outcomes/ Action Items Raised	Resolution of Action	Stakeholder Response
(BAC) – Rodney Monaghan, Kieran Geary, Darshen Hayes, Michael Williams, Aiden Perry, Peter Woodman, Steven Yabby, Branden Geary.			Phone/ Report			Natasha Sanders, Terra Rosa Consulting.	good-standing with BAC.
Barlbinbinya Aboriginal Corporation (BAC) – Rodney Monaghan, Kieran Geary, Darshen Hayes, Michael Williams, Aiden Perry, Peter Woodman, Steven Yabby, Branden Geary.	Brendan Bow, Monica Goggin	May-19	Email/ Phone/ Report	AI160 survey and reporting to support approvals.	Miralga Creek survey and reporting.	Report May 2019, Asharlon Morison and Natasha Sanders, Terra Rosa Consulting.	Acceptable, Atlas in very good-standing with BAC.
Njamal NT Party via Barlbinbinya Aboriginal Corporation (BAC)	Cara Librizzi	April 2019 - ongoing	NT tenure process	Parallel Native Title process triggered via various tenure applications - E45/4987, M45/1282, M45/1281 & M45/1280, L45/525, G45/343, G45/340, L45/538.	Still in progress.	In progress.	In progress.
Njamal People – Barlbinbinya	Alison Llewellyn	2019 - ongoing	Discussions/	Single Claim-wide Agreement, Transfer of	Atlas are undergoing discussions regarding	In progress.	In progress.



Stakeholder	Atlas Representative	Date	Method	Topics/ Issues Raised	Key Outcomes/ Action Items Raised	Resolution of Action	Stakeholder Response
Aboriginal Corporation (BAC)			Agreement	name and section 31 State Deed.	two further agreements with the Njamal people; a Deed of Assignment and a Section 31 State Deed to satisfy the Native Title Act. These are relatively administrative in nature to finalise the Miralga Creek Project.		





### 3.3.2 Ongoing Community and Stakeholder Engagement

Atlas Iron recognises that ongoing consultation with stakeholders is critical to ensuring environmental and social concerns that are raised can be addressed during the life of the mine. As such, Atlas Iron will continue its proactive consultation program until after closure of the Proposal. The details of this consultation will continue to be documented in the Proposal's consultation register.

Note that ongoing stakeholder consultation is required to be documented in the MCP under the *Mining Act 1978* and updated every three years.



## 4. Environmental Principles and Factors

### 4.1 EPA Principles

Table 4.1 shows how the EP Act principles have been considered in the development of this Proposal.

**Table 4.1 – EP Act Principles**

Principle	Consideration
<p><b>1. The precautionary principle</b></p> <p>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 application of this precautionary principle, decisions should be guided by:</p> <p>a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and</p> <p>b) an assessment of the risk-weighted consequences of various options.</p>	<p>Atlas Iron has in place a Health Safety and Environmental Management System (HSEMS), which will be implemented to ensure environmental risks associated with all Proposal activities are mitigated to as low as reasonably practicable (ALARP).</p> <p>Specific to the Miralga Creek Proposal, various environmental studies have been completed 2019-2020 to identify key environmental values and assess the risk of impact to these values from the Proposal. Atlas Iron also has a wide database across its other tenure and approved projects from which to draw additional data and information. Where there has been information gaps or scientific uncertainty, Atlas Iron has sought to address these through additional investigations and specialist advice and has otherwise applied a conservative approach when assessing risk.</p> <p>Careful evaluation has been made of options to avoid or minimise any potential environmental impacts, followed by the identification and development of management measures and rehabilitation considerations for any residual risks to key environmental factors.</p> <p>Specific examples of the application of the precautionary principle in the development of this Proposal are summarised below, others are described throughout the remainder of this document:</p> <ul style="list-style-type: none"> <li>• Direct impacts to the following conservation significant flora have been avoided through re-design of the Development Envelope: <ul style="list-style-type: none"> <li>– <i>Corchorus</i> sp. Yarrie (J. Bull &amp; D. Roberts CAL 01.05), P1</li> <li>– <i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i>, P2</li> <li>– <i>Oldenlandia</i> sp. Hamersley Station (A.A. Mitchell PRP 1479), P3</li> <li>– <i>Triodia chichesterensis</i>, P3</li> <li>– <i>Goodenia nuda</i>, P4</li> <li>– <i>Polymeria</i> sp. potentially undescribed</li> <li>– <i>Desmodium campylocaulon</i>, outlier of known range</li> <li>– <i>Fimbristylis nuda</i>, outlier of known range</li> </ul> </li> </ul>



Principle	Consideration
	<ul style="list-style-type: none"> <li>- <i>Scleria rugosa</i>, outlier of known range</li> <li>- <i>Abutilon</i> aff. <i>hannii</i>, potentially undescribed</li> <li>- <i>Cyperus microcephalus</i> subsp. <i>saxicola</i>, range extension</li> <li>- <i>Dodonaea petiolaris</i>, range extension</li> <li>- <i>Ophioglossum lusitanicum</i>, range extension</li> <li>• Retention of all potentially permanent water habitat features</li> <li>• Retention of 15 out of 16 cave features identified by Biologic (2020a): <ul style="list-style-type: none"> <li>- 11 are separated from the pits area by at least 100 m</li> <li>- 2 are separated by at least 50 m</li> <li>- Cave CMRC-15 is separated from the pit by 23 m (distance from the rear wall of the cave to the pit)</li> <li>- Cave CMRC-15 and adjacent caves will be subject to specific monitoring and blast management as part of implementation of the Proposal's Significant Species Management Plan: <ul style="list-style-type: none"> <li>- All blasts to be designed to achieve 85 mm/s at the cave.</li> <li>- Blast vibration not to exceed 100 mm/s at the cave (Blast It, 2020).</li> </ul> </li> </ul> </li> <li>• Exclusion of over 80% of all vertebrate fauna habitats from the Development Envelope; high value habitat types are retained as follows: <ul style="list-style-type: none"> <li>- 98% of Major Drainage retained</li> <li>- 86% of Hillcrest/ Hillslope retained</li> <li>- 83% of Gorge/ Gully habitat retained.</li> </ul> </li> <li>• Exclusion of over 85% of all potential SRE fauna habitats from the Development Envelope; high and moderate-high value habitat types are retained as follows: <ul style="list-style-type: none"> <li>- 90% of Gorge/ Gully habitat retained</li> <li>- 87% of Hillcrest/ Hillslope retained.</li> </ul> </li> </ul> <p>Atlas Iron's approach to risk management is proactive and ongoing. The Environmental Risk Register will be reviewed and updated on a biannual basis by the site Environmental Advisor and on an annual basis by the site Management Team.</p> <p>Furthermore, in developing the mine plan, various options are regularly reviewed and addressed to ensure the most economical and environmentally sound option is adopted, including consideration of progressive rehabilitation and the backfilling of pits.</p>



Principle	Consideration
<p><b>2. The principle of intergenerational equity</b></p> <p>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.</p>	<p>Atlas Iron is committed to minimising harm to the environment and leaving an enduring positive legacy in the communities in which it operates. Atlas Iron considers excellence in environmental management essential to our future, as documented in our HSE Policy.</p> <p>Atlas Iron will implement the Proposal to ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.</p> <p>Furthermore, rehabilitation and closure planning is fully integrated into operating mine planning throughout the life of the mine. This along with the Proposal's short mine life support early return of disturbed areas to self-sustaining ecosystems.</p>
<p><b>3. Principles relating to improved valuation, pricing and incentive mechanisms</b></p> <p>a) Environmental factors should be included in the valuation of assets and services.</p> <p>b) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.</p> <p>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 waste.</p> <p>d) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.</p>	<p>Environmental constraint avoidance and management costs have been considered in the design of the Proposal.</p> <p>Atlas Iron also actively implements programs to conserve resources, reduce waste, promote recycling and prevent pollution, in accordance with our HSE Policy.</p> <p>The Proposal will also be subject to a Mine Closure Plan (MCP) prepared in accordance with the 2020 <i>Guidelines for Mine Closure Plans in Western Australia</i>, prepared by DMIRS. The MCP is a dynamic document, which having identified post-mining land use objectives will be reviewed and updated regularly, taking into consideration ongoing stakeholder consultation and further studies and research.</p> <p>The integration of rehabilitation and closure planning into operating mine planning will ensure cost-effective measures and mechanisms to reduce liability and risks with mine closure are identified and implemented.</p>
<p><b>4. The principle of the conservation of biological diversity and ecological integrity</b></p> <p>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</p>	<p>Conservation of biological diversity and ecological integrity is fundamental to Atlas Iron's approach to environmental management, as outlined under Principle 1.</p> <p>Extensive biological surveys have been undertaken over the last two years to identify conservation significant species and associated habitat within and outside of the Development Envelope in an effort to understand, avoid and/or minimise potential impacts of the Proposal. The risk of this Proposal on these values has been regularly assessed in response to additional information/studies, stakeholder consultation and specialist advice.</p> <p>Consideration of biological diversity is detailed in Chapters 5 and 5.6.</p>



Principle	Consideration
	In accordance with the Proposal's MCP, Atlas Iron also strives to return disturbed areas (excluding pits) to self-sustaining ecosystems through rehabilitation.
<p><b>5. The principle of waste minimisation</b></p> <p>All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.</p>	<p>Atlas Iron is committed to minimising environmental harm, and has established a series of plans, procedures and work statements to minimise impacts on the local environment, prevent pollution, reduce waste and reduce the consumption of resources.</p> <p>Atlas Iron's Waste Management Procedure is centred around three key principles:</p> <ul style="list-style-type: none"> <li>• Stewardship (i.e., avoiding unnecessary waste generation through the lifecycle of a product).</li> <li>• Waste Hierarchy (i.e., avoid, reduce, reuse, recycle).</li> <li>• Resource Efficiency (i.e., getting the most out of a resource).</li> </ul> <p>This procedure ensures waste minimisation and recycling opportunities are explored throughout the lifecycle of products used, appropriate waste management practices are in place and compliance with relevant legislation and standards.</p> <p>Major waste streams for this Proposal include waste rock, waste for landfill (inert and putrescible) treated wastewater and hydrocarbon/hazardous waste.</p>

## 4.2 Environmental Factors

Atlas Iron has conducted desktop assessments and field studies at local and regional scales to investigate potential risks to the Environmental Factors potentially relevant to the Proposal:

- Land:
  - Flora and Vegetation
  - Landforms
  - Subterranean Fauna
  - Terrestrial Environmental Quality
  - Terrestrial Fauna
- Inland Waters
- Air Quality
- Social Surroundings.

EPA Factors within the Sea theme were not considered because marine impacts are not relevant to this Proposal. Product will be exported through the existing Utah Point facility within that facility's existing approvals. Given the absence of asbestiform and radioactive



material in the ore and waste, the Human Health factor was also not considered relevant to this Proposal.

Biological surveys have been carried out within the study areas defined in Figure 4.1. Note that the size and location of study areas differ depending on the factor being considered.

#### **4.2.1 Preliminary Key Environmental Factors**

On the basis of the EPA's Factors and Objectives guidance (Environmental Protection Authority, 2018a), the following preliminary key environmental factors have been identified for the Proposal:

- Flora and Vegetation
- Terrestrial Fauna.

In considering the potential significant impacts of the Proposal, Atlas has drawn on its experience with previous iron ore projects in the region, including at the former Abydos mine located 10 km southwest of the Sandtrax deposit. Abydos had similar environmental values, particularly with regard to conservation significant terrestrial fauna species and their habitats. Management measures and other mitigations proposed as part of this Proposal are therefore based on previous experience, current best practice and site-specific context.

Detailed impact assessments of the two key factors are outlined in Chapters 5 and 5.6.

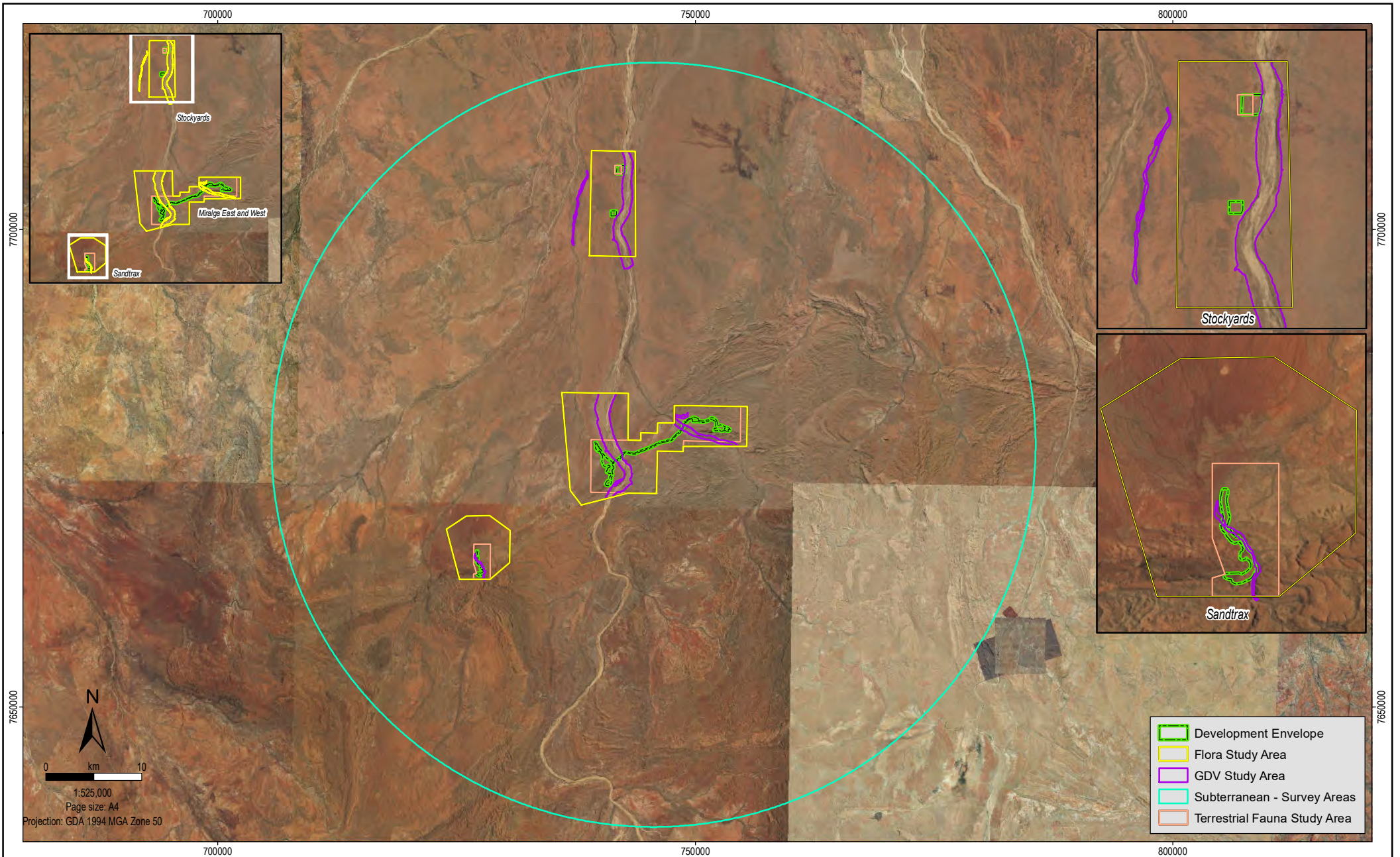
#### **4.2.2 Other Environmental Factors**


In addition to the key environmental factors discussed in previous sections, the Proposal has the potential to interact with several other environmental factors considered by the EPA, including:

- Subterranean Fauna
- Landforms
- Terrestrial Environmental Quality
- Inland Waters
- Air Quality
- Social Surroundings.

These factors are discussed in more detail in Chapter 6.6.






 GIS\_2722\_MIR\_S38\_Fig4\_1\_StudyAreas.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:

## Study Areas

Figure No:  
**4-1**



## 5. Flora and Vegetation

### 5.1 Receiving Environment

#### 5.1.1 Environmental Studies

Flora and vegetation studies and reports completed for the Proposal and relevant to the consideration of the Flora and Vegetation factor generally are summarised in Table 5.1. These studies and reliable, publicly available data (e.g. the DBCA-managed Florabase database) have been used to describe the botanical context for the Proposal in Sections 5.1.2, 5.1.3 and 5.1.4.

**Table 5.1 – Flora and Vegetation Studies**

Study Title	Survey Timing	Purpose and Limitations
<p>Miralga Creek Iron Ore Project Detailed Flora and Vegetation Survey. Prepared for Atlas Iron (Woodman Environmental, 2019a)</p> <p>Appendix A</p>	<p>13-19 May 2019</p> <p>27-31 May 2019.</p>	<p>The overall objectives of the study were to provide relevant botanical information to support the EIA process for the Proposal. The study area was 21,501.4 ha, and included potential groundwater draw-down zones. More specifically, the objectives were to:</p> <ul style="list-style-type: none"> <li>• Identify locations and determine the extent of conservation significant flora</li> <li>• Identify locations and determine the extent of introduced flora (weeds)</li> <li>• Identify, map and describe vegetation types and determine whether any are of conservation significance.</li> </ul> <p>Limitations noted in Woodman Environmental (2019a) include:</p> <ul style="list-style-type: none"> <li>• Potential limitation: Multiple quadrats were established in each vegetation pattern identified in the Study Area. The targeted survey involved transects or opportunistic searching of suitable habitat across the Study Area. All significant taxa identified as potentially occurring in the Study Area were searched for as part of the targeted survey. However, time constraints restricted intensive/additional targeted survey, with targeted searching of all potential habitat not undertaken, with resultant plant numbers and occupancy not considered extensive particularly for: <ul style="list-style-type: none"> <li>– <i>Corchorus</i> sp. Yarrie (J. Bull &amp; D. Roberts CAL 01.05) (P1)</li> <li>– <i>Goodenia nuda</i> (P4)</li> <li>– <i>Oldenlandia</i> sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3)</li> <li>– <i>Triodia chichesterensis</i> (P3).</li> </ul> </li> <li>• Ease of access to parts of the Study Area enabled detailed vegetation type and condition mapping to be undertaken in parts of the Study Area via foot and vehicle transects. However large areas were not easily accessible or were</li> </ul>





Study Title	Survey Timing	Purpose and Limitations
		<p>recently burnt, therefore mapping reliability is potentially reduced.</p> <ul style="list-style-type: none"> <li>• Potential Limitation: A large proportion of the Study Area was relatively recently burnt (within the last 12 months), which limited the areas in which quadrats could be placed. Quadrats were placed in unburnt areas of similar vegetation where possible, and mapping notes taken where recently burnt. The remainder of the Study Area had not been significantly affected by fire in recent years.</li> <li>• Minor Limitation: Flooding from a recent cyclone restricted access over several river crossings within the study area which limited access to a small number of sites. Otherwise, there were no impediments to access within the Study Area, with numerous tracks present to and within all parts of the Study Area. All areas were accessible on foot from adjacent tracks and roads.</li> </ul> <p>The limitations identified are common to the Pilbara region and do not pose a significant impact to the survey results.</p> <p>Woodman (2019a) and Atlas Iron have not identified any further limitations to the adequacy of the flora and vegetation survey with respect to EPA Guidance (Environmental Protection Authority, 2016a).</p>
<p>Desktop Review of Potential Groundwater Dependent Vegetation (Woodman Environmental, 2019b) Appendix A</p>	<p>Not applicable</p>	<p>The aim of this scope of work was to provide mapping of the distribution of potential GDV within the area of modelled groundwater drawdown to support Atlas' environmental impact assessment process. The specific objectives were:</p> <ul style="list-style-type: none"> <li>• Present the rationale utilised to define potential GDV at Miralga Creek.</li> <li>• Present a map of potential GDV at Miralga Creek that may be at risk of impacts from groundwater drawdown associated with the proposed mining operation.</li> </ul>

Study Title	Survey Timing	Purpose and Limitations
Miralga Groundwater Dependent Vegetation Assessment (Biologic, 2019) Appendix C	3–5 December 2019	<p>The overarching objective of the project was to refine the above potential GDV mapping by Woodman (2019), to validate confirmed GDV areas.</p> <p>The field survey was subject to the following minor limitations (Biologic, 2019):</p> <ul style="list-style-type: none"> <li>• Due to the extent of the Study Area and the limited accessibility via formal tracks, site traverses were restricted to easily accessible areas and pre-identified areas of vegetation that may support obligate phreatophytic flora. For example, the aerial imagery was interrogated to identify areas of dense canopy cover along Shaw River, which was hypothesised that these areas may contain mature <i>Melaleuca argentea</i>.</li> <li>• The field survey was undertaken during very hot daytime conditions with maximum's ranging between 42.6°C to 44.9°C at the Marble Bar weather station (station number 4106; BoM, 2019). As a result of the high daytime temperatures, site traverses were limited to easily accessible areas. Traverses from the vehicle were limited to a maximum of 2 km straight line distances from the vehicle for health and safety reasons. Due to the hot temperatures and restrictions in walking distance from the vehicle a portion of Six Mile Creek (approximately 6.5 km) was not traversed as the nearest access tracks were beyond 2 km from the creek. A 1.5 km section of Six Mile Creek was traversed, with access obtained near the northern extent of the area of the creek requiring a field survey.</li> </ul> <p>The limitations identified are common to the Pilbara region and do not pose a significant impact to the survey results.</p>

The following sections are primarily based on information from the studies and impact assessments listed in Table 5.1; the studies covered the study areas shown in Figure 4.1.

### 5.1.2 Regional Vegetation

The Proposal is in the Pilbara Interim Biogeographical Regionalisation for Australia (IBRA). The majority of the Proposal lies within the Chichester subregion, apart from the northernmost stockyard which lies in the Roebourne subregion (Department of Sustainability, Environment, Water, Population and Communities, 2012). The Chichester subregion is characterised by undulating granite and basalt plains with significant areas of basaltic ranges. The plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* (spinifex) hummock grasslands and the ranges support *Eucalyptus leucophloia* tree steppes (Kendrick, 2001).

#### 5.1.2.1 Land Systems

Land system classifications are used to map the land according to similarities in landform, soil, vegetation, geology and geomorphology (Van Vreeswyk, 2004). Ten land systems occur within the Study Area and are briefly described in Table 5.2 and shown on Figure 5.1.

**Table 5.2 – Land Systems Within the Study Area**

Land System	Description	Mapped Extent (ha) <sup>1</sup>	Percentage within the Development Envelope (%)
Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard (and occasionally soft spinifex) grasslands.	2,299,300	0.3%
Macroy	Sandy/Stony plains and occasional tor fields based on granite supporting hard and soft spinifex shrubby grasslands.	1,309,500	1.0%
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	774,800	6.5%
Uaroo	Broad sandy plains supporting shrubby hard and soft spinifex grasslands	768,100	13.0%
Capricorn	Hills and ridges of sandstone and dolomite supporting low shrublands or shrubby spinifex grasslands.	529,600	49.0%
River	Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.	408,800	7.1%
Mallina	Sandy surfaced alluvial plains supporting soft spinifex (and occasionally hard spinifex)	255,700	–
Platform	Dissected slopes and raised plains supporting spinifex grasslands	157,000	3.6%
Calcrete	Low calcrete platforms and plains supporting hard spinifex grasslands	144,400	–
Satirist	Stony plains and low rises supporting hard spinifex grasslands, and gilgai plains supporting tussock grasslands.	37,700	19.5%

Source: Woodman Environmental (2019).

(1) Total extent of land system, not just the portion within the Study Area.

### 5.1.2.2 Pre-European Vegetation

The Proposal is located within the Fortescue Botanical District (Beard, 1990). The District is characterised by tree (*Eucalyptus* spp. and *Corymbia* spp.) and shrub (*Acacia* spp., *Hakea* spp., *Grevillea* spp. and *Senna* spp.) steppe communities and *Triodia* spp. hummock grasslands (Beard, 1970; Beard, 1975).

The Pilbara region was mapped by Beard (1975) at a scale of 1:1,000,000. These vegetation systems have since been updated to conform to National Vegetation Information System (NVIS) standards (Executive Steering Committee for Australian Vegetation Information, 2003) (Shepherd, 2002). The update also accounts for extensive clearing since the Beard (1975) mapping. Shepherd et al. (2002) developed a series of systems to assist in the removal of mosaics; however, some mosaics still occur. The Development Envelope is located within the Abydos Plain and George Ranges, which still have close to 100% of the pre-European vegetation remaining (Table 5.3) (Figure 5.2).



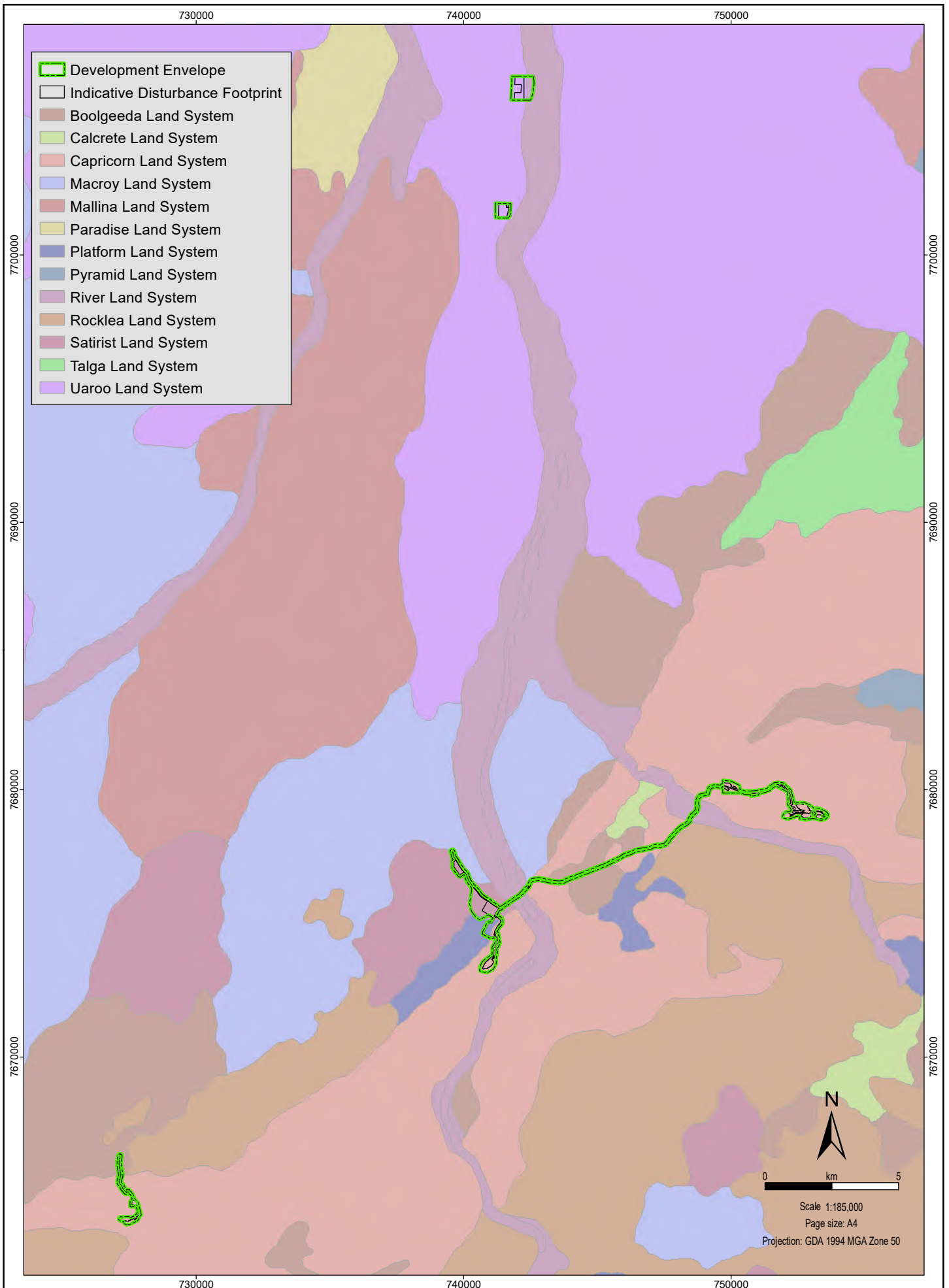
Within the Development Envelope, the most common vegetation system is the George Ranges:

- George Ranges 53.1%
- Abydos Plain Chichester 35.1%
- Abydos Plain 11.8%.

**Table 5.3 – Vegetation System Associations Intersecting the Study Area**

Vegetation System Association	Code	Description	Current Extent (ha)	Percentage of Pre-European Extent Remaining (%)
Abydos Plain	589	Mosaic: Short bunch grassland - savannah / grass plain (Pilbara) / Hummock grasslands, grass steppe; soft spinifex	597,147.91	99.58%
Abydos Plain	619	Medium woodland; river gum ( <i>Eucalyptus camaldulensis</i> )	42,551.05	97.62%
Abydos Plain-Chichester	93	Hummock grasslands, shrub steppe; kanji over soft spinifex	2,478,504.06	99.86%
Abydos Plain-Chichester	171	Hummock grasslands, low tree steppe; snappy gum over soft spinifex & <i>Triodia brizoides</i>	56,180.57	100.00%
Abydos Plain-Chichester	619	Medium woodland; river gum ( <i>Eucalyptus camaldulensis</i> )	71,200.58	99.96%
George Ranges	82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>	316,855.11	99.90%
George Ranges	93	Hummock grasslands, shrub steppe; kanji over soft spinifex	8,902.19	100.00%
George Ranges	171	Hummock grasslands, low tree steppe; snappy gum over soft spinifex & <i>Triodia brizoides</i>	269,728.31	99.52%
George Ranges	619	Medium woodland; river gum ( <i>Eucalyptus camaldulensis</i> )	4,402.59	100.00%

Source: Government of Western Australia (2019)



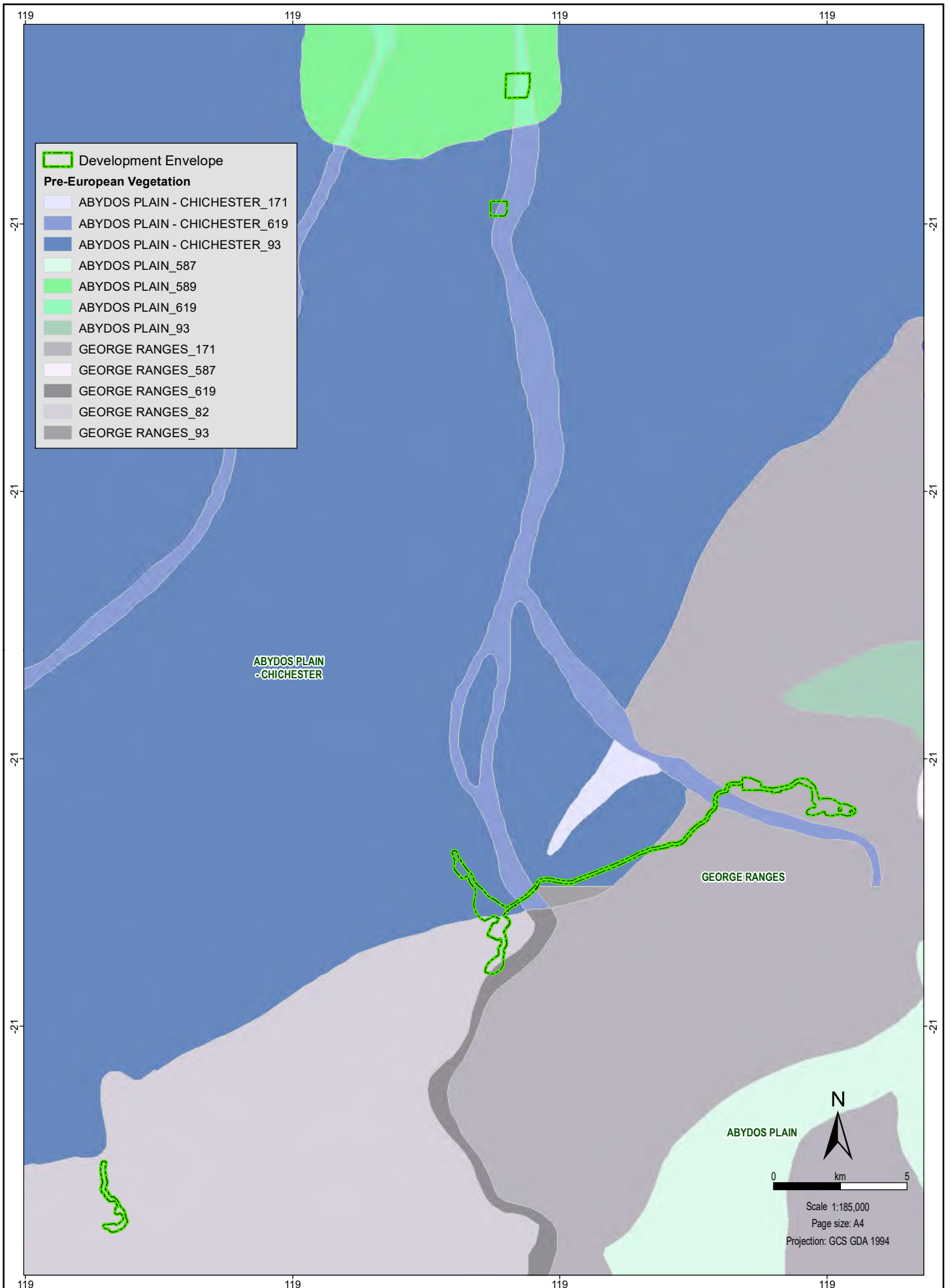
	File Name: GIS_2728_MIR_S38_Fig5_1_LandSystems.mxd
	Date: 2/04/2020
	Author: Heath.Maconachie

Source & Notes:

# Land Systems

Figure No:  
**5-1**







### 5.1.3 Local Vegetation

#### 5.1.3.1 Vegetation types

A combination of floristic analysis and manual dissection defined 12 vegetation types (VTs) within the Woodman Environmental Study Area (Figure 5.3). Vegetation types are defined in Table 5.4 and further described in Woodman Environmental (2019a) (Appendix A).

**Table 5.4 – Vegetation Types within Study Area**

Broad Group	Vegetation Type	Description	Area within Study Area (ha)
Granite and dolorite hills and ranges	VT 1	Isolated clumps of trees, mainly represented by <i>Eucalyptus leucophloia</i> , <i>Corymbia hamersleyana</i> or <i>Corymbia ferritcola</i> , over mid to tall isolated shrubs of mixed <i>Acacia</i> species including <i>Acacia inaequilatera</i> , <i>A. tumida</i> var. <i>pilbarensis</i> and <i>A. orthocarpa</i> , and <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> over low sparse shrubland of <i>Solanum phlomoides</i> , <i>Senna glutinosa</i> subsp. <i>glutinosa</i> and <i>Clerodendrum tomentosum</i> var. <i>lanceolatum</i> over hummock grassland to open hummock grassland dominated by <i>Triodia brizoides</i> , and less commonly <i>Triodia wiseana</i> and <i>Triodia epactia</i> , over isolated clumps of tussock grasses of <i>Cymbopogon ambiguus</i> , <i>Eriachne mucronata</i> and <i>Cyperus hesperius</i> on steep mid to upper slopes, usually adjoining cliff faces, with exposed granite, dolorite, ironstone or occasional quartz bedrock with skeletal red-brown sandy loam.	1,836.1
	VT 2	Low woodland of <i>Terminalia circumalata</i> over tall isolated clumps of shrubs to tall shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Ehretia saligna</i> var. <i>saligna</i> over low isolated clumps of hummock grasses to mid open hummock grassland of <i>Triodia epactia</i> on red-brown sandy loam with granite or sandstone outcropping in drainage lines of gorges	33.0
Hills and steep slopes on ironstone	VT 3	Open to sparse tall shrubland of <i>Acacia orthocarpa</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> over hummock grassland of <i>Triodia epactia</i> on moderate to steep upper slopes and crests of metamorphic quartz, sandstone and granite hills and ridges with red-brown sandy loam soils.	2,134.7
	VT 4	Mid to tall isolated clumps of shrubs of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> and <i>Acacia orthocarpa</i> with occasional emergent <i>Eucalyptus leucophloia</i> over open hummock grassland to hummock grassland dominated by <i>Triodia basitricha</i> (P3) and/or <i>Triodia epactia</i> with isolated clumps of low shrubs including <i>Ptilotus calyostachyus</i> and <i>Bonamia pilbarensis</i> mainly on gentle but occasionally on steep crests, influenced by ironstone or granite and occasionally quartz or jasper, on red-brown sandy clay loam soils.	595.1



Broad Group	Vegetation Type	Description	Area within Study Area (ha)
Rivers and claypans on alluvial sediments	VT 5	Mid to low woodland dominated by <i>Eucalyptus camaldulensis</i> , <i>Eucalyptus victrix</i> , <i>Melaleuca glomerata</i> and/or <i>Melaleuca argentea</i> over tall open shrubland of <i>Atalaya hemiglauca</i> , <i>Flueggea virosa</i> subsp. <i>melanthesoides</i> and <i>Acacia trachycarpa</i> over sparse low shrubland and grassland of mixed species, occasionally dominated by <i>*Cenchrus ciliaris</i> on major drainage lines or rivers on brown sandy to clay loam with alluvial river stones, with occasional tall shrubland of <i>Acacia pyrifolia</i> , <i>Acacia trachycarpa</i> and <i>Atalaya hemiglauca</i> with sparse <i>Corymbia hamersleyana</i> over low mixed shrubs and grassland dominated by <i>*Cenchrus ciliaris</i> on brown sandy-clay loam on floodplains associated with river systems.  All or portions of this vegetation type may be Groundwater dependent ecosystems.	2,820.8
	VT 6	Open shrubland to sparse shrubland of <i>Acacia synchronicia</i> over open grassland and herbfield of mixed species, dominated by <i>Eragrostis setifolia</i> , <i>Cullen graveolens</i> , <i>Cynodon convergens</i> , <i>Desmodium filiforme</i> , <i>Dichanthium sericeum</i> subsp. <i>humilius</i> , <i>Neptunia dimorphantha</i> , <i>Sida fibulifera</i> and <i>Triodia epactia</i> on red sandy clay in claypans.	186.5
	VT 12	Isolated shrubs of mixed <i>Acacia</i> species over hummock grassland of <i>Triodia epactia</i> and occasionally <i>Triodia brizoides</i> on low rises and lower slopes on red-brown sandy loam with granite or ironstone influence.	1,161.5
Minor drainage lines and sheet flow on flood plains	VT 7	Open woodland of <i>Corymbia hamersleyana</i> and occasionally <i>Corymbia flavescens</i> or <i>Terminalia circumalata</i> over tall open shrubland to sparse shrubland of mixed <i>Acacia</i> species dominated by <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Acacia acradenia</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> over low sparse shrubland of mixed species including <i>Corchorus parviflorus</i> , <i>Hybanthus aurantiacus</i> and <i>Indigofera monophylla</i> over sparse grassland and sparse hummock grassland of species including <i>Chrysopogon fallax</i> , <i>Eriachne tenuiculmis</i> , <i>Triodia epactia</i> and occasionally <i>*Cenchrus ciliaris</i> on minor drainage lines and plains on red-brown sandy loam to clay loam.	2,648.0
	VT 8	Isolated clumps of <i>Corymbia hamersleyana</i> over low open shrubland to sparse shrubland of <i>Acacia stellaticeps</i> over hummock grassland of <i>Triodia lanigera</i> and occasionally <i>Triodia epactia</i> on red-brown sand to sandy loam on plains.	3,111.6
	VT 9	Occasional low open shrubland of <i>Acacia stellaticeps</i> over hummock grassland usually dominated by <i>Triodia longiceps</i> and/or <i>Triodia epactia</i> and occasionally <i>*Cenchrus ciliaris</i> on red brown sands and clay loam in basins and open depressions on plains.	192.6



Broad Group	Vegetation Type	Description	Area within Study Area (ha)
Sandy and stony plains	VT 10	Tall isolated shrubs of mixed <i>Acacia</i> species including <i>Acacia inaequilatera</i> and <i>Acacia bivenosa</i> with occasional isolated trees of <i>Corymbia hamersleyana</i> over hummock grassland dominated by <i>Triodia lanigera</i> , and occasionally <i>Triodia epactia</i> , <i>Triodia wiseana</i> and/or <i>Triodia brizoides</i> with isolated small shrubs on red-brown clay loam to sandy-clay loam on undulating plains, midslopes to crests of low gentle rises influenced by ironstone, granite, dolerite and occasionally calcrete.	6,522.8
	VT 11	Sparse shrubland to isolated shrubs of <i>Acacia stellaticeps</i> and <i>Acacia spondylophylla</i> over hummock grassland of <i>Triodia lanigera</i> with isolated shrubs including <i>Goodenia stobbsiana</i> on red-brown sandy clay loam on flats to low rises underlain by granite or dolerite.	111.7

### 5.1.3.2 Vegetation Condition

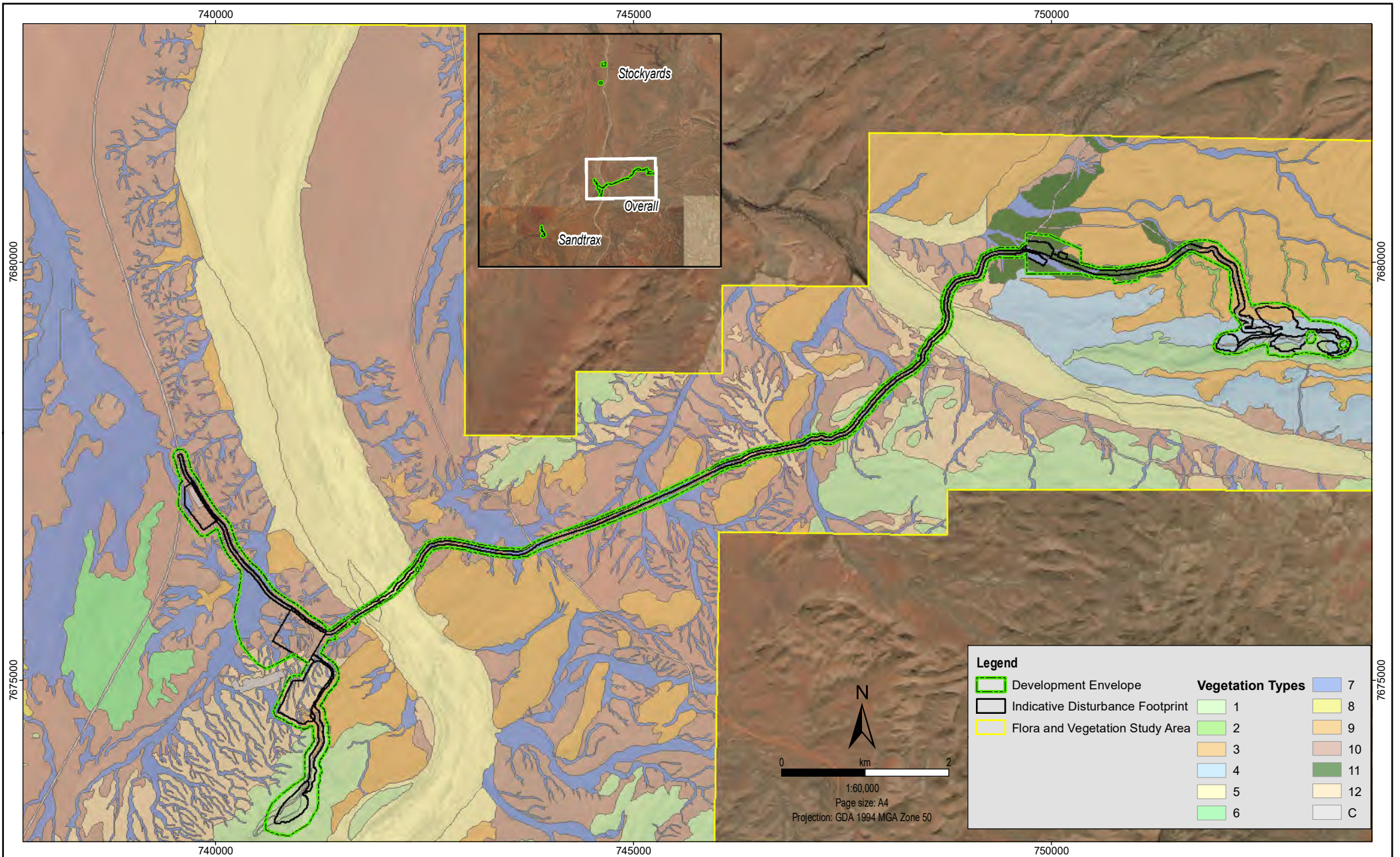
The majority of the vegetation in the Study Area (80.0%) was ranked as being in 'Excellent' condition, with little to no human disturbance and an absence or low levels of introduced flora taxa (Table 5.5 and Figure 5.3B). It was noted in the field that introduced taxa such as *Cenchrus ciliaris* and *Aerva javanica* were common when adjacent to tracks and roads within the study area (Woodman Environmental, 2019a). These species are not listed as WoNS, and are typical of disturbed sites in the Pilbara region, with both of these taxa being commonly distributed throughout. Vegetation condition polygons were only adjusted to lower condition rankings in areas where notes regarding severe infestations away from cleared areas and tracks were taken.

Areas of VT 5 and VT 7 were typically not in 'Excellent' condition (Woodman Environmental, 2019a). These areas recorded a lower condition score as a result of the presence of high densities of aggressive introduced flora taxa, and high grazing and trampling impacts from cattle. These condition scores were often correlated with the size of the drainage feature, with large creeks and rivers tending to be ranked lower than smaller flow lines and creeks. These scores varied from 'Good' to 'Degraded', depending on the levels of introduced taxa and trampling impacts recorded.

**Table 5.5 – Vegetation Condition**

Condition type	Area Mapped (ha)	Proportion of Study Area (%)
Excellent	17,196.7	80.0
Very Good	1,170.1	5.4
Good	2,618.2	12.2
Poor	20.3	0.1
Degraded	349	1.6
Completely Degraded	147	0.7





GIS\_2731\_MIR\_S38\_Fig\_3A\_VegTypes.mxd

Date: 6/04/2020

Author: Heath.Maconachie

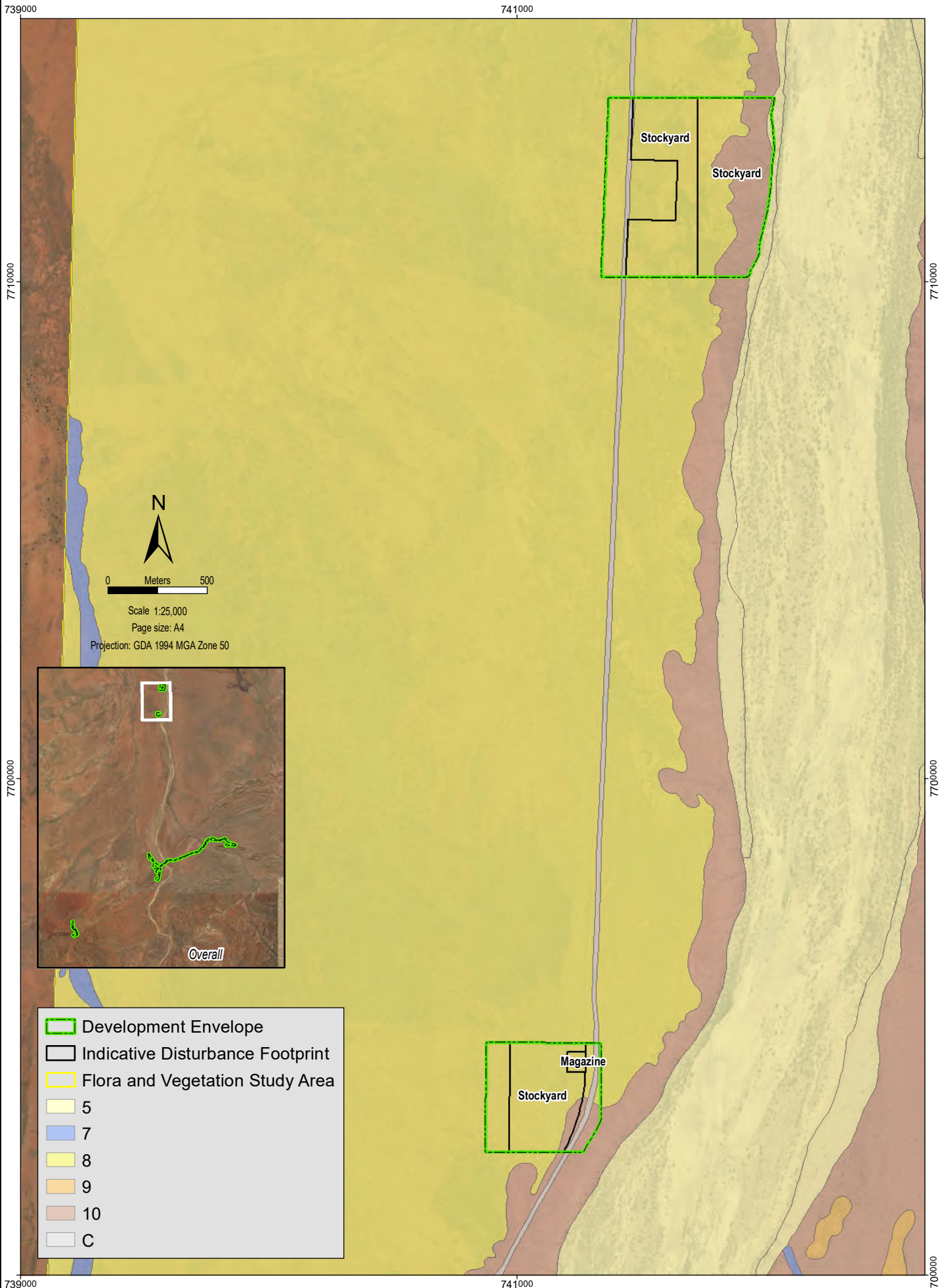
Source & Notes:

## Vegetation Types

Figure No:

**5-3A**





- Development Envelope
- Indicative Disturbance Footprint
- Flora and Vegetation Study Area
- 5
- 7
- 8
- 9
- 10
- C



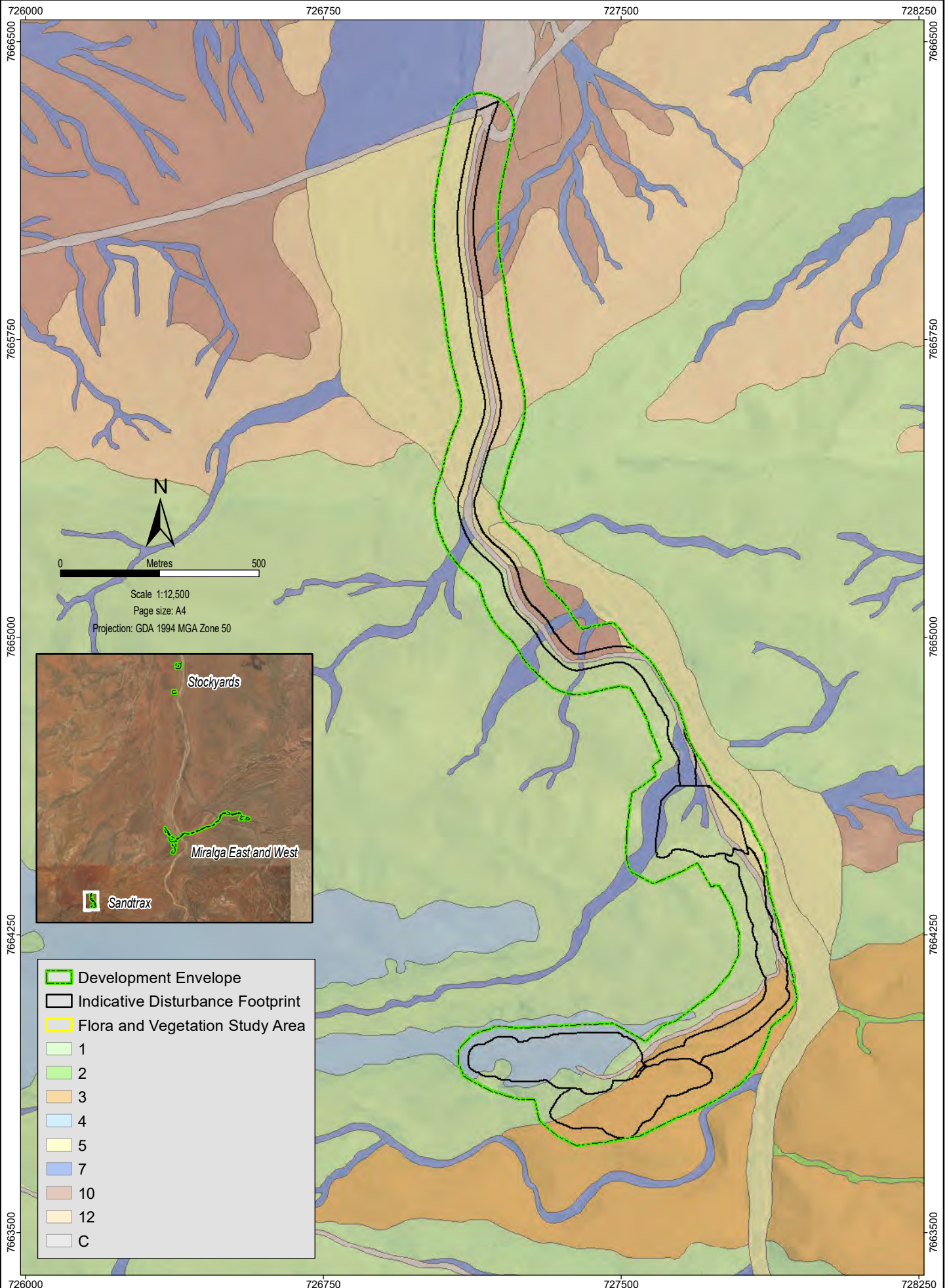
File Name: GIS\_2731\_MIR\_S38\_Fig\_3B\_VegTypesStockyards.mxd  
 Date: 6/04/2020  
 Author: Heath.Maconachie

Source & Notes:

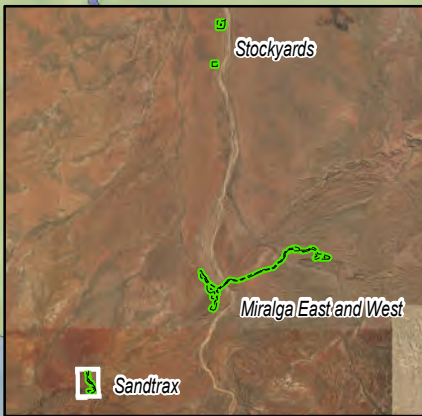
**Vegetation Types  
Stockyards**

Figure No:  
**5-3B**

















N  
 0 Metres 500  
 Scale 1:12,500  
 Page size: A4  
 Projection: GDA 1994 MGA Zone 50



- Development Envelope
- Indicative Disturbance Footprint
- Flora and Vegetation Study Area
- 1
- 2
- 3
- 4
- 5
- 7
- 10
- 12
- C

## Vegetation Types

-  1 - Isolated clumps of trees, mainly represented by *Eucalyptus leucophloia*, *Corymbia hamersleyana* or *Corymbia ferritcola*, over mid to tall isolated shrubs of mixed *Acacia* species including *Acacia inaequilatera*, *A. tumida* var.
-  2 - Low woodland of *Terminalia circumalata* over tall isolated clumps of shrubs to tall shrubland of *Acacia tumida* var. *pilbarensis* and *Ehretia saligna* var. *saligna* over low isolated clumps of hummock grasses to mid open hummock grassland of *Triodia epactia* o
-  3 - Open to sparse tall shrubland of *Acacia orthocarpa*, *Acacia tumida* var. *pilbarensis* and *Grevillea wickhamii* subsp. *hispidula* over hummock grassland of *Triodia epactia* on moderate to steep upper slopes and crests of metamorphic quartz, sandstone and granite
-  4 - Mid to tall isolated clumps of shrubs of *Acacia tumida* var. *pilbarensis*, *Grevillea wickhamii* subsp. *hispidula* and *Acacia orthocarpa* with occasional emergent *Eucalyptus leucophloia* over open hummock grassland to hummock grassland dominated by *Triodia basi*
-  5 - Mid to low woodland dominated by *Eucalyptus camaldulensis*, *Eucalyptus victrix*, *Melaleuca glomerata* and/or *Melaleuca argentea* over tall open shrubland of *Atalaya hemiglauc* , *Flueggea virosa* subsp. *melanthesoides* and *Acacia trachycarpa* over sparse low shr
-  6 - Open shrubland to sparse shrubland of *Acacia synchronicia* over open grassland and herbfield of mixed species, dominated by *Eragrostis setifolia*, *Cullen graveolens*, *Cynodon convergens*, *Desmodium filiforme*, *Dichanthium sericeum* subsp. *humilius*, *Neptunia di*
-  7 - Open woodland of *Corymbia hamersleyana* and occasionally *Corymbia flavescens* or *Terminalia circumalata* over tall open shrubland to sparse shrubland of mixed *Acacia* species dominated by *Acacia tumida* var. *pilbarensis*, *Acacia acradenia* and *Acacia pyrifolia*
-  9 - Occasional low open shrubland of *Acacia stellaticeps* over hummock grassland usually dominated by *Triodia longiceps* and/or *Triodia epactia* and occasionally \**Cenchrus ciliaris* on red brown sands and clay loam in basins and open depressions on plains.
-  10 - Tall isolated shrubs of mixed *Acacia* species including *Acacia inaequilatera* and *Acacia bivenosa* with occasional isolated trees of *Corymbia hamersleyana* over hummock grassland dominated by *Triodia lanigera*, and occasionally *Triodia epactia*, *Triodia wisean*
-  11 - Sparse shrubland to isolated shrubs of *Acacia stellaticeps* and *Acacia spondylophylla* over hummock grassland of *Triodia lanigera* with isolated shrubs including *Goodenia stobbsiana* on red-brown sandy clay loam on flats to low rises underlain by granite or
-  12 - Isolated shrubs of mixed *Acacia* species over hummock grassland of *Triodia epactia* and occasionally *Triodia brizoides* on low rises and lower slopes on red-brown sandy loam with granite or ironstone influence.
-  C - Cleared Land.



GIS\_2731\_MIR\_VegTypesLegendFig3D.mxd

Date: 2/04/2020

Author: Heath.Maconachie

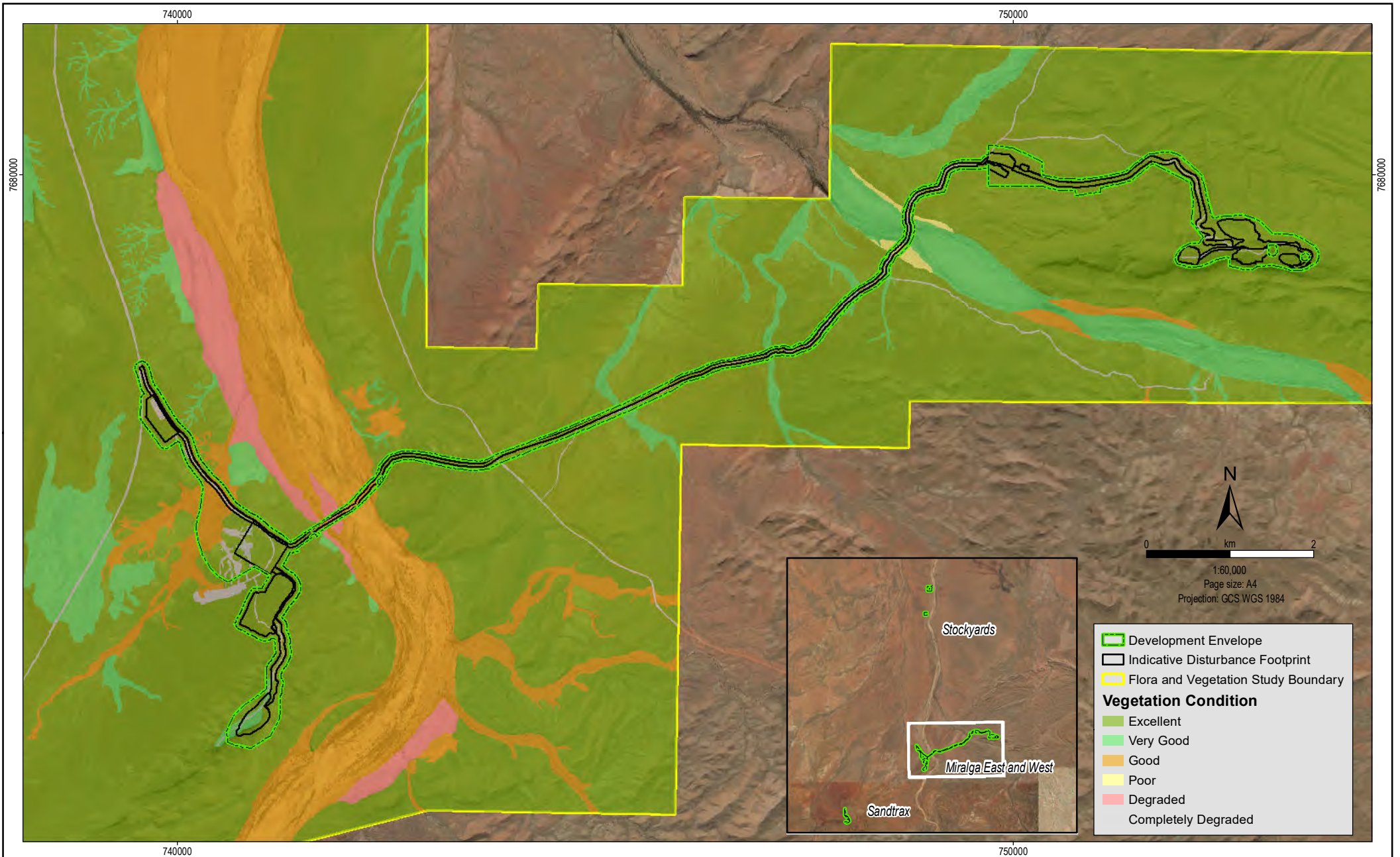
Source & Notes:

## Vegetation Types Legend

Figure No:

**5-3D**






Development Envelope  
 Indicative Disturbance Footprint  
 Flora and Vegetation Study Boundary

**Vegetation Condition**

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

	File Name: GIS_2733_MIR_S38_Fig5_4A_VegConditionMIR_EW.mxd
	Date: 2/04/2020
	Author: Heath.Maconachie

Source & Notes:

## Vegetation Condition Miralga East and West

Figure No:  
**5-4A**





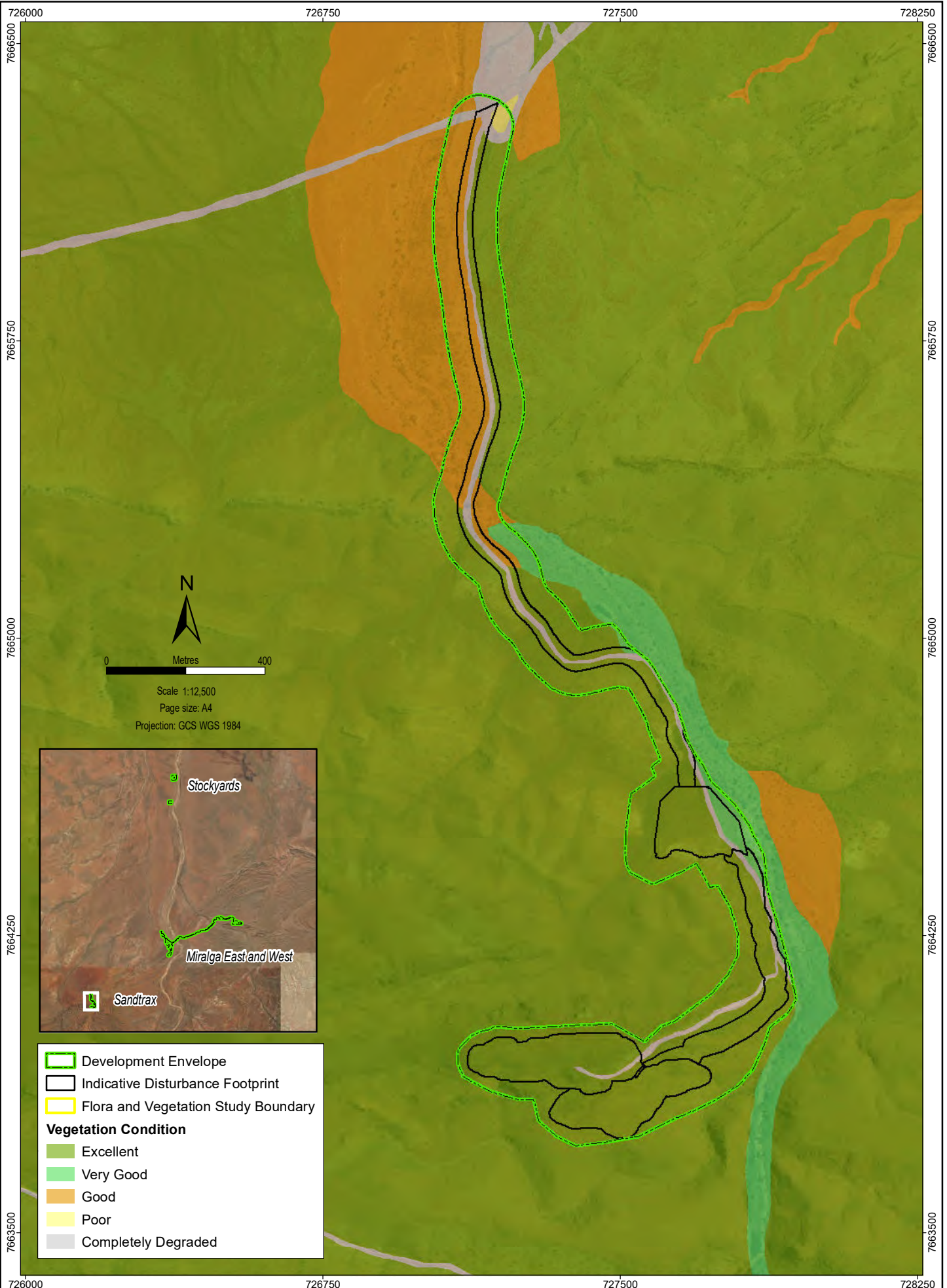
File Name: GIS\_2733\_MIR\_S38\_Fig5\_4B\_VegConditionStockyards.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:

## Vegetation Condition Stockyards

Figure No:  
**5-4B**







### 5.1.3.3 Conservation Significant Vegetation

None of the VTs mapped in the Study Area are considered to represent any Threatened Ecological Community (TEC) protected under the *Biodiversity Conservation Act 2016*, or as listed under the EPBC Act. None of the VTs mapped in the Study Area are considered to represent any DBCA-classified Priority Ecological Community (PEC) (Woodman Environmental, 2019a). In addition, no TECs or PECs occur within, or have previously been recorded, within 100 km of the Biologic Study Area (Biologic, 2020a).

The majority of VTs have limited regional conservation significance as they were not determined to be restricted within the wider region or provide habitat for significant flora species (Woodman Environmental, 2019a), the exceptions being:

- VT 2: occurs in shallow gorge/creek areas and provides habitat for significant flora taxa
- VT 6: is mapped on a claypan, which is a limited habitat and supports significant flora taxa, it also has limited representation in the Study Area
- VT 9: has an unknown regional extent and has limited representation in the Study Area
- VT 11: has an unknown regional extent and has limited representation in the Study Area.

### 5.1.4 Flora

A total of 380 discrete vascular flora taxa, one known hybrid and one putative hybrid were recorded in the Study Area during this survey, including 360 native taxa and 20 introduced taxa (Woodman Environmental, 2019a). The most well-represented families were Fabaceae (73 taxa), Poaceae (61 taxa) and Malvaceae (35 taxa), and Cyperaceae (21 taxa). Of the discrete flora taxa recorded, the life-cycle of 135 taxa (36%) were classified as annual, and 245 taxa (64%) were classified as perennial.

#### 5.1.4.1 Conservation Significant Flora

Conservation significant flora includes species listed as:

- MNES under the EPBC Act.
- Threatened or Specially Protected (includes migratory species) under the *Biodiversity Conservation Act 2016* (BC Act).
- Priority species listed by DBCA.

No Threatened Flora taxa listed under the BC Act or EPBC Act were recorded within the Study Area (Woodman Environmental, 2019a). Habitat for *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) is present within the Study Area and records are known from 1 km south of the Study Area. It is a highly visible shrub which would have been observable at the time of the survey along tracks and in/ near quadrats (Woodman Environmental, 2019).

Eight DBCA classified Priority Flora taxa were recorded within the Study Area (Figure 5.5):

- *Corchorus* sp. Yarrie (J. Bull & D. Roberts CAL 01.05) (P1)
- *Eragrostis crateriformis* (P3)
- *Euphorbia clementii* (P3)
- *Euphorbia inappendiculata* var. *inappendiculata* (P2)



- *Goodenia nuda* (P4)
- *Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3)
- *Triodia basitricha* (P3)
- *Triodia chichesterensis* (P3).

A further eight species were considered significant for other reasons, in line with (Environmental Protection Authority, 2016a) (Environmental Protection Authority, 2016b) due to:

- The identification of a taxa having anomalous features, and therefore potentially being undescribed:
  - *Abutilon* aff. *hannii*
  - *Polymeria* sp.
- Representing a range extension or outlier of the main range:
  - *Cyperus microcephalus* subsp. *saxicola*
  - *Desmodium campylocaulon*
  - *Dodonaea petiolaris*
  - *Fimbristylis nuda*
  - *Ophioglossum lusitanicum*
  - *Scleria rugosa*.

See also the pull-out box on the following page for a discussion on how a location of *Polymeria* sp. has been avoided.

#### **5.1.4.2 Introduced Flora**

A total of 20 introduced flora taxa were recorded within the Study Area, including one Declared Pest, \**Caltropis procera* (Figure 5.6). This taxa was recorded at 24 locations within the Study Area, however it is considered to be exempt from management or control requirements with regard to agriculture (Woodman Environmental, 2019a).

No introduced taxa listed as Weeds of National Significance (WoNS) were recorded in the Study Area (Woodman Environmental, 2019a).

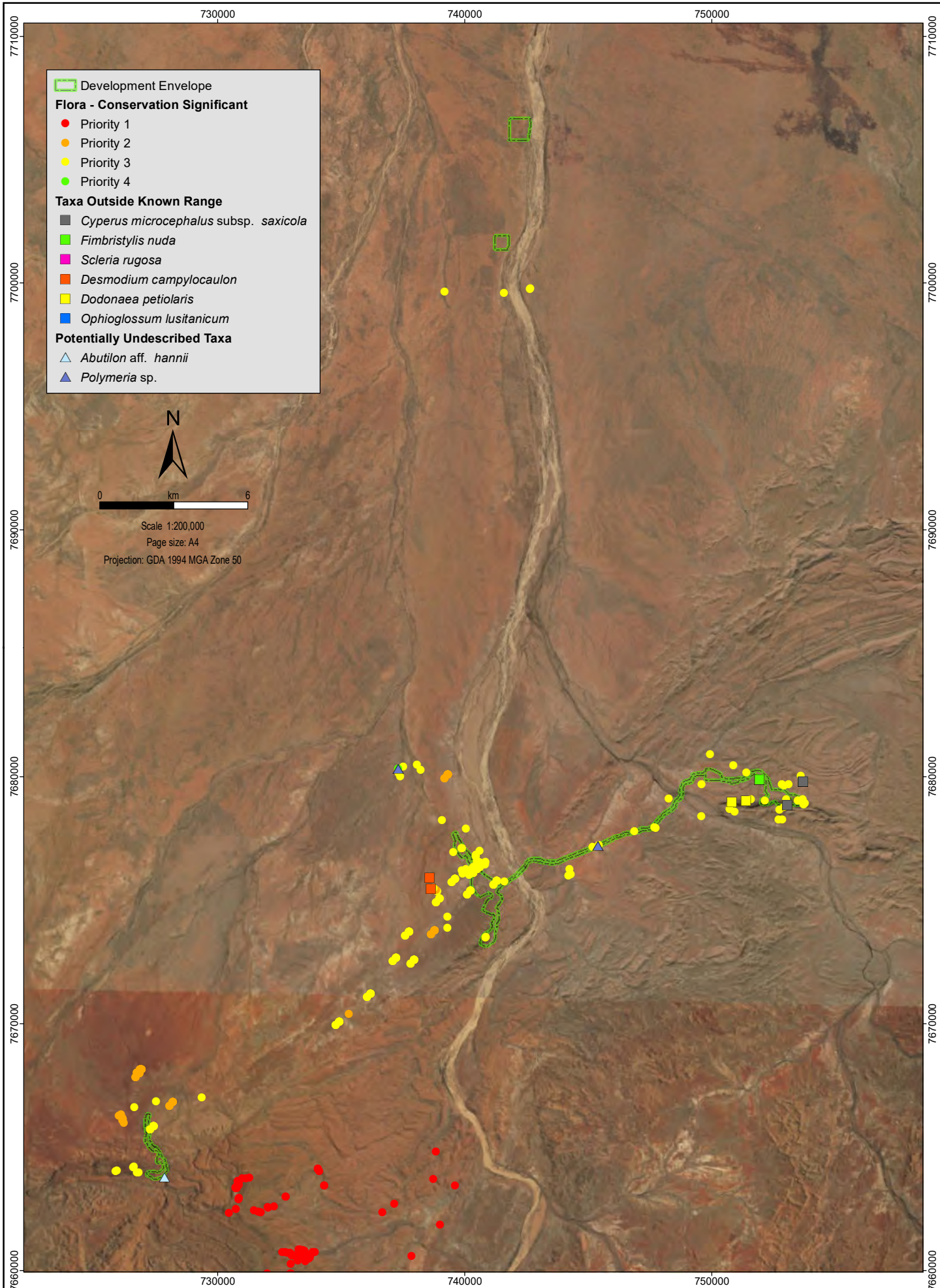


### **Redesign of the Development Envelope to avoid impacts to a potentially undescribed flora species**

Field surveys conducted by Woodman Environmental (2019a) identified a potentially undescribed species *Polymeria* sp., from two locations. One location was over 3.4 km from the Development Envelope, the other was recorded in a quadrat that partially overlapped the Development Envelope. During the development of this Section 38 Referral, Atlas Iron determined that a re-design of the Development Envelope was warranted, to remove the potential for direct impacts to both known locations. Exact GPS locations were not recorded in the field for the taxon, only the location of the quadrats that the taxon was recorded within. Atlas Iron allocated the whole 50 x 50 m quadrat a 10 m buffer and removed the overlap area from the Development Envelope (Figure 5.7).

The Indicative Disturbance Footprint associated with that part of the Development Envelope (a haul road) was re-designed to sit within the new Development Envelope. The re-design reduced the size of the Development Envelope from 621.3 ha to 621.1 ha. As this re-design to remove 0.2 ha from the Development Envelope happened in late February, after most of the numerical components of this impact assessment were completed, the exact details of percentage impacts are slightly inaccurate. However, Atlas Iron considers that these are inconsequential due to the small nature of the change (a decrease in the Development Envelope of less than 0.33%).





**Development Envelope**

**Flora - Conservation Significant**

- Priority 1
- Priority 2
- Priority 3
- Priority 4

**Taxa Outside Known Range**

- *Cyperus microcephalus* subsp. *saxicola*
- *Fimbristylis nuda*
- *Scleria rugosa*
- *Desmodium campylocaulon*
- *Dodonaea petiolaris*
- *Ophioglossum lusitanicum*

**Potentially Undescribed Taxa**

- △ *Abutilon* aff. *hannii*
- △ *Polymeria* sp.

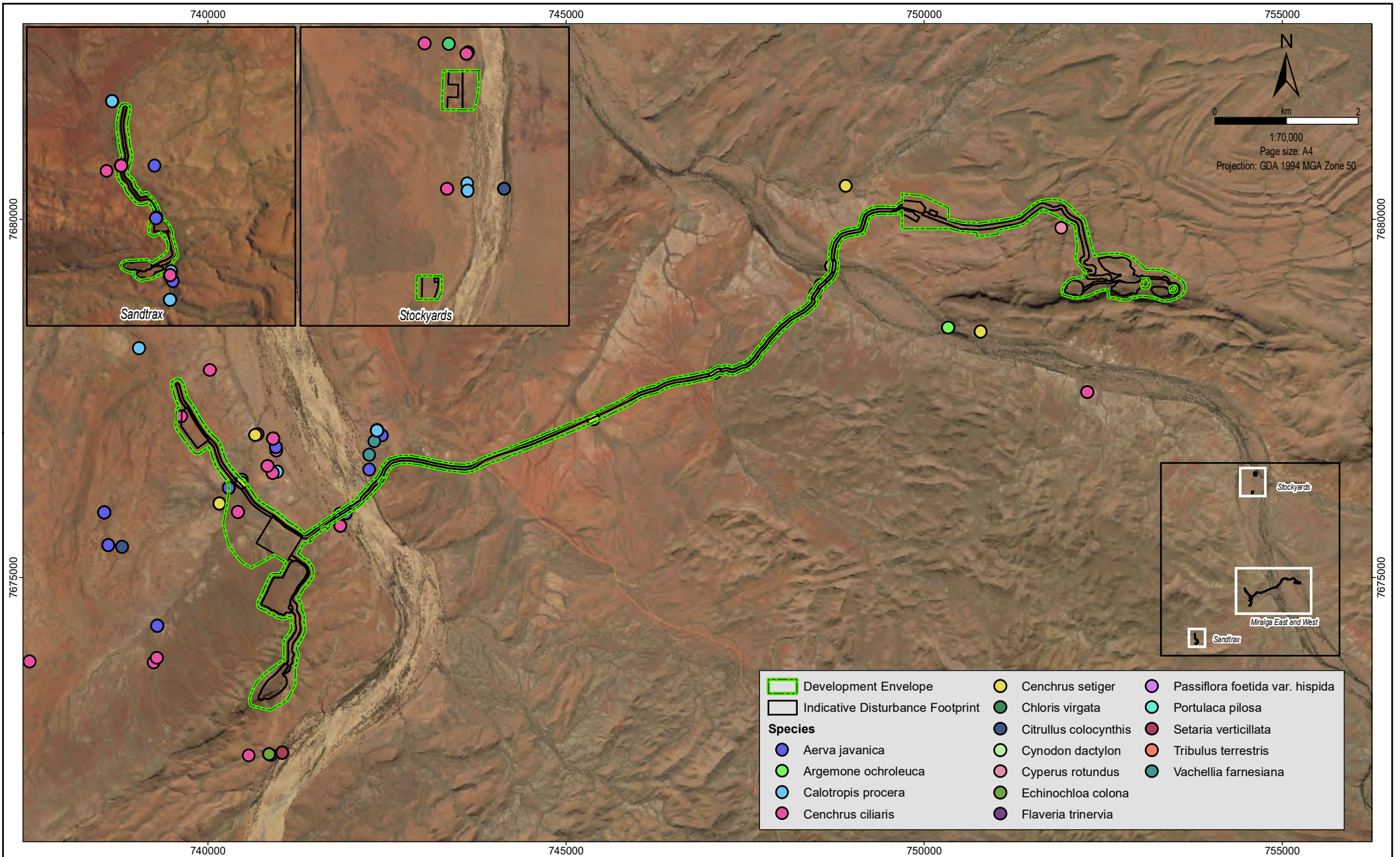
N

0      km      6

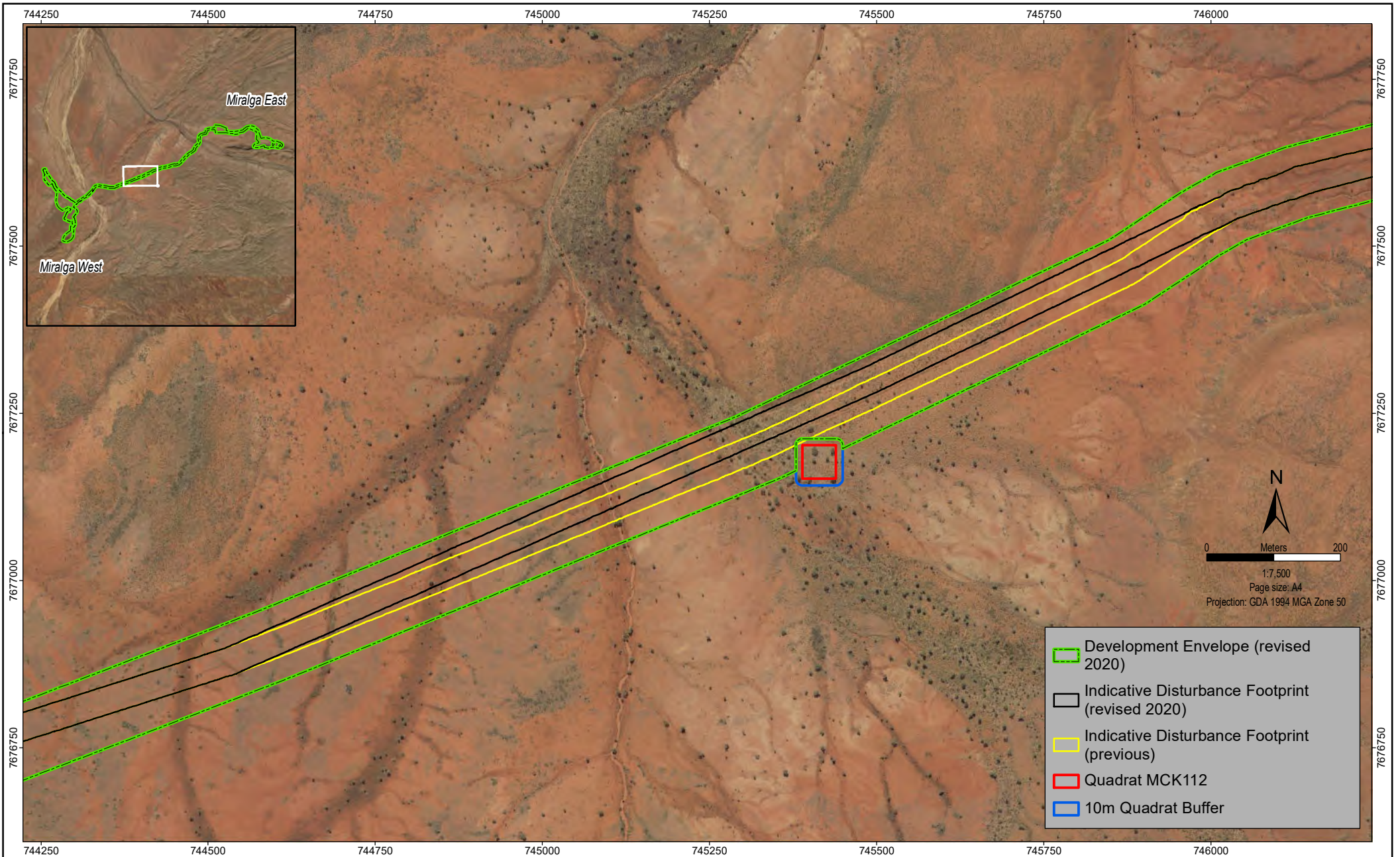
Scale 1:200,000  
Page size: A4  
Projection: GDA 1994 MGA Zone 50

	File Name: GIS_2749_MIR_S38_Fig5_5_ConsSigFlora.mxd	Source & Notes: Some species are recorded in the same location, only one is visible in the figure.	Figure No:
	Date: 2/04/2020		<b>5-5</b>
	Author: Heath.Maconachie		









File Name: GIS\_2774\_MIR\_S38\_Fig5\_7\_PolymeriaRealign.mxd

Date: 2/04/2020

Source & Notes:

Author: Heath.Maconachie

## Polymeria sp. Realignment

Figure No:

5-7



### 5.1.5 Groundwater Dependent Vegetation and Surface Water Flows

As vegetation may obtain its water from surface and/or groundwater sources, these environmental aspects are discussed in relation to Flora and Vegetation.

Miralga East is located in the Miralga Creek catchment, a sub-component of the larger Shaw River Catchment (approximately 790,000 ha). Miralga West and both stockyards are located in the Shaw River Catchment. Sandtrax lies within the separate Strelley River catchment (approximately 280,000 ha). No perennial streams occur in the immediate vicinity of the Proposal.

The Proposal is located in the proclaimed Pilbara Groundwater Area. Groundwater in the area is available in the following primary aquifers (MWH, 2012):

- Alluvial Aquifers
- Fractured Rock Aquifers.

The vegetation type analysis and mapping discussed in Section 5.1.3 (Woodman Environmental, 2019a) was undertaken using classification analysis to determine similarities of floral composition between sampling sites. VT 5 was found to be restricted to major creek and river channels on deeper alluvium has been identified as containing phreatophytes (*Melaleuca argentea* and *Eucalyptus camaldulensis*). As such, VT 5 was determined to partially represent GDV. Groundwater dependency is not considered consistent throughout any particular VT including VT 5 (Woodman Environmental, 2019b).

Woodman Environmental (2019b) (Appendix A) conducted a desktop review of potential GDV relevant to the Proposal and determined that *M. argentea* appears to be the most sensitive to changes in groundwater regimes and has been the focus of studies by Atlas Iron to support the Proposal. *E. camaldulensis* and other potential GDV were considered in the assessment and as *M. argentea* appears to be the most sensitive, the protective measures put in place for *M. argentea* will in turn protect the other species.

Studies by Graham (2001) indicate that this species has a shallow planiform root system adapted to areas of very shallow groundwater (2 to 3 m below ground level) and has difficulties adjusting to short periods of dry conditions (Department of Water, 2010). Studies undertaken by BHP (1997) indicate that a decline in groundwater level of 0.5 m may result in decreased vigour.

Biologic (2019) (Appendix C) conducted a field survey of areas identified by Woodman Environmental (2019b) as VT 5 and areas considered to have potential to support GDV that could be impacted by groundwater drawdown from the existing Abydos borefield. The field survey delineated seven broad functional units, further split into 14 riparian vegetation units (Table 5.6) (Biologic, 2019). Known water pools in the area were also visited to assess their permanency, with permanency being an indication that the pools and surrounding vegetation could be groundwater fed/dependent (Appendix D). The majority of the pools (some initially thought to be permanent) have been determined to be non-permanent.



Table 5.6 – Broad Functional Units and Riparian Vegetation Units

Broad Functional Units	Riparian Vegetation Units
Acacia dominated shrublands (139.21 ha):	<b>AM:</b> <i>Acacia coriacea</i> subsp. <i>pendens</i> , <i>Melaleuca glomerata</i> and <i>Melaleuca linophylla</i> tall shrubland over <i>Triodia epactia</i> low sparse hummock grassland.
	<b>AT:</b> <i>Acacia trachycarpa</i> , <i>Atalaya hemiglauca</i> and occasional * <i>Calotropis procera</i> mid to tall shrubland over * <i>Cenchrus ciliaris</i> scattered low tussock grasses.
Bare river-bed (116 ha)	<b>B:</b> Bare river bed with isolated shrubs, herbs and sedges.
<i>Corymbia</i> dominated woodland (2.72 ha)	<b>CH:</b> <i>Corymbia hamersleyana</i> low scattered trees over <i>Acacia pyrifolia</i> and <i>Acacia trachycarpa</i> tall to mid scattered shrubs over * <i>Cenchrus ciliaris</i> scattered tussock grasses.
<i>Eucalyptus camaldulensis</i> dominated woodlands (482.59 ha)	<b>EC1:</b> <i>Eucalyptus camaldulensis</i> and occasional <i>Melaleuca argentea</i> mid to low open woodland over <i>Atalaya hemiglauca</i> , <i>Acacia trachycarpa</i> and * <i>Calotropis procera</i> tall to mid scattered to open shrubland over * <i>Cenchrus ciliaris</i> low scattered tussock grasses.
	<b>EC2:</b> <i>Eucalyptus camaldulensis</i> and <i>Eucalyptus victrix</i> mid to low open woodland over <i>Atalaya hemiglauca</i> , <i>Acacia trachycarpa</i> and <i>Melaleuca glomerata</i> with occasional * <i>Calotropis procera</i> tall to mid sparse shrubland over low scattered tussock grasses.
	<b>EC3:</b> <i>Eucalyptus camaldulensis</i> mid to low open woodland over <i>Acacia trachycarpa</i> , <i>Melaleuca glomerata</i> and * <i>Calotropis procera</i> mid to tall sparse shrubland over * <i>Cenchrus ciliaris</i> low scattered tussock grasses.
<i>Eucalyptus victrix</i> dominated woodlands (88.59 ha)	<b>EV1:</b> <i>Eucalyptus victrix</i> with occasional <i>Eucalyptus camaldulensis</i> mid to low open woodland over <i>Acacia trachycarpa</i> , <i>Melaleuca glomerata</i> and <i>Acacia coriacea</i> subsp. <i>pendens</i> tall to mid scattered shrubs over scattered tussock or hummock grasses.
	<b>EV2:</b> <i>Eucalyptus victrix</i> mid to low scattered trees over <i>Melaleuca glomerata</i> , <i>Acacia trachycarpa</i> and <i>Atalaya hemiglauca</i> tall sparse shrubland over scattered hummock and tussock grasses.
Floodplains (0.10 ha)	<b>FP:</b> Floodplain dominated by * <i>Cenchrus ciliaris</i> .
<i>Melaleuca argentea</i> dominated woodlands (582.62 ha)	<b>MA1:</b> <i>Melaleuca argentea</i> with occasional <i>Eucalyptus camaldulensis</i> and <i>Sesbania formosa</i> mid to low open forest over <i>Cyperus vaginatus</i> low to mid scattered sedges.
	<b>MA2:</b> <i>Melaleuca argentea</i> with occasional <i>Eucalyptus camaldulensis</i> mid to low open woodland over <i>Acacia trachycarpa</i> , <i>Atalaya hemiglauca</i> and * <i>Calotropis procera</i> tall to mid sparse to scattered shrubs over <i>Cyperus vaginatus</i> mid scattered sedges.
	<b>MA3:</b> <i>Melaleuca argentea</i> low scattered trees over <i>Acacia trachycarpa</i> , <i>Melaleuca glomerata</i> and occasional * <i>Calotropis procera</i> mid to tall sparse shrubland over scattered shrubs and sedges.
	<b>MA4:</b> <i>Melaleuca argentea</i> low scattered trees over isolated patches of <i>Cyperus vaginatus</i> and <i>Cyperus ixiocarpus</i> over isolated herbs and tussock grasses.

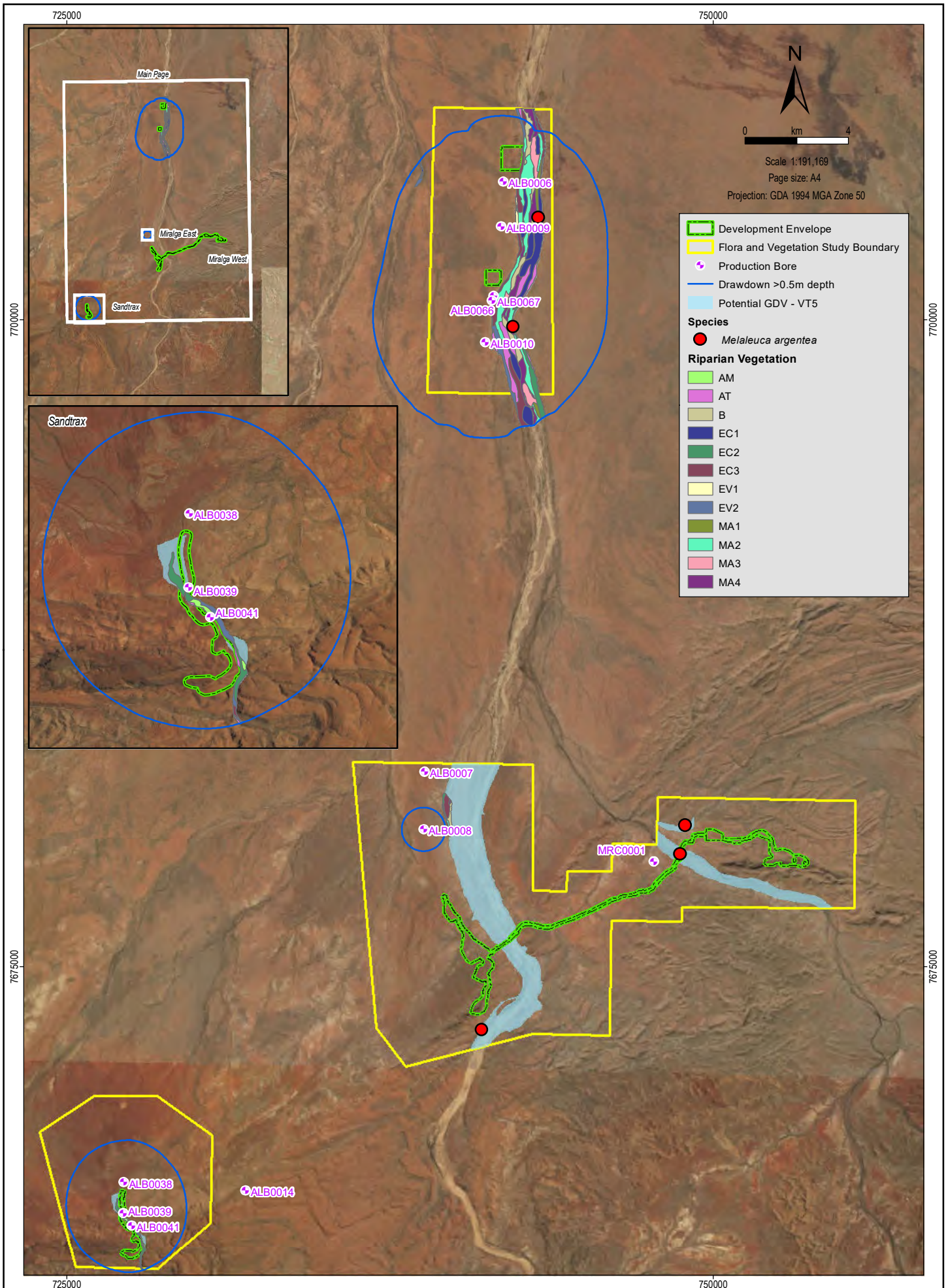
The obligate phreatophyte *M. argentea* was recorded from all survey areas except for the unnamed creek located near bore ALB0008. Other phreatophytic species were identified



during the survey, with *M. argentea* and *S. formosa* considered the key phreatophytic species observed across the Study Area.

Substantial stands and individuals of *M. argentea* were recorded from within the 0.5 m drawdown contour, with individuals of and vegetation units dominated by *M. argentea* located within 500 m of the proposed bores (Figure 5.8). *M. argentea* vegetation units are known to occur in areas of potential habitat in the wider area (Biologic, 2019).





Development Envelope  
 Flora and Vegetation Study Boundary  
● Production Bore  
 Drawdown >0.5m depth  
 Potential GDV - VT5

**Species**

● *Melaleuca argentea*

**Riparian Vegetation**

- AM
- AT
- B
- EC1
- EC2
- EC3
- EV1
- EV2
- MA1
- MA2
- MA3
- MA4



## 5.2 Potential Impacts

Potential impacts to flora and vegetation from the Proposal include:

- Direct clearing of flora and vegetation resulting in a change to the local or regional representation of vegetation communities and flora species.
- Changes to vegetation composition, condition and/or health resulting from the following indirect impacts:
  - Introduction and/or spread of weeds.
  - Dust deposition.
  - Altered hydrological regimes (i.e., drainage shadowing and ponding).
  - Groundwater drawdown.

## 5.3 Assessment of Impacts

The following sections discuss the potential impacts to flora and vegetation identified in Section 5.2, generally prior to applying mitigations (avoidance, minimisation and rehabilitation – discussed in Section 5.4).

### 5.3.1 Clearing of Flora and Vegetation

Clearing would reduce the size and quality of vegetation types, both directly and indirectly through edge effects and fragmentation, and may heighten the effects of other threatening processes such as introduced flora.

#### 5.3.1.1 Vegetation

Table 5.7 lists the extent of each VT within the Study Area, the Development Envelope and the Indicative Disturbance Footprint. The Development Envelope contains all vegetation types (VTs) present within the Study Area, with the exception of VT 6 and VT 9, which have both been avoided. VT 6 and VT 9 are considered by Atlas to be of conservation interest as they support conservation significant flora species. Impacts to VT 2 (which also supports conservation significant flora) are less than 1%.

With the exception of VT 11, the vast majority of the mapped extent of each VT (over 90%) is outside the Development Envelope.

For VT 11, 29.8% of the mapped area is within the Development Envelope and 11.3% is within the Indicative Disturbance Footprint. VT 11 is “potentially regionally significant” because of its lack of representation within the Atlas regional vegetation dataset; however, it occurs on soil and landform types that are considered relatively common in the region (Woodman Environmental, 2019a). As such, it is likely that VT 11 is more widely distributed than is presented in the Study Area. The probability of regional significance is low despite the moderate level of local impact associated with this Proposal (i.e. the potential removal of 29.8% of the extent mapped in this EIA).



**Table 5.7 – Potential Impact to Vegetation Types in the Indicative Disturbance Footprint**

Vegetation Type	Extent in Study Area (ha)	Development Envelope		Indicative Disturbance Footprint	
		Area mapped (ha)	Proportion of Extent in Study Area	Area mapped (ha)	Proportion of Extent in Study Area
VT 1	1,836.1	70.5	3.8%	24.8	1.4%
VT 2 <sup>1</sup>	33.0	0.3	0.9%	0	0.0%
VT 3	2,134.7	61.7	2.9%	24.5	1.1%
VT 4	595.1	46.1	7.7%	23.9	4.0%
VT 5	2,820.8	26.4	0.9%	8.9	0.3%
VT 6 <sup>1,2</sup>	186.5	–	–	–	–
VT 7	2,648.0	88.7	3.3%	26.5	1.0%
VT 8	3,111.6	80.7	2.6%	56.1	1.8%
VT 9 <sup>2</sup>	192.6	–	–	–	–
VT 10	6,522.8	131.7	2.0%	57.9	0.9%
VT 11 <sup>2</sup>	111.7	33.3	29.8%	12.6	11.3%
VT 12	1,161.5	45.4	3.9%	22.9	2.0%
Cleared Land	147.0	36.5	24.8%	26.8	18.2%
<b>Total</b>	<b>24,760.6</b>	<b>621.3<sup>3</sup></b>		<b>284.9</b>	

Source: Woodman (2019)

- (1) VT 2 and VT 6 are considered by Atlas Iron to be of conservation interest as they support flora species that are of conservation significance.
- (2) VT 6, VT 9 and VT 11 are considered by Atlas Iron to be of conservation interest due to their limited representation in the Woodman Environmental Study Area.
- (3) As noted in Section 5.1.4.1, the Development Envelope was revised down to 621.1 ha to avoid impacts to *Polymeria* sp. These calculations were completed by Woodman Environmental prior to the re-design. Numerical impacts are insignificant.

The following definition of the magnitude of impacts has been used in the assessment of the significance of impacts to vegetation types recorded in the Survey Area:

- Negligible: Loss of individual, non-Threatened plants, up to 10% of the VT's mapped extent
- Low: Loss of individuals but at least 75% of the population extent is retained
- Moderate: More than 25% but less than 50% of the population is removed
- High: Population persistence threatened.

Eleven of the 12 VTs identified by Woodman Environmental (2019a) have over 90% of their mapped extent outside of the development Envelope. These 11 VTs are considered to be only Negligibly impacted by the implementation of the Proposal. VT 11 has 29.8% of its mapped extent within the Development Envelope. This is the only VT with a potential





Moderate impact. A Moderate impact would only eventuate if its entire distribution within the Development Envelope was cleared; this is unlikely to be the case.

Based on the current design of the Proposal, only 11.3% of VT 11 lies within the Indicative Disturbance Footprint. VT 11 was considered by Woodman Environmental (2019a) to be “potentially regionally significant” because of its lack of representation within the Atlas regional vegetation dataset, however it occurs on soil and landform types that are considered relatively common in the region (Woodman Environmental, 2019a). As such, it is likely that the vegetation type is more widely distributed than is presented in the Study Area. Atlas Iron concludes that the local-scale impact is Low, and regional impact is expected to be Negligible.

### 5.3.1.2 Clearing of Conservation Significant Flora

The majority of recorded conservation significant flora species are outside of the Development Envelope, and even more are outside of the Indicative Disturbance Footprint (Table 5.8).

**Table 5.8 – Locations of Priority Flora in the Development Envelope and Indicative Disturbance Footprint**

Species	Conservation Status <sup>1</sup>	Number of Locations		
		Study Area	Development Envelope	Indicative Disturbance Footprint
<i>Corchorus</i> sp. Yarrie (J. Bull & D. Roberts CAL 01.05)	P1	3	–	–
<i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i>	P2	3	–	–
<i>Eragrostis crateriformis</i>	P3	17	2	–
<i>Euphorbia clementii</i>	P3	29	5	3
<i>Oldenlandia</i> sp. Hamersley Station (A.A. Mitchell PRP 1479)	P3	2	–	–
<i>Triodia basitricha</i>	P3	31	2	2
<i>Triodia chichesterensis</i>	P3	1	–	–
<i>Goodenia nuda</i>	P4	1	–	–
<i>Desmodium campylocaulon</i>	Outlier of known range	2	–	–
<i>Fimbristylis nuda</i>	Outlier of known range	2	–	–
<i>Scleria rugosa</i>	Outlier of known range	2	–	–
<i>Abutilon</i> aff. <i>hannii</i>	Potentially undescribed	1	–	–



Species	Conservation Status <sup>1</sup>	Number of Locations		
		Study Area	Development Envelope	Indicative Disturbance Footprint
<i>Polymeria</i> sp.	Potentially undescribed	2	–	–
<i>Cyperus microcephalus</i> subsp. <i>saxicola</i>	Range extension	2	–	–
<i>Dodonaea petiolaris</i>	Range extension	3	–	–
<i>Ophioglossum lusitanicum</i> (outside known range)	Range extension	1	–	–

Source: Woodman (2019)

(1) Conservation codes for DBCA listings:

P1 – Priority 1 (species that are known from one or a few locations (generally five or less) which are potentially at risk)

P2 – Priority 2 (species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation)

P3 – Priority 3 (species that are known from several locations, and the species does not appear to be under imminent threat, or from few or widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat)

P4 – Priority 4 (rare, near threatened and other species in need of monitoring). The estimated quantity of each conservation significant flora species within the Study Area, Development Envelope and Indicative Disturbance Footprint is presented in Table 5.8. The Development Envelope has been designed to avoid all but five of locations that Priority (and otherwise conservation significant) species were located.

Similarly, to vegetation types, the following definitions of impact to conservation significant species were applied:

- Negligible: Loss of individual groups of non-Threatened plants
- Low: Loss of individuals but at least 75% of the known locations are retained
- Moderate: More than 25% but less than 50% of the known locations are removed
- High: Population persistence threatened.

Overall, vegetation removal and degradation are considered to be the primary impact to conservation significant flora within the Study Area.

A potentially undescribed species was located within Development Envelope, *Polymeria* sp. As described in Section 5.1.4.1, the Disturbance Envelope has been re-designed to avoid the species and establish a 10 m buffer around the quadrat in which it was recorded (Figure 5.7). This taxon was found within VT 7, of which there was over 3,000 ha mapped in the Study Area (Woodman Environmental, 2019a). Application of the impact criteria defined above results in *Polymeria* sp. being considered to have a Negligible level of impact as all known locations are outside of the Development Envelope. Being conservative due to the taxa being located only twice during the baseline survey, Atlas considers that the impact category is more realistically classified as Low. It is likely that more specimens of this taxa are found outside of the Development Envelope rather than inside as only 3.3% of the mapped extent of VT 7 (where both *Polymeria* sp. were recorded) is within the Development Envelope.



### 5.3.2 Weeds

Ground disturbance and vehicle and machinery movements all have the potential to spread and introduce weeds. Several introduced flora are already known to occur within or adjacent to the Development Envelope (Woodman Environmental, 2019a):

- *Aerva javanica*
- *Argemone ochroleuca*
- *Calotropis procera*
- *Cenchrus ciliaris*
- *Cenchrus setiger*
- ?*Chenopodium* sp.
- *Chloris virgate*
- *Citrullus colocynthis*
- *Cynodon dactylon*
- *Cyperus rotundus*
- *Echinochloa colona*
- *Flaveria trinervia*
- *Malvastrum americanum*
- *Passiflora foetida* var. *hispida*
- *Portulaca pilosa*
- *Setaria verticillata*
- *Solanum nigrum*
- *Stylosanthes hamata*
- *Tribulus terrestris*
- *Vachellia farnesiana*.

Of the introduced taxa recorded in the Development Envelope, one Declared Pest (*Calotropis procera*) was recorded at three locations. The most common weeds in the Development Envelope were *Aerva javanica* (Kapok Bush) and *Cenchrus ciliaris* (Buffel Grass) recorded five and 33 times, respectively (Woodman Environmental, 2019a). These are also ranked as having a high ecological impact and invasiveness ranking of 'rapid' (Department of Biodiversity, Conservation and Attractions, 2014). The presence of the significant introduced taxon *Calotropis procera* also reflects the high level of disturbance caused by cattle in the areas where these taxa were recorded (Woodman Environmental, 2019a).

Weeds are generally managed on site as a business as usual matter through ground disturbance permitting and procedures. This will be reflected both in the management of the site, and post-closure considerations and expectations in terms of criteria for vegetation condition.

Atlas does not regard weeds in the Development Envelope to be a significant issue as they can be managed appropriately through existing procedures and management plans.



Pre-mitigation, the potential impact of weeds is considered to be Moderate, diminishing after the mitigations in Section 5.4 are in place.

### 5.3.3 Dust

The development and operation of the Proposal will create dust emissions associated with ground disturbance and construction, blasting, haulage and general traffic activities, the impacts of which may not be confined to the Development Envelope. Dust emissions have the potential to affect surrounding flora and vegetation. Dust deposition on individual taxa may have either a physical impact (such as blocking stomata, or physically smothering leaves), or chemical impacts, either on the individuals themselves or through contact with the soil. This may place pressure on conservation significant flora located in close proximity of the Indicative Disturbance Footprint if not appropriately managed.

Dust is generally managed on site as a business as usual matter through dust suppression and the stabilisation/ rehabilitation of exposed surfaces. Pre-mitigation, the potential impact of dust is considered to be Low, diminishing after the mitigations in Section 5.4 are in place.

### 5.3.4 Altered Hydrological Regimes

Clearing for the Proposal will result in the loss of a very small proportion of the Strelley and Shaw catchments; the Development Envelope covers significantly less than 0.25% of each catchment.

Impacts to flora and vegetation can occur through the following mechanisms:

- Blockage or modification of existing flow paths leading to shadow and ponding effects on vegetation.
- Sediment transport and deposition off disturbed surfaces leading to smothering of vegetation.

Where surface water flows are intercepted or modified there is an increase in the potential for localised ponding to occur immediately upstream and water shadows to develop immediately downstream. This can starve the downstream environment of surface water, and flood the local upstream environment during periods of heavy rainfall. Both impacts can alter vegetation in and adjacent to the shadow and ponding zones.

The two main watercourse crossings of the Shaw River and Miralga Creek on the Miralga Haul Road have the potential to cause an impact to upstream and downstream environments when flow is impeded, leading to a shadow and ponding effect. In the absence of appropriate management, local impacts to vegetation may be Moderate, with impacts decreasing with distance from the haul road.

As the level of impact on a catchment-wide scale is small (less than 0.25% of the Strelley and Shaw River catchments will be cleared), the region-level impact to vegetation from changes in the surface water regime is considered Negligible, even prior to the implementation of engineering and management controls.

Runoff from cleared surfaces (e.g. waste dumps) will occur in response to rainfall, which is sporadic in nature. Increased sediment run-off is expected, particularly from waste rock dumps prior to rehabilitation and closure (RPS, 2019). For example, the Miralga West waste dump lies upstream of VT 5, and drains into the Shaw River. Local impacts to vegetation immediately downstream of the waste dumps can be expected to be Low to Moderate, with



the level of impact decreasing with distance from the source. The greatest impacts are expected in the early stages of deposition because surfaces will stabilise over time as transportable elements are removed from the exposed surface and existing vegetation acts to limit spread. Regional impacts from erosion on vegetation are anticipated to be Negligible to Low as the area is well vegetated, which slows the rate of transport of erodible material, impeding its spread.

### 5.3.5 Groundwater Drawdown

Groundwater drawdown occurs when the water table is lowered caused by pumping of groundwater from wells or excavations. Drawdown can lead to impacts to groundwater dependent vegetation (GDV). While aquifer dewatering is not required to enable mining (as all pits are above the water table), drawdown will occur at the various water-supply bores, all of which already exist, and are licensed for more abstraction than is required for the Proposal (Atlas Iron, 2020). Biologic (2019) assessed the impact of abstraction from the existing bores and concluded that drawdown in exceedance of 0.5 m is likely to have some impact on the most sensitive GDV.

Of the dominant riparian tree species in major creeks and rivers of the Pilbara, obligate phreatophytes such as *M. argentea* require continuous access to groundwater. *Eucalyptus camaldulensis* subsp. *obtusata* is a facultative phreatophyte and can either access groundwater or water from the capillary fringe, meaning it can tolerate some degree of groundwater drawdown depending on the rate of fall and ability of roots to continue to access the capillary fringe. *Eucalyptus victrix* on the other hand is considered a facultative phreatophyte or a vadophyte (accessing moisture from throughout the soil profile) and is usually tolerant of drawdown. The response of individual trees is variable however and often depends on the conditions of their establishment. These species and similar vegetation types have been found in the surrounding area, beyond the Development Envelope (Biologic, 2019).

Any calculations on percent retained versus at risk of the functional groups mapped by Biologic (2019) are inflated above 'real' levels because the surveys were focused on areas of impact, rather than being designed to investigate local versus regional impact. With this in mind, the higher level VT 5 from Woodman Environmental (2019a) was used to calculate impacts to potential GDV; VT 5 supports the obligate phreatophyte *M. argentea* and facultative phreatophytes. Note that the use of VT 5 to estimate GDV extent leads to an overestimation of potential impacts, as not all vegetation within VT 5 is expected to be solely dependent on groundwater (Woodman Environmental, 2019a). However, as VT 5 was mapped across a wider area it provides a better indicator of local impact. A total of 26.4 ha of VT 5 was mapped within the Development Envelope and could potentially be directly impacted by clearing. A total of 97.7 ha of VT 5 was mapped within the 0.5 m drawdown contours near the water supply borefield, and thus is at risk of indirect impacts from the temporary decrease in groundwater level. As some of the Development Envelope overlaps with some of the drawdown contours this equates to a maximum estimated loss or degradation of 114.8 ha, or 4% of its mapped extent.

Drawdown from the existing borefield will be short in nature, due to the short life of mine. Natural mitigation may also occur through inputs from significant periodic inputs associated with cyclones (Biologic, 2019), although cyclones are stochastic events and therefore cyclonic inputs cannot be relied upon to occur during the life of mine.

Impacts are anticipated to be Negligible at the regional and local scale, with impacts tightly linked to drawdown areas around each bore, diminishing with distance from the bore.





## 5.4 Mitigation

Atlas Iron has in place a HSEMS supported by an Environmental Management Plan (EMP), which defines Atlas Iron's approach to environmental management and integrates regulatory and HSEMS requirements. Atlas Iron has been operating iron ore mines in the Pilbara since 2008. During this time, Atlas Iron has developed, implemented and refined its Environmental Management Plans and Procedures.

The mitigation hierarchy (avoid, minimise and rehabilitate) has been applied during Proposal design to reduce the Proposal's potential impacts to flora and vegetation. Table 5.9 summarises the mitigations that will be applied during construction and operation of the Proposal.

**Table 5.9 – Mitigation of Impacts to Flora and Vegetation**

	Mitigations to be Applied
<b>Avoidance</b>	<p>The Development Envelope was designed through several revisions to:</p> <ul style="list-style-type: none"> <li>• Avoid impact to VT 6 and VT 9, both of which are considered by Atlas Iron to be of conservation interest as they support conservation significant flora species.</li> <li>• Avoid known locations of priority flora including: <ul style="list-style-type: none"> <li>– Avoid both known locations of <i>Polymeria</i> sp. (potentially undescribed)</li> <li>– Avoid 5 out of 7 locations of <i>Eragrostis crateriformis</i> (P3)</li> <li>– Avoid 23 out of 28 locations of <i>Euphorbia clementii</i> (P3)</li> <li>– Avoid 29 out of 31 locations of <i>Triodia basitricha</i> (P3)</li> </ul> </li> <li>• The Proposal has avoided the need to clear additional vegetation by using existing camp, haul road and borefield infrastructure at Atlas Iron's Abydos Project.</li> </ul>
<b>Minimisation</b>	<p>The following plans and procedures will be implemented to assist in minimising impacts to flora and vegetation:</p> <ul style="list-style-type: none"> <li>• Ground Disturbance Permit (GDP) Procedure (950-HSE-EN-PRO-0001).</li> <li>• Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).</li> <li>• Flora Management Procedure (950-HSE-EN-PRO-0010).</li> <li>• Weed Hygiene Procedure (950-HSE-EN-PRO-0002).</li> <li>• Dust Management Procedure (950-HSE-EN-PRO-0026).</li> <li>• Water Management Plan and Site Water Operating Plan (<i>in preparation</i>).</li> </ul> <p>Key management measures contained in these plans include:</p> <ul style="list-style-type: none"> <li>• No more than 284.9 ha of vegetation/habitat within the 621.1 ha Development Envelope will be cleared/disturbed.</li> <li>• Restricting clearing to the minimum necessary for safe construction and operation of the Proposal and to within approved areas through GDP Procedure.</li> <li>• Accurate delineation of the GDP boundary in the field prior to any works commencing, including all buffers and values to be avoided and weed infested areas.</li> <li>• Prohibition of off-road driving unless otherwise authorised by Senior Management.</li> <li>• Weed hygiene inspections and certification to ensure all mobile equipment arriving on site is clean and free of material.</li> <li>• Weeds and weed contaminated topsoil will be cleared, handled and stockpiled separately to native vegetation and 'clean' topsoil.</li> </ul>



	Mitigations to be Applied
	<ul style="list-style-type: none"> <li>Regular and targeted weed control (e.g. by spraying, physical removal) will be undertaken as appropriate (during all stages of operation including care and maintenance).</li> <li>Standard dust suppression techniques shall be used on roads, stockpiles and infrastructure areas (e.g., water carts, sprinklers) as required.</li> <li>Road train trailers will be fitted with covers during product transport to port.</li> <li>Atlas Iron will abstract water in accordance with 5C Licences to take groundwater, a Water Management Plan and Site Water Operating Plan in accordance with the Department of Water and Environmental Regulations requirements.</li> </ul> <p>Design of river crossings over Miralga Creek and the Shaw River:</p> <ul style="list-style-type: none"> <li>The river crossing at Shaw River will be designed and constructed to over-top during periods of major stream flow. This will enable water flow past the crossing points and prevent significant amounts of water ponding up-stream, as well as prevent water shadow effects downstream.</li> <li>The haul road crossing at Miralga Creek will be designed and constructed to enable water flow past the crossing point and prevent significant amounts of water ponding up-stream, as well as prevent water shadow effects downstream. This will be enabled through an over-topping design, or the installation of appropriate under-road drainage.</li> </ul>
<b>Rehabilitation</b>	<ul style="list-style-type: none"> <li>The removal and stockpiling of all vegetative matter during clearing for future use in rehabilitation.</li> <li>All areas of the Indicative Disturbance Footprint (except for open pits) will be progressively rehabilitated as soon as practicable and as required by the MCP. Rehabilitation works are expected to return disturbed areas to a stable and vegetated state</li> <li>A MCP will be updated triennially or as required when significant changes are made to the Proposal. A detailed MCP, which will contain further information on rehabilitation works, will be prepared approximately one year to six months prior to the cessation of mining.</li> </ul>
<b>Offset</b>	A contribution to the Pilbara Environmental Offset Fund is expected to be made, for clearing of vegetation in good or better condition in the Chichester subregion.

## 5.5 Predicted Outcome

The predicted impacts to Flora and Vegetation from the Proposal after the mitigation hierarchy (avoid, minimise, rehabilitate) are:

- No impact to Threatened Flora, TECs or PECs.
- Removal of a maximum of 284.9 ha of native vegetation within the 621.1 ha of Development Envelope.
- Removal of up to 26% of VT 11 which had a limited distribution within the Study Area (Woodman Environmental, 2019a).
- No loss of the potentially undescribed *Polymeria* sp. due to revised Development Envelope and Indicative Disturbance Footprint.



After the application of mitigation hierarchy to apply avoidance, minimisation and rehabilitation measures, Atlas Iron expects that the EPA's objective for Flora and Vegetation can be met.

## 5.6 Flora and Vegetation Summary

A summary of this factor is provided in Table 5.10. Further details are provided in the remainder of this chapter.

**Table 5.10 – Flora and Vegetation Summary**

Factor	Flora and Vegetation Summary
<b>EPA Objective</b>	To protect flora and vegetation so that biological diversity and ecological integrity are maintained (Environmental Protection Authority, 2018a).
<b>Policy and Guidance</b>	<ul style="list-style-type: none"> <li>• Environmental Factor Guideline: Flora and Vegetation (Environmental Protection Authority, 2016a).</li> <li>• Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (Environmental Protection Authority, 2016b).</li> </ul>
<b>Receiving Environment</b>	<p>12 vegetation types (VTs) were mapped, with 80% of vegetation being considered to be in Excellent condition. The 12 VTs were broadly grouped into:</p> <ul style="list-style-type: none"> <li>• Granite and dolorite hills and ranges</li> <li>• Hills and steep slopes on ironstone</li> <li>• Rivers and claypans on alluvial sediments</li> <li>• Minor drainage lines and sheet flow on flood plains</li> <li>• Sandy and stony plains.</li> </ul> <p>None of the VTs were considered to represent Threatened or Priority Ecological Communities. The only VTs considered to be of local significance were:</p> <ul style="list-style-type: none"> <li>• VT 2: occurs in shallow gorge/creek areas and provides habitat for significant flora taxa</li> <li>• VT 6: is mapped on a claypan, which is a limited habitat and supports significant flora taxa, it also has limited representation in the Study Area</li> <li>• VT 9: has an unknown regional extent and has limited representation in the Study Area</li> <li>• VT 11: has an unknown regional extent and has limited representation in the Study Area.</li> </ul> <p>No Threatened Flora taxa listed under the BC Act or EPBC Act, were recorded within the Study Area. Eight DBCA classified Priority Flora taxa were recorded within the Study Area:</p> <ul style="list-style-type: none"> <li>• <i>Corchorus</i> sp. Yarrie (J. Bull &amp; D. Roberts CAL 01.05) (P1)</li> <li>• <i>Eragrostis crateriformis</i> (P3)</li> <li>• <i>Euphorbia clementii</i> (P3)</li> <li>• <i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i> (P2)</li> <li>• <i>Goodenia nuda</i> (P4)</li> <li>• <i>Oldenlandia</i> sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3)</li> <li>• <i>Triodia basitricha</i> (P3)</li> <li>• <i>Triodia chichesterensis</i> (P3).</li> </ul> <p>A further eight species were considered significant for other reasons:</p>



Factor	Flora and Vegetation Summary
	<ul style="list-style-type: none"> <li>• Taxa having anomalous features, and therefore potentially being undescribed:               <ul style="list-style-type: none"> <li>– <i>Abutilon</i> aff. <i>hannii</i></li> <li>– <i>Polymeria</i> sp.</li> </ul> </li> <li>• Records representing a range extension or outlier of the main range:               <ul style="list-style-type: none"> <li>– <i>Cyperus microcephalus</i> subsp. <i>saxicola</i></li> <li>– <i>Desmodium campylocaulon</i></li> <li>– <i>Dodonaea petiolaris</i></li> <li>– <i>Fimbristylis nuda</i></li> <li>– <i>Ophioglossum lusitanicum</i></li> <li>– <i>Scleria rugosa</i>.</li> </ul> </li> </ul>
<b>Potential Impacts</b>	<p>Potential impacts to flora and vegetation from the Proposal include:</p> <ul style="list-style-type: none"> <li>• Direct clearing of flora and vegetation resulting in a change to the local or regional representation of vegetation communities and flora species.</li> <li>• Changes to vegetation composition, condition and/or health resulting from the following indirect impacts:               <ul style="list-style-type: none"> <li>– Introduction and/or spread of weeds</li> <li>– Dust deposition</li> <li>– Altered hydrological regimes (i.e., drainage shadowing and ponding)</li> <li>– Groundwater drawdown.</li> </ul> </li> </ul>
<b>Avoidance</b>	<p>The Development Envelope was designed through several revisions to:</p> <ul style="list-style-type: none"> <li>• Avoid impact to VT 6 and VT 9, both of which are considered by Atlas Iron to be of conservation interest as they support conservation significant flora species.</li> <li>• Avoid known locations of priority flora including:               <ul style="list-style-type: none"> <li>– Both known locations of <i>Polymeria</i> sp. (potentially undescribed)</li> <li>– 5 out of 7 locations of <i>Eragrostis crateriformis</i> (P3)</li> <li>– 23 out of 28 locations of <i>Euphorbia clementii</i> (P3)</li> <li>– 29 out of 31 locations of <i>Triodia basitricha</i> (P3)</li> </ul> </li> </ul> <p>The Proposal has avoided the need to clear additional vegetation by using existing camp, haul road and borefield infrastructure at Atlas Iron's Abydos Project.</p>
<b>Minimisation</b>	<p>The following plans and procedures will be implemented to assist in minimising impacts to flora and vegetation:</p> <ul style="list-style-type: none"> <li>• Ground Disturbance Permit (GDP) Procedure (950-HSE-EN-PRO-0001).</li> <li>• Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).</li> <li>• Flora Management Procedure (950-HSE-EN-PRO-0010).</li> <li>• Weed Hygiene Procedure (950-HSE-EN-PRO-0002).</li> <li>• Dust Management Procedure (950-HSE-EN-PRO-0026).</li> <li>• Water Management Plan and Site Water Operating Plan (<i>in preparation</i>).</li> </ul> <p>Key management measures contained in these plans include:</p> <ul style="list-style-type: none"> <li>• No more than 284.9 ha of vegetation/habitat within the 621.1 ha Development Envelope will be cleared/disturbed.</li> </ul>





Factor	Flora and Vegetation Summary
	<ul style="list-style-type: none"> <li>• Restricting clearing to the minimum necessary for safe construction and operation of the Proposal and to within approved areas through GDP Procedure.</li> <li>• Accurate delineation of the GDP boundary in the field prior to any works commencing, including all buffers and values to be avoided and weed infested areas.</li> <li>• Prohibition of off-road driving unless otherwise authorised by Senior Management.</li> <li>• Weed hygiene inspections and certification to ensure all mobile equipment arriving on site is clean and free of material.</li> <li>• Weeds and weed contaminated topsoil will be cleared, handled and stockpiled separately to native vegetation and 'clean' topsoil.</li> <li>• Regular and targeted weed control (e.g. by spraying, physical removal) will be undertaken as appropriate (during all stages of operation including care and maintenance).</li> <li>• Standard dust suppression techniques shall be used on roads, stockpiles and infrastructure areas (e.g., water carts, sprinklers) as required.</li> <li>• Road train trailers will be fitted with covers during product transport to port.</li> <li>• Atlas Iron will abstract water in accordance with 5C Licences to take groundwater, a Water Management Plan and Site Water Operating Plan in accordance with the Department of Water and Environmental Regulations requirements.</li> </ul> <p>Design of river crossings over Miralga Creek and the Shaw River:</p> <ul style="list-style-type: none"> <li>• The river crossing at Shaw River will be designed and constructed to over-top during periods of major stream flow. This will enable water flow past the crossing points and prevent significant amounts of water ponding up-stream, as well as prevent water shadow effects downstream.</li> <li>• The haul road crossing at Miralga Creek will be designed and constructed to enable water flow past the crossing point and prevent significant amounts of water ponding up-stream, as well as prevent water shadow effects downstream. This will be enabled through an over-topping design, or the installation of appropriate under-road drainage.</li> </ul>
<b>Rehabilitation</b>	<ul style="list-style-type: none"> <li>• The removal and stockpiling of all vegetative matter during clearing for future use in rehabilitation.</li> <li>• All areas of the Indicative Disturbance Footprint (except for open pits) will be progressively rehabilitated as soon as practicable and as required by the MCP. Rehabilitation works are expected to return disturbed areas to a stable and vegetated state</li> <li>• A MCP will be updated triennially or as required when significant changes are made to the Proposal. A detailed MCP, which will contain further information on rehabilitation works, will be prepared approximately one year to six months prior to the cessation of mining.</li> </ul>
<b>Offset</b>	A contribution to the Pilbara Environmental Offset Fund is expected to be made, for clearing of vegetation in good or better condition in the Chichester subregion.



Factor	Flora and Vegetation Summary
<b>Predicted Outcome</b>	<ul style="list-style-type: none"><li>• No impact to Threatened Flora, TECs or PECs.</li><li>• Removal of a maximum of 284.9 ha of native vegetation within the 621.1 ha of Development Envelope.</li><li>• Removal of up to 26% of VT 11 which had a limited distribution within the Study Area (Woodman Environmental, 2019a).</li><li>• No loss of the potentially undescribed <i>Polymeria</i> sp. due to revised Development Envelope and Indicative Disturbance Footprint.</li></ul>



## 6. Terrestrial Fauna

### 6.1 Receiving Environment

#### 6.1.1 Environmental Studies

Terrestrial fauna studies and reports completed for the Proposal and relevant to the consideration of the Terrestrial Fauna factor generally are summarised in Table 6.1. These studies and reliable, publicly available data (e.g. distribution data from the DBCA-managed Naturemap database) have been used to describe the zoological context for the Proposal in sections 6.1.2, 6.1.3, 0.

**Table 6.1 – Terrestrial Fauna Studies**

Study Title	Survey Timing	Study Purpose and Limitations
<p>Miralga Creek Project: Level 2 Vertebrate Fauna and Short-range Endemic Invertebrate Fauna Assessment (Biologic, 2020a)</p> <p>Appendix E</p>	<p>Level 2 survey</p> <p>9 to 20 May 2019</p> <p>11 to 21 July 2019</p>	<p>Specifically, the key objectives of the assessment were to:</p> <ul style="list-style-type: none"> <li>• Conduct a comprehensive desktop assessment of vertebrate and SRE invertebrate fauna likely to occur within and within the vicinity (40 km) of the Study Area.</li> <li>• Conduct a baseline Level 2 survey for vertebrate fauna to determine vertebrate fauna assemblages occurring within the Study Area.</li> <li>• Conduct a baseline Level 2 SRE invertebrate fauna survey to determine the occurrence and likelihood of occurrence for SRE invertebrates.</li> <li>• Define and delineate broad fauna habitats occurring Within the Study Area, and report on their significance.</li> <li>• Assess the likelihood for vertebrate and SRE invertebrate fauna of conservation significance to occur within the Study Area.</li> <li>• Survey included targeted cave assessments for bats and use of ultrasonic bat detectors.</li> </ul> <p>Biologic (2020a) states that there was no significant limitation to the adequacy of the vertebrate survey with respect to EPA Guidance (Environmental Protection Authority, 2010).</p> <p>In terms of the invertebrate survey carried out concurrently with the vertebrate survey:</p> <ul style="list-style-type: none"> <li>• There are several general limitations with regard to the target fauna living in cryptic habitats, occurring in low numbers and being difficult to detect – this is normal for a survey of this type</li> <li>• Biologic concluded that the 2019 survey is not considered to have suffered from any specific constraints in relation to the number of samples, coverage of SRE habitat types or the sampling and preservation methods used.</li> </ul>



Study Title	Survey Timing	Study Purpose and Limitations
		<ul style="list-style-type: none"> <li>A number of SRE taxa (collected as juvenile or female specimens) were unable to be conclusively identified due to the absence of key diagnostic features only present in male specimens. Again, this is normal for a survey of this type.</li> <li>Taxonomic and ecological knowledge is evolving for this group, therefore SRE-classifications may change over time.</li> </ul>
Miralga Creek Ghost Bat Review – March 2020 (Bat Call WA, 2020) Appendix F	NA	Provide impact assessment and management recommendations in relation to Ghost Bat habitat.  This memo was revised in December, January and March to provide varying recommendations and expert advice on gaps to be investigated and closed as the LIDAR scanning, geotechnical studies and blast modelling progressed.
LIDAR Scans of Four Caves (Land Surveys 2020)	November 2019	Scan the internal dimensions of caves at Miralga East for use in determining habitat value and assessing impacts the Ghost Bats.  The caves were successfully scanned and accurate three-dimensional models of their interiors developed.
Miralga Creek - Assessment of Potential Mining Activities Impact on the Structural Integrity of the Caves (PSM Consult, 2020) Appendix G	14-16 November 2019	Assess the potential impact of the proposed mining activities at Miralga East on a series of three caves (CMRC-13, -14, -15).
Assessment of Blasting at Miralga Creek Project: Preservation of Ghost Bat Habitats Post Mining Activities (Blast It Global, 2020) Appendix H	NA	Model blast parameters to determine how blasting can be undertaken at Miralga East while maintaining the habitat values of nearby caves, in particular CMRC-15.

The following sections are primarily based on information from the studies and impact assessments listed in Table 6.1; the studies covered the study areas shown in Figure 4.1.

### 6.1.2 Fauna Habitat

Six broad fauna habitat types were identified in the Biologic Study Area. These habitat types are described in Table 6.2 and shown on Figure 6.1 (vertebrates) and Figure 6.2 (invertebrates). Although habitat descriptions are broadly the same between vertebrate and invertebrate habitat types, the mapping differs because of the different way that SRE invertebrates (typically with limited dispersal abilities) interact with their habitat. The most common habitats present in the Study Area are of least significance to SRE and conservation significant vertebrates (Biologic, 2020a; 2020b; 2020c).



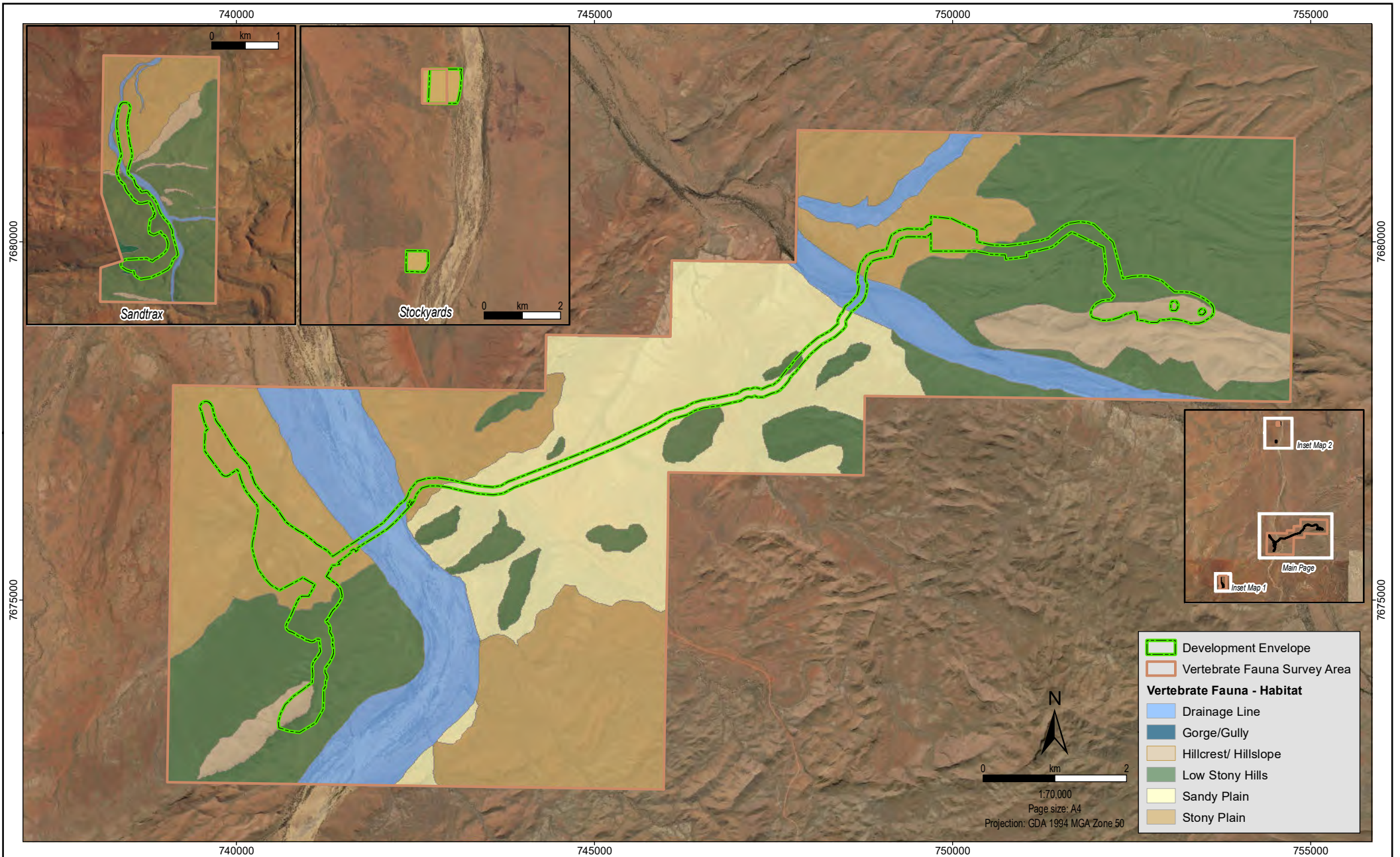



Table 6.2 – Broad Fauna Habitat

Habitat Type	Description	Significance to Vertebrate Fauna and Extent (ha)	Significance to SRE Invertebrate Fauna and Extent (ha)
Low Stony Hills	<p>Low undulating stony hills often dominated by <i>Triodia</i> spp. grassland and/or sparse open shrubland understory with sparsely scattered <i>Corymbia</i> species on gravelly clay loam substrate.</p> <p>Low Stony Hills is broadly distributed across the Pilbara region and is a common habitat throughout the Study Area.</p>	Low 2,586.20	Low 2,213.78
Stony Plain	<p>Stony Plain habitat comprises areas with vegetation dominated by <i>Triodia</i> hummock grasses of various life stages and scattered patches of various small to medium shrub species on gravelly clay loam substrates.</p> <p>This habitat is widespread within the Study Area and more broadly across the Pilbara region.</p>	Low 2,282.43	Low 2,223.98
Sand Plain	<p>Vegetation within Sand Plain habitat is variable, often comprising a mosaic of open <i>Eucalyptus</i> woodland or sparsely scattered individual trees over an understory dominated by small to medium <i>Acacia</i> shrubs and/or <i>Triodia</i> hummock grasses.</p> <p>Sand Plain is regionally common for the Pilbara region and is widespread in parts of the Study Area.</p>	Moderate 1,535.32	Low–moderate 1,640.13
Major Drainage (vertebrate) Drainage Line (invertebrate)	<p>Large permanently or seasonally fed drainage lines with fringing riparian vegetation comprising scattered <i>Eucalyptus</i> species over a patchy understory often dominated by <i>Acacia</i> spp. and small ephemerals grasses and herbs.</p> <p>There are two major drainage lines dissecting parts of the Study Area, the Shaw River and Miralga Creek. These drainage lines are continuous outside of the Study Area and are representative of Major Drainage habitat occurring across the Pilbara.</p>	High 996.28	Moderate 1,000.13



Habitat Type	Description	Significance to Vertebrate Fauna and Extent (ha)	Significance to SRE Invertebrate Fauna and Extent (ha)
Hillcrest/ Hillslope	<p>Hillcrest/Hillslope habitat tends to be more open and structurally simple due to their position in the landscape than other fauna habitats and are dominated by varying species of hummock grasses. A common feature of these habitats is a rocky substrate, often with exposed bedrock, and skeletal red soils. These are usually dominated by open scattered <i>Eucalyptus</i> woodlands, <i>Acacia</i> and <i>Grevillea</i> scrublands and <i>Triodia</i> low hummock grasslands.</p> <p>Hillcrest/ Hillslope habitat is broadly represented across the Pilbara region. This habitat makes up the majority of the elevated areas within the Study Area.</p>	High 429.79	Moderate–high 791.47
Gorge/ Gully	<p>Gorge/ Gully habitat comprises rugged, steep-sided rocky valleys incised into the surrounding landscape forming shallow gullies and gorges. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open (but not as open as Major Drainage Line). Caves and rock waterholes are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred.</p> <p>The Gorge/ Gully habitat is commonly associated within the ranges, and occurs in small areas within the Study Area.</p>	High 4.58	High 11.64



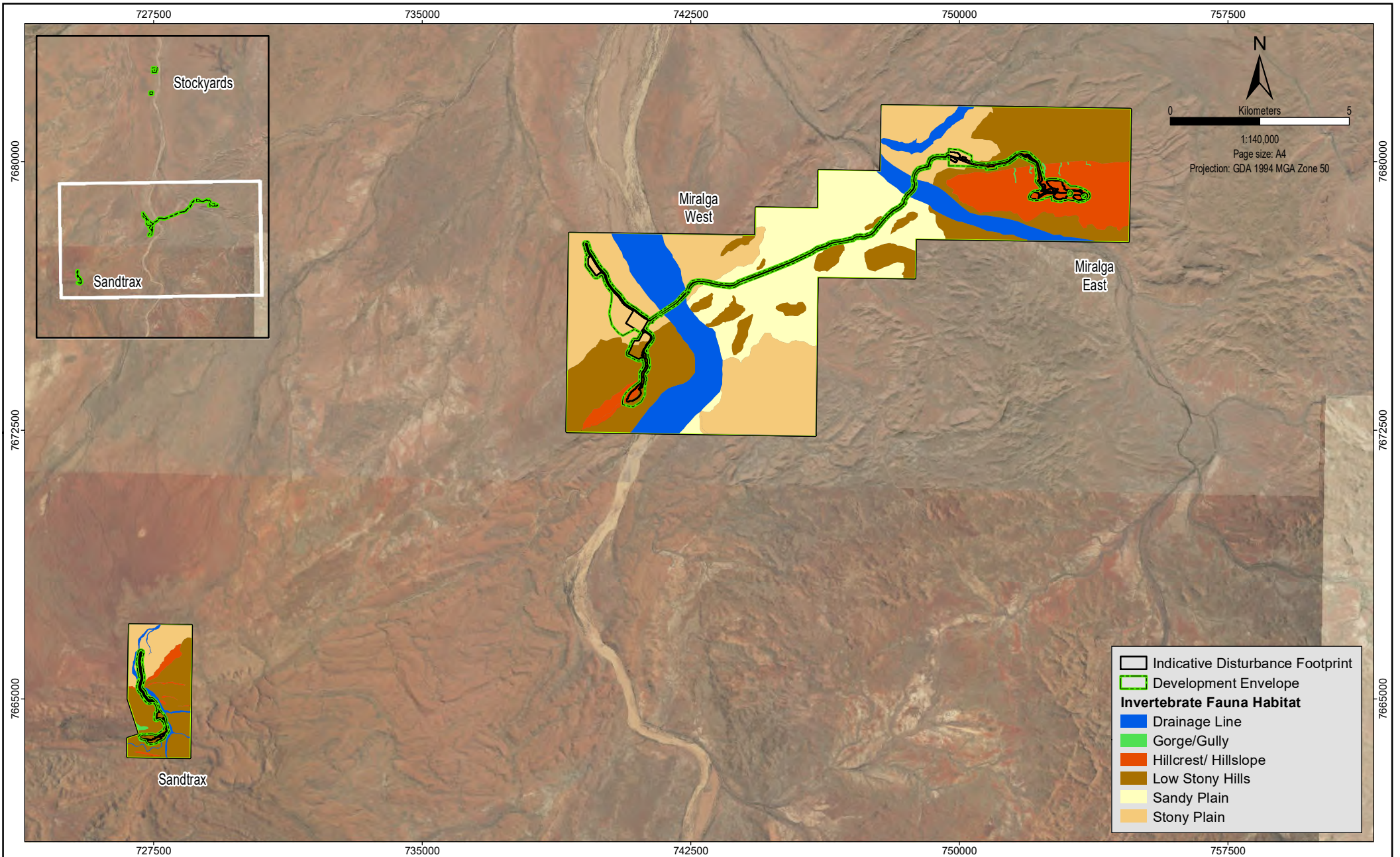

 GIS\_2760\_MIR\_S38\_Fig6\_1\_VertFaunaHab - Copy.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:

**Vertebrate Fauna Habitats**

Figure No:  
**6-1**





File Name: GIS\_2790\_MIR\_S38\_MIR\_InvertebrateFaunaHabitats\_Fig6\_2.mxd

Date: 2/04/2020

Author: Heath.Maconachie

Source & Notes:

## Invertebrate Fauna Habitats

Figure No:

6-2





### 6.1.3 Habitat Features

A number of important microhabitat features are present within the Study Area, including caves and water sources. These features provide important sources of shelter, food and water for species of conservation significance. Many of these features were located within the Rocky Ridge and Gorge/ Gully habitat and were not commonly recorded in other broad habitat types of the Study Area.

#### 6.1.3.1 Caves

Caves can be particularly important features within a landscape, particularly in arid zone systems, often providing stable microclimates, shelter and protection (Medellin, 2017).

Sixteen caves were recorded across the Study Area (Figure 6.3). Usage of these caves by Ghost Bats and Pilbara Leaf-nosed Bats is summarised in Table 6.3.

**Table 6.3 – Caves Recorded in the Study Area**

Cave	Habitat Value and Use of Caves	
	Ghost Bats <sup>1</sup>	Pilbara Leaf-nosed Bat <sup>2</sup>
CMRC-01 <sup>3</sup>	Nocturnal roost	Unknown
CMRC-02	Potential nocturnal roost	Unknown
CMRC-03	Nocturnal roost	Nocturnal refuge
CMRC-04	Nocturnal roost	Nocturnal refuge
CMRC-06	Diurnal roost	Nocturnal refuge
CMRC-07	Diurnal roost	Unknown
CMRC-08	Nocturnal roost	Unknown
CMRC-10	Nocturnal roost	Unknown
CMRC-12	No usage	Unknown
CMRC-13	Nocturnal roost	Unknown
CMRC-14	Diurnal roost	Unknown
CMRC-15	Diurnal roost/ possible maternity roost	Nocturnal refuge
CMRC-16	No usage	Unknown
CMRC-17	No usage	Unknown
CMRC-18	Potential diurnal roost	Unknown
CMRC-19	Night roost	Nil
Unsurveyed cave <sup>4</sup>	Potential diurnal roost	Unknown

(1) Bat Call (2020)

(2) Biologic (2020a)



(3) Note that the location of cave CMRC-01 was incorrectly reported in Biologic (2020a) as being on the edge of pit 3 at Miralga East and was assumed to be at risk of direct impact. Its true location was confirmed in the field by Land Surveys (2019). CMRC-01 is actually located midway between pits 2 and 3 at Miralga East, approximately 100 m from the previously reported location. Its coordinates are 20.97131°S, 119.43425°E and its actual location is shown in Figure 6.3.

(4) Identified by field personnel in a subsequent heritage survey.

The 'unsurveyed cave' referred to in Table 6.3 was identified during a heritage survey outside of the Development Envelope. A number of Ghost Bats were flushed from this cave, however it was not inspected by Biologic during their site work due to earthquake activity in the area (Biologic, 2020a). As it is outside the Development Envelope and not in close proximity to the mining areas it is not considered further in this impact assessment.

Bat Call WA (2020) has classified Ghost Bat caves into four categories (Bat Call WA, 2020) as follows:

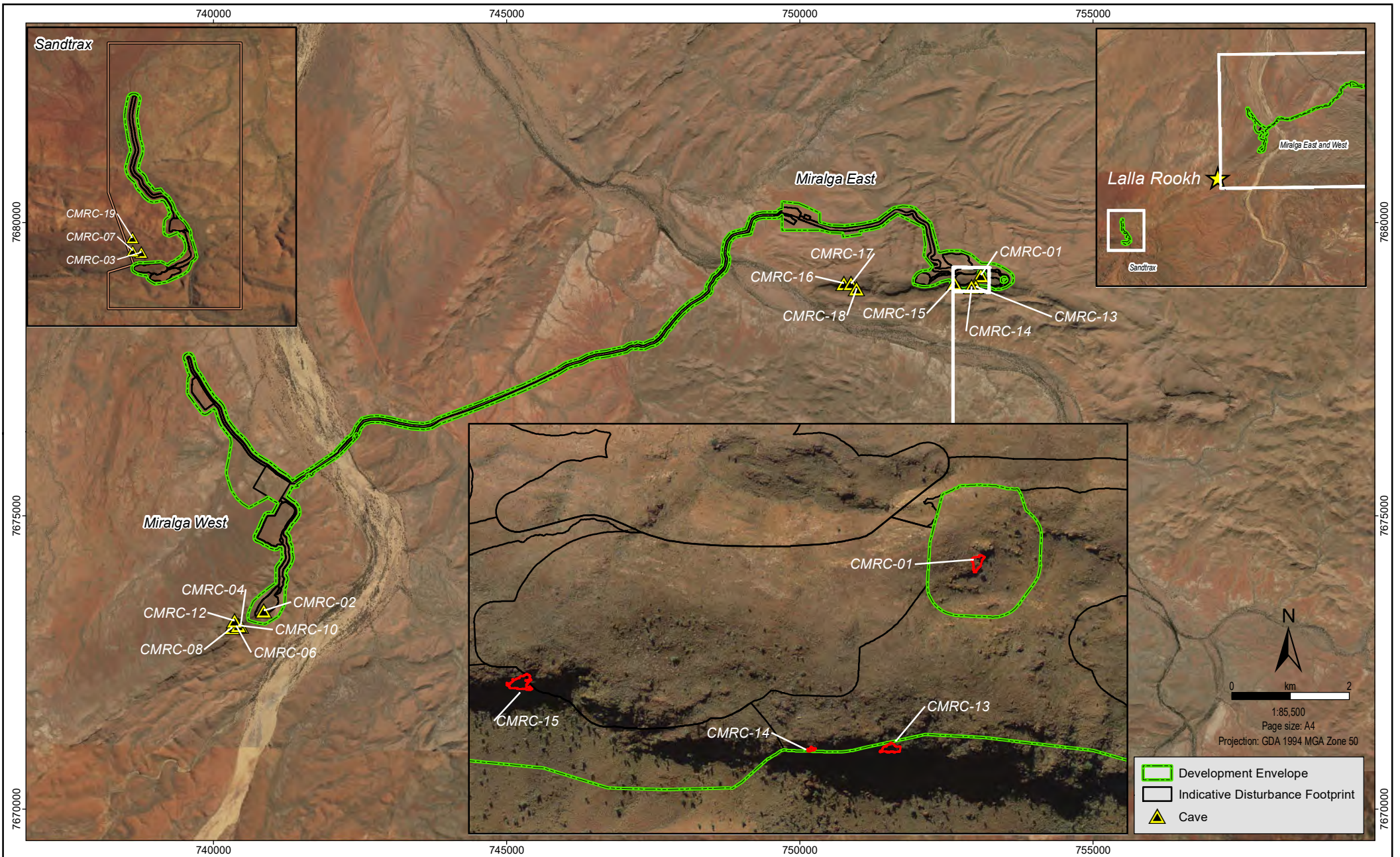
- Category 1 – diurnal roosts with permanent occupancy
- Category 2 – diurnal roosts with regular occupancy
- Category 3 – roosts with occasional occupancy
- Category 4 – nocturnal roosts with opportunistic usage.


Full definitions are provided in Appendix A of Bat Call WA (2020). More details about the classification of Ghost Bat roosts are provided later in the discussion on Ghost Bats (see Section 6.1.5.2). The following discussion relates to the physical features of some of these caves.

A number of caves at Miralga East have internal chambers extending back into the ridge, close to proposed pits. Plate 6.1 shows the conceptual layout of pits and ramps at Miralga East with respect to Ghost Bat roost caves:

- Category 2 roosts:
  - CMRC-15
- Category 3 roosts:
  - CMRC-14
- Category 4 roosts:
  - CMRC-13
  - CMRC-01 (technically an overhang rather than a cave).





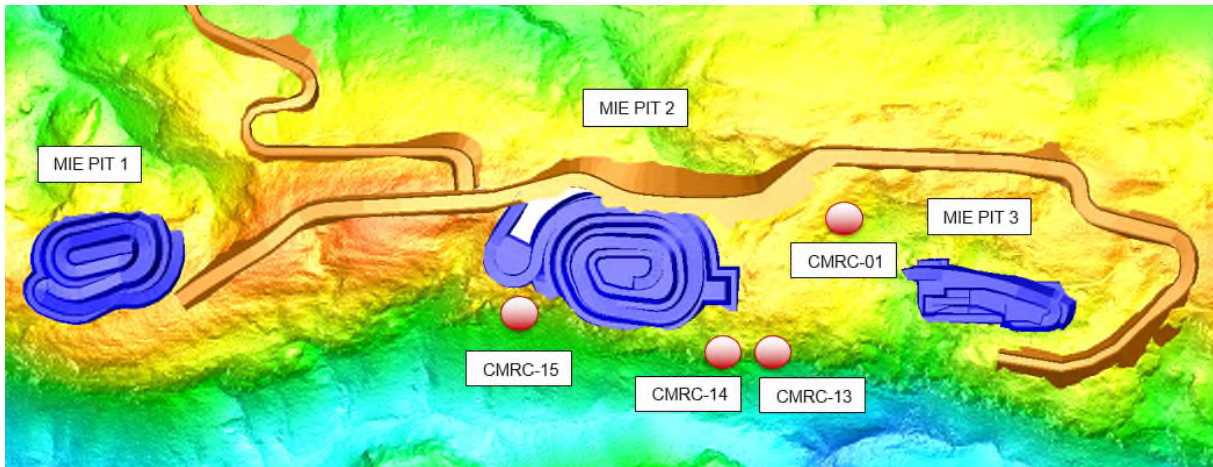

 GIS\_2761\_MIR\_S38\_Fig6\_3\_Caves.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:

**Caves**

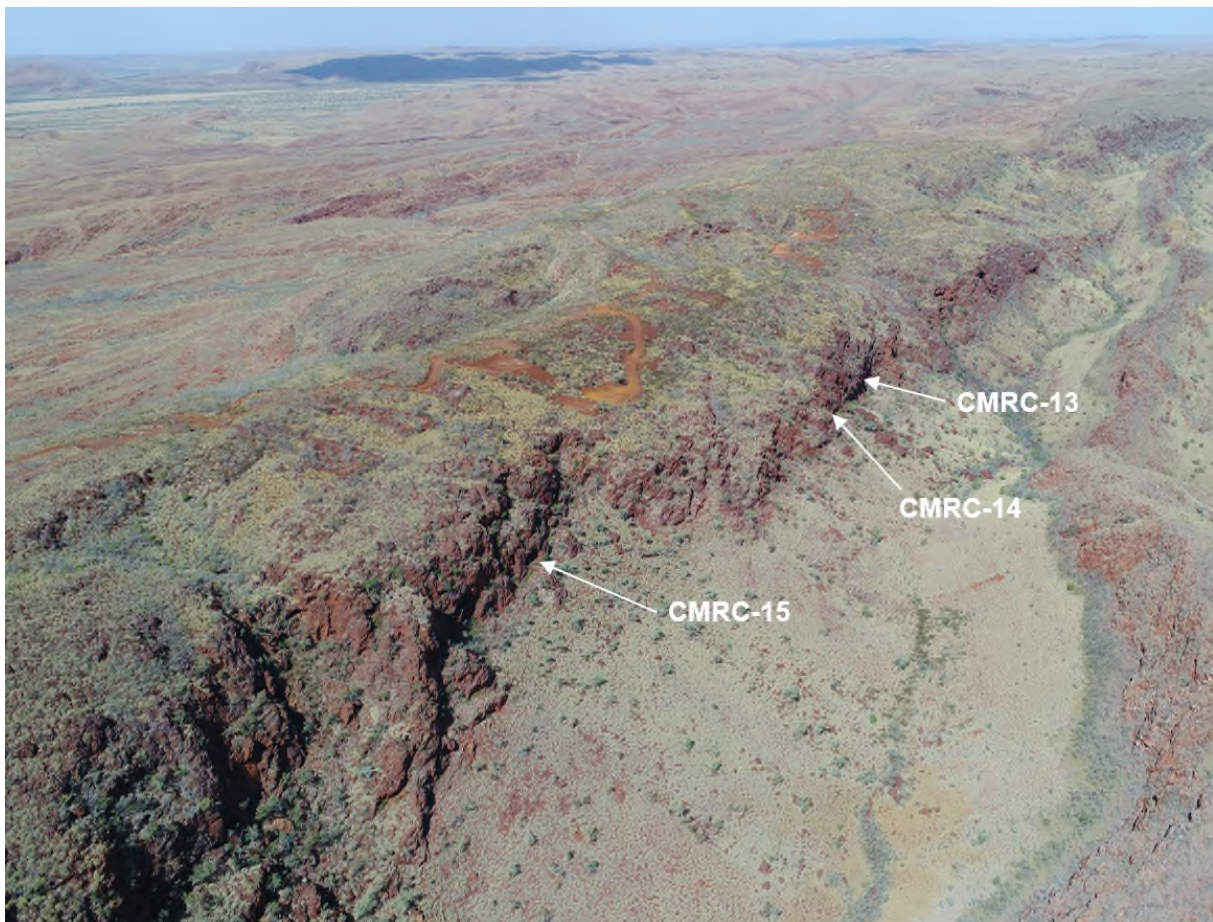
Figure No:  
**6-3**





**Plate 6.1 – Conceptual Layout of Pits, Ramps and Caves at Miralga East**

Plate 6.2 shows an aerial view of the ridge. The locations of three caves of particular interest – caves CMRC-13, -14 and -15 – are indicated along the bottom of the southern side of the ridge.



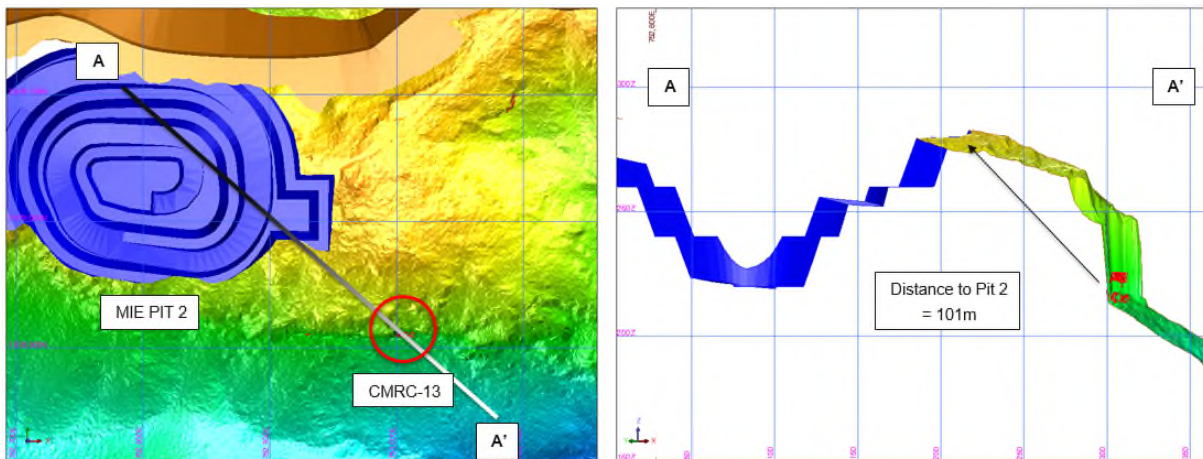
Source: PSM Consult (2019)

**Plate 6.2 – Aerial View Looking East Along the Escarpment Showing Locations of Caves**



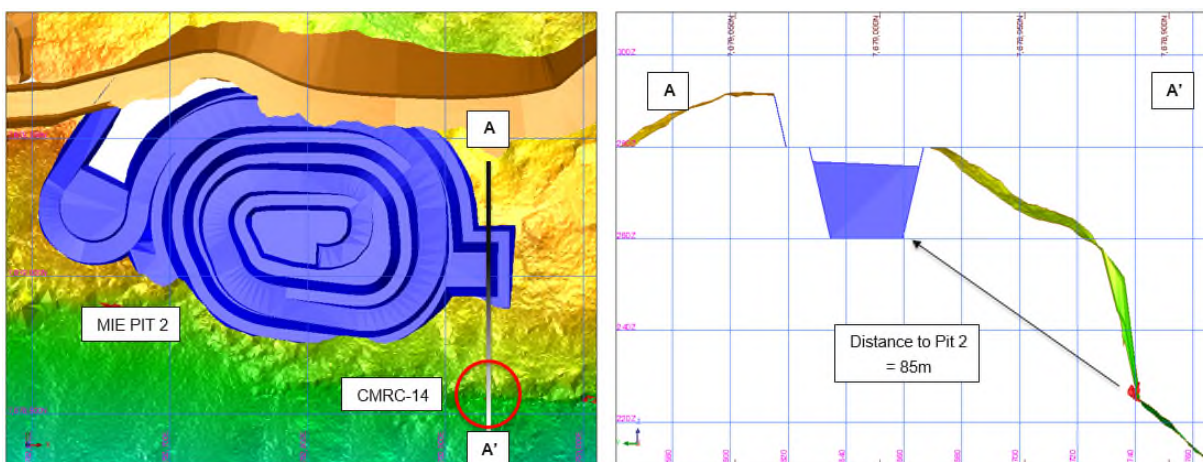
In November 2019, Land Surveys Pty Ltd carried out a LIDAR survey of caves CMRC-01, -13, -14 and -15 (Land Surveys, 2019). The internal dimensions were mapped and a three-dimensional model generated for each cave, accurate to approximately 6 cm. A plan view of the extent of the four mapped caves is shown in Figure 6.3.

Cave CMRC-13 is a category 4 shallow cave located at the bottom of a ridge line on the opposite face of the ridge to Miralga East pit 2 (Plate 6.3). It is approximately 101 m from the edge of pit 2 and approximately level with the base of the pit.



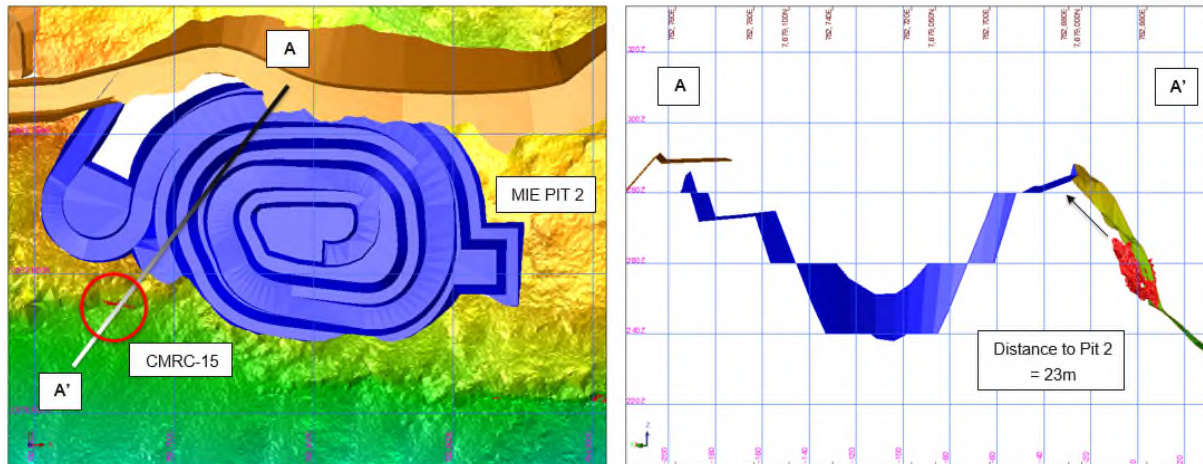
**Plate 6.3 – Cross-section of Cave CMRC-13 (Category 4) and Miralga East Pit 2**

Cave CMRC-14 is a shallow category 3 overhang immediately west of CMRC-13. It is approximately 85 m from the nearest part of the pit shell at Miralga East pit 2 (Plate 6.4).



**Plate 6.4 – Cross-section of Cave CMRC-14 (Category 3) and Miralga East Pit 2**

Cave CMRC-15 is a deep, category 2 cave located southwest of Miralga East pit 2. It is approximately 300 m west of caves CMRC-13 and -14, which are further along the base of the same ridge. The cave extends backwards and upwards into the ridge, its internal chamber measuring approximately 16 m from the entrance to the innermost extremity. The rear of the cave is separated from the closest part of Miralga East pit 2 by 23 m (Plate 6.5).



**Plate 6.5 – Cross-section of Cave CMRC-15 (Category 2) and Miralga East Pit 2**

PSM conducted a geotechnical assessment of caves CMRC-13, -14 and -15 (PSM, 2019; Appendix G), followed by a review of the available geological, geotechnical and cave information to qualitatively assess the potential impact of proposed mining activities (primarily drilling and blasting) on the structural integrity of the three caves. The review concluded that (PSM, 2020):

- Caves CMRC-13 and -14 have a low risk of mine-induced structural instability.
- Cave CMRC-15 has a higher risk of mine-induced structural instability, principally due to the shorter distance to mining activities and the presence of a geological structure (shear zone) at the rear of the cave. While the risk is higher than for caves CMRC-13 and -14, the risk more likely represents the possibility of hanging blocks of rock in the roof or walls falling or collapsing. It is less likely that the cave would collapse (either partially or wholly) or that a new surface entrance would be opened.

As this was a qualitative review, PSM recommended that the effect of blasting be predicted and evaluated to determine a blasting strategy to mitigate any effects on cave CMRC-15. In consultation with Bob Bullen, Atlas Iron commissioned Blast It Global to model blasting impacts which is discussed in more detail in Section 6.3.2.1.

Note that caves are an evolving (albeit over long timescales) feature of the environment. The natural structure of banded iron formations and cherts, being heavily jointed, provide the ideal setting for small localised failures and loose rocks dropping out of the walls and roofs of the caves (Blast It Global, 2020). Evidence of the evolution of caves relevant to the Proposal was observed, particularly at CMRC-15, where naturally accumulated rock debris lie on the floor of the cave. The rock debris are a result of the natural weathering processes (PSM Consultants, 2019; Blast It Global, 2020).

### 6.1.3.2 Water Features

Water sources are a limiting factor for arid-zone ecosystems such as the Pilbara (Burbidge, 2010) (Doughty, 2011); they often represent areas of comparatively high ecological productivity (Murray, 2003). These features are highlighted because they may provide important sources food and water for species of conservation significance.

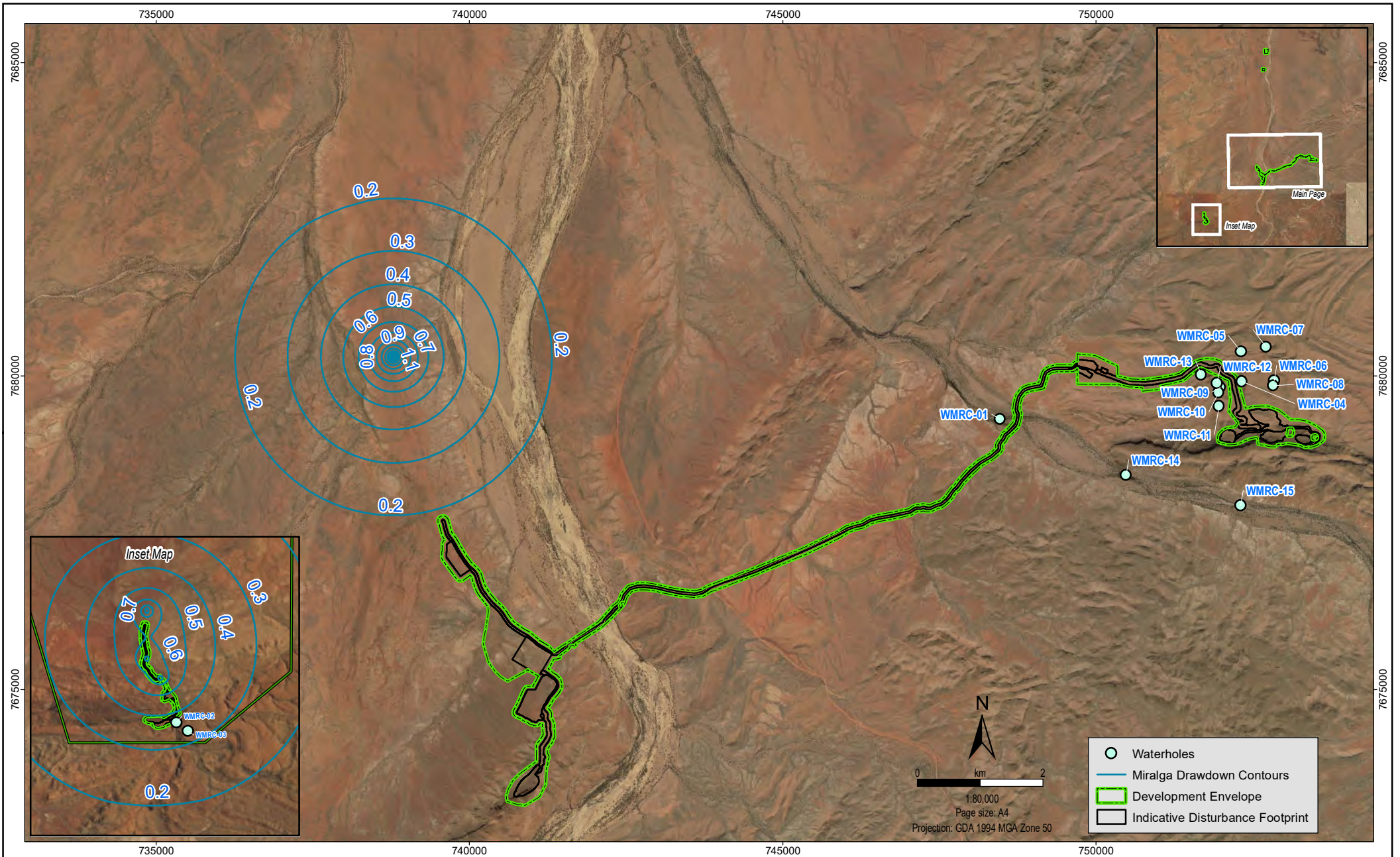
Fifteen natural water features (other than creeks and rivers) were recorded by Biologic during the fauna survey (Figure 6.4), plus a turkey's nest (dam). An additional 17 were mapped




during the GDV field survey. WMRC-02 was investigated in both field surveys (Biologic, 2019). It is important to note that significant rainfall was recorded in March 2019 as a result of Cyclone Veronica (246.2 mm; 324% above the long-term average). This event may have influenced the size of these water features at the time of the first phase of the fauna survey (Biologic, 2020a). Many of the water features were heavily impacted by cattle with algae presence and turbidity high (Biologic, 2019). Biologic (2020a) initially considered four of the natural water features were likely to be semi-permanent to permanent sources of water. However, follow-up site visits observed water to be absent from two of these locations WMRC-01 and -02. Appendix D details observations for each of the waterholes identified during the four field surveys by Biologic and Atlas Iron. The majority of pools have been determined to be non-permanent. WMRC-14 and -15 may be permanent based on site observations to date.

All water sources in the Study Area provide foraging habitat for the Pilbara Leaf-nosed Bat and other fauna (when water is present). Artificial water sources also provide valuable fauna habitat, including a turkey's nest near Sandtrax where Biologic (2019) recorded Pilbara Leaf-nosed Bat and Ghost Bat calls.





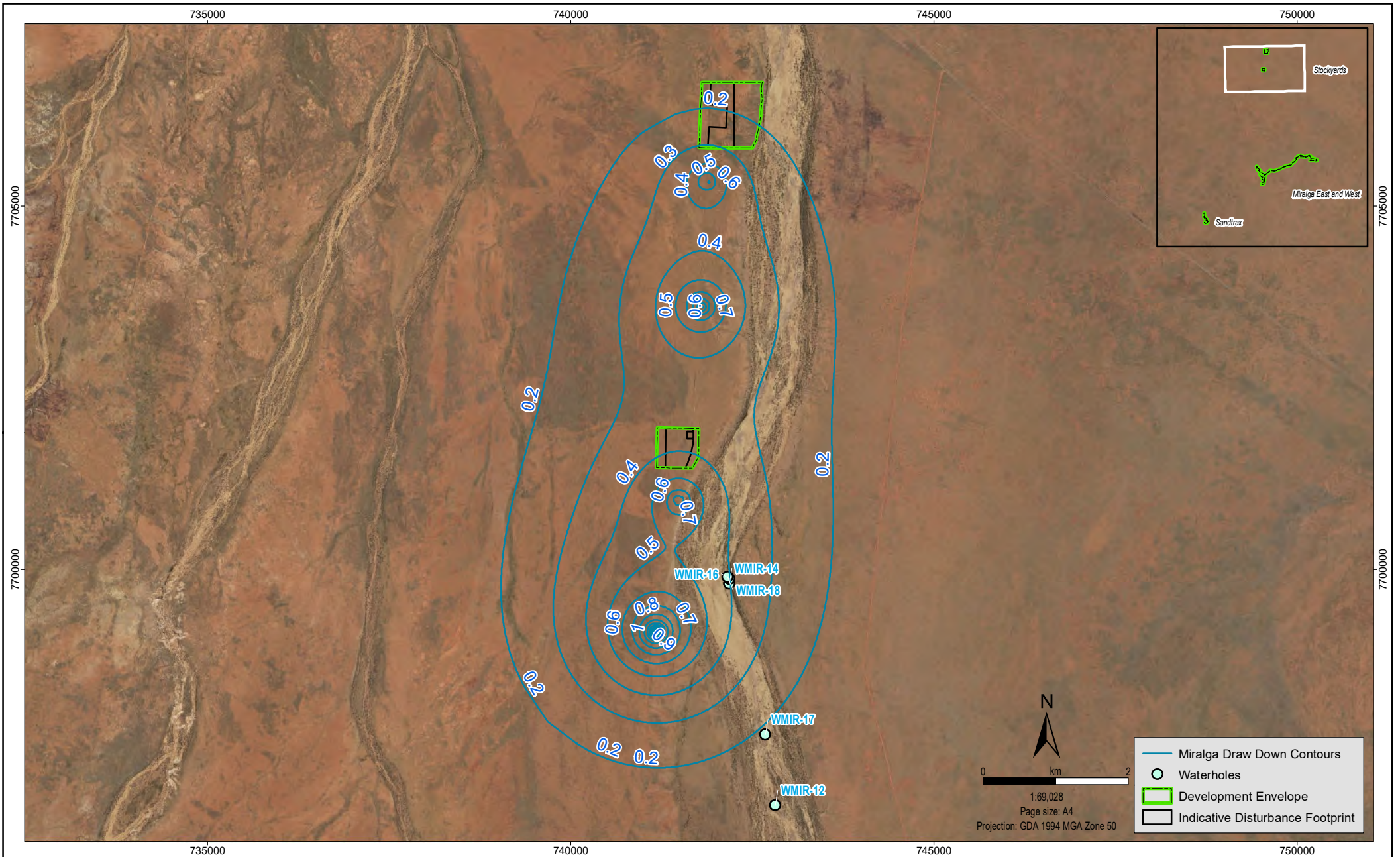

 GIS\_2726\_MIR\_S38\_Fig6\_4A\_Waterholes.mxd  
 Date: 2/04/2020  
 Author: Heath Maconachie


Source & Notes:  
 Disclaimer: Waterholes shown on this figures are a combination of data from the Biologic GDV Study (2020) and Biologic Terrestrial Fauna Study (2020)

**Waterholes**

Figure No:  
**6-4A**






 GIS\_2726\_MIR\_S38\_Fig6\_4B\_Waterholes.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:  
 Disclaimer: Waterholes shown on this figures are a combination of data from the Biologic GDV Study (2020) and Biologic Terrestrial Fauna Study (2020)

**Waterholes**

Figure No:  
**6-4B**

### 6.1.4 Vertebrate Fauna Assemblage

The desktop study and field survey identified that approximately 343 vertebrate species occurred in the study area. A total of 154 vertebrate fauna species comprising 24 native and four introduced mammal species, 84 bird species, 39 reptile species, and three amphibian species were recorded during the survey (Biologic, 2020a). This number of species is comparable with other surveys of equivalent scope and size in the vicinity of the Study Area (Biologic, 2020a). A summary of the vertebrate fauna assemblage recorded within the Study Area is provided in Table 6.4 see Appendix D for further details. No unusual or unexpected species were recorded during the survey; all species had been recorded in the area by at least two previous surveys considered in the literature review.

**Table 6.4 – Native Vertebrate Fauna Assemblage**

Group	Number of Species	Number of Families	Description
Mammals (573 records)	28	12	<p>The most commonly recorded groups were:</p> <ul style="list-style-type: none"> <li>• Bats (244 records)</li> <li>• Rodents (157 records)</li> <li>• Dasyurids (103 records).</li> </ul> <p>The most abundantly recorded species was Common Rock Rat (<i>Zyromys argurus</i>), with 138 records, followed by Northern Quoll with 89 records. This is largely attributed to the targeted sampling (trapping and motion camera trap transects) for Northern Quoll, during which Common Rock Rat was frequently recorded as bycatch.</p> <p>The following conservation significant mammals were recorded within the Study Area during the survey:</p> <ul style="list-style-type: none"> <li>• Northern Quoll (89 records)</li> <li>• Pilbara Leaf-nosed Bat (35 records)</li> <li>• Ghost Bat (11 records)</li> <li>• Western Pebble-mound Mouse (15 records)</li> <li>• Northern Brushtail Possum (2 records).</li> </ul>
Birds (641 records)	84	42	<p>The most commonly recorded families were:</p> <ul style="list-style-type: none"> <li>• Honeyeaters and allies (family Meliphagidae) (97 records)</li> <li>• Crows (family Corvidae) (64 records) of a single species (Torresian Crow, <i>Corvus orru</i>) which was the most commonly recorded species during the survey.</li> <li>• Woodswallows and butcherbirds (family Artamidae) (28 records)</li> <li>• Hawks and eagles (family Accipitridae) (16 records).</li> </ul> <p>Species diversity, abundance and complexity was highly variable throughout the Study Area, particularly due to the variable presence and abundance of vegetation between sites.</p>



Group	Number of Species	Number of Families	Description
			<p>Two conservation significant birds were recorded during the current survey:</p> <ul style="list-style-type: none"> <li>• Grey Falcon: recorded once during the Phase 1 from direct observation of a group of four individuals (two adults and two young) and twice during the Phase 2 survey from direct observation of a single individual.</li> <li>• Peregrine Falcon: recorded once during both Phases of the survey, both from direct observation of a single individual.</li> </ul>
Amphibians (13 records)	3	2	<p>Amphibians were only recorded from two sites (VMRC-05 and VMRC-08) and four opportunistic locations, all of which had water present in varying capacities at the time of the record.</p> <p>The most commonly recorded amphibian during the survey was the Little Red Tree Frog (<i>Litoria rubella</i>), recorded a total of seven times.</p> <p>No frog species of conservation significance were recorded during the survey, nor are any known to occur within the Pilbara bioregion.</p>
Reptiles (117 records)	39	11	<p>The most common groups were:</p> <ul style="list-style-type: none"> <li>• Skinks (55 records)</li> <li>• Agamids (dragon lizards) (16 records)</li> <li>• Varanids (monitor lizards) (8 records with a high diversity of 7 species).</li> </ul> <p>The most commonly recorded species were the Inornate Ctenotus (<i>Ctenotus inornatus</i>), recorded 20 times from seven sites.</p> <p>Species diversity, composition and abundance was variable between sites.</p> <p>Note that three species of gecko, <i>Gehyra macra</i>, <i>Gehyra media</i>, and <i>Gehyra montium</i> were recorded for the first time in the area. This is due to revision of the <i>Gehyra punctata</i> species complex, where <i>G. macra</i> and <i>G. media</i> were previously known as <i>G. punctata</i>. The <i>Gehyra variegata</i> species complex was also revised and resulting in the distribution of <i>G. montium</i> being redefined.</p> <p>No conservation significant reptile species were recorded within the Study Area during the current survey.</p>

### 6.1.5 Conservation Significant Vertebrate Fauna

Conservation significant fauna includes species listed as:

- Threatened or Migratory under the EPBC Act
- Threatened or Specially Protected (includes migratory species) under the *Biodiversity Conservation Act 2016* (BC Act)
- Priority species listed by DBCA.





Seven vertebrate species recorded during the field survey are listed as conservation significant:

- Northern Quoll (89 records from 15 sites)
- Pilbara Leaf-nosed Bat (35 records from 14 sites)
- Western Pebble-mound Mouse (15 records from 15 sites)
- Ghost Bat (11 records from six sites)
- Northern Brushtail Possum (two records from one site)
- Grey Falcon (four records from one site)
- Peregrine Falcon (two records from two sites).

No conservation significant species were identified in the stockyard areas.

Based on regional records and habitats identified within the Study Area, five additional species were considered Likely to occur and 16 were considered Possible to occur. The remaining conservation significant species were considered to occur Rarely, Unlikely or Highly Unlikely. Table 6.5 summarises the 28 conservation significant fauna species that Biologic (2020a) confirmed were present or considered Likely or Possible to occur in the Study Area

Vertebrate species protected as Threatened under the BC Act and/or EPBC Act that were either 'Confirmed' or 'Likely' to be present based on Biologic (2019) are discussed in more detail in Sections 6.1.5.1 to 6.1.5.7.





Table 6.5 – Conservation Significant Fauna in the Study Area

Common Name	Species	EPBC Act <sup>1</sup>	BC Act <sup>2</sup>	DBCAs Lists <sup>3</sup>	Likelihood of Occurrence
Night Parrot	<i>Pezoporus occidentalis</i>	EN	CR	–	Possible
Northern Quoll	<i>Dasyurus hallucatus</i>	EN	EN	–	Confirmed
Pilbara Leaf-nosed Bat	<i>Rhinioncteris aurantius</i> 'Pilbara form'	VU	VU	–	Confirmed
Pilbara Olive Python	<i>Liasis olivaceus barroni</i>	VU	VU	–	Likely
Ghost Bat	<i>Macroderma gigas</i>	VU	VU	–	Confirmed
Greater Bilby	<i>Macrotis lagotis</i>	VU	VU	–	Possible
Grey Falcon	<i>Falco hypoleucos</i>	–	VU	–	Confirmed
Northern Brushtail Possum	<i>Trichosurus vulpecula arnhemensis</i>	–	VU	–	Confirmed
Peregrine Falcon	<i>Falco peregrinus</i>	–	OS	–	Confirmed
Black-tailed Godwit	<i>Limosa limosa</i>	MI	MI	–	Possible
Common Greenshank	<i>Tringa nebularia</i>	MI	MI	–	Possible
Common Sandpiper	<i>Tringa hypoleucos</i>	MI	MI	–	Possible
Fork-tailed Swift	<i>Apus pacificus</i>	MI	MI	–	Possible
Glossy Ibis	<i>Plegadis falcinellus</i>	MI	MI	–	Possible
Marsh Sandpiper	<i>Tringa stagnatilis</i>	MI	MI	–	Possible
Pectoral Sandpiper	<i>Calidris melanotos</i>	MI	MI	–	Possible
Oriental Plover	<i>Charadrius veredus</i>	MI	MI	–	Possible
Osprey	<i>Pandion haliaetus</i>	MI	MI	–	Possible
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	MI	MI	–	Possible
Wood Sandpaper	<i>Tringa glareola</i>	MI	MI	–	Possible
Gane's Blind Snake	<i>Anilius ganei</i>	–	–	P1	Likely
Black-lined Ctenotus	<i>Ctenotus nigrilineatus</i>	–	–	P1	Likely
Spotted Ctenotus	<i>Ctenotus uber johnstonei</i>	–	–	P2	Possible
Brush-tailed Mulgara	<i>Dasyercus blythi</i>	–	–	P4	Likely
Long-tailed Dunnart	<i>Sminthopsis longicaudata</i>	–	–	P4	Possible
Spectacled Hare-wallaby	<i>Lagorchestes conspicillatus leichardti</i>	–	–	P4	Likely
Short-tailed Mouse	<i>Leggadina lakedownensis</i>	–	–	P4	Possible



Common Name	Species	EPBC Act <sup>1</sup>	BC Act <sup>2</sup>	DBCA Lists <sup>3</sup>	Likelihood of Occurrence
Western Pebble-mound Mouse	<i>Pseudomys chapmani</i>	–	–	P4	Confirmed

Source: Biologic 2020a

Conservation status definitions:

- (1) EPBC Act: EN – Endangered, VU – Vulnerable, MIG – Migratory.
- (2) WA (BC Act): CR – Critically Endangered, EN – Endangered, VU – Vulnerable, MI – Migratory species not otherwise listed as threatened, OS – Other specially protected fauna.
- (3) WA (DBCA lists): P1 – Priority 1 (species that are known from one or a few locations (generally five or less) which are potentially at risk), P2 – Priority 2 (species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation), P3 – Priority 3 (species that are known from several locations, and the species does not appear to be under imminent threat, or from few or widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat), P4 – Priority 4 (rare, near threatened and other species in need of monitoring).

### 6.1.5.1 Northern Quoll

The Northern Quoll is listed as Endangered under the EPBC Act and BC Act. Quolls are carnivorous marsupials endemic to Australia and occur in Queensland, Northern Territory and WA. The Northern Quoll has undergone a rapid decline from cumulative effects of inappropriate fire regimes, predation, habitat loss and invasion of its habitat by cane toads (*Rhinella marina*) (Department of the Environment and Energy, 2019).

The species was originally found across northern Australia from the North-West Cape of Western Australia to south-east Queensland; however, its abundance has significantly declined in recent years. This species is now restricted to five regional populations across Queensland, the Northern Territory and Western Australia on both the mainland and offshore islands (Department of the Environment, 2016). Northern Quoll are known to occur within a range of habitats, including ironstone and sandstone ridges, scree slopes, granite boulders and outcrops, drainage lines, riverine habitats dissected rocky escarpments, open forest of lowland savannah and woodland (Biologic, 2019). Rocky habitats tend to support higher densities, as they offer protection from predators and are generally more productive in terms of availability of resources (Biologic, 2020a).

The EPBC Act Referral guideline for the species defines critical habitat for Northern Quoll as habitat within the modelled distribution for the species which provides shelter for breeding, refuge from fire and/or predation by Cane Toad. This includes:

- Rocky habitats such as ranges, escarpments, mesas, gorges, breakaways, boulder fields and major drainage lines or treed creeks
- Structurally diverse woodland or forest areas containing large diameter trees, termite mounds or hollow logs.

Habitat that is considered critical to the survival of this species also includes dispersal and foraging habitat associated with or connecting populations that are important to the long-term survival of the species (Department of the Environment, 2016). As per the referral guidelines, foraging or dispersal habitat is any land that comprises predominantly native vegetation in the immediate area (i.e. within 1 km) of shelter habitat, quoll records or land comprising predominantly native vegetation that is connected to shelter habitat within the range of the species.

Populations that constitute an important population for Northern Quoll include (Department of the Environment, 2016):



- High density quoll populations that occur in refuge-rich habitat that is critical to the survival of the species. This includes habitat where cane toads are present.
- Populations that are free of cane toads and are unlikely to sustain cane toad populations upon their arrival; for example, populations within a desert context and without permanent water, the granite habitats found in Western Australia.
- Populations subject to conservation or research programs – that is, populations that are monitored by government agencies or universities.

In addition to the above, the National Recovery Plan for the Northern Quoll (Hill & Ward, 2010) identifies four categories of important populations, including populations in the Pilbara region as these are outside of the predicted range of cane toads. Since publication of this guidance, predictions for the spread of cane toad have been revised to include the Pilbara within the area of spread (Department of Parks and Wildlife, 2017).

Of the five conservation significant mammal species recorded within the Study Area, Northern Quoll was the most commonly recorded species, with 89 records from 15 sites, including nine opportunistic locations. This number of records is considered to represent a permanent and important population of Northern Quoll (Biologic, 2020b). Evidence of Quolls (including scats and individuals) was identified in Gorge/ Gully, Major Drainage Line, Low Stony Hills, Hillcrest/Hillslope and Sand Plain habitats. The Hillcrest/Hillslope and Gorge/ Gully habitat provides foraging and denning habitat, while the other habitats provide foraging and dispersal habitat.

Records were as follows (Figure 6.5):

- 44 times from trapped individuals (comprising 28 unique individuals),
- 35 times from motion camera captures (comprising 10 or 11 unique individuals) and
- 10 times from secondary evidence (six scats and four tracks).

The species showed a strong association with Hillcrest/ Hillslope and Gully/ Gorge habitats, where available of suitable denning and/or foraging habitat is higher, with the majority of records occurring within these habitats. Northern Quoll are likely to occur throughout the Study Area, particularly within Gorge/ Gully and Hillcrest/ Hillslope habitats where suitable denning/shelter and/or foraging habitat is present. These two habitats form part of the core habitats critical to the survival of Northern Quoll (Department of the Environment, 2016).

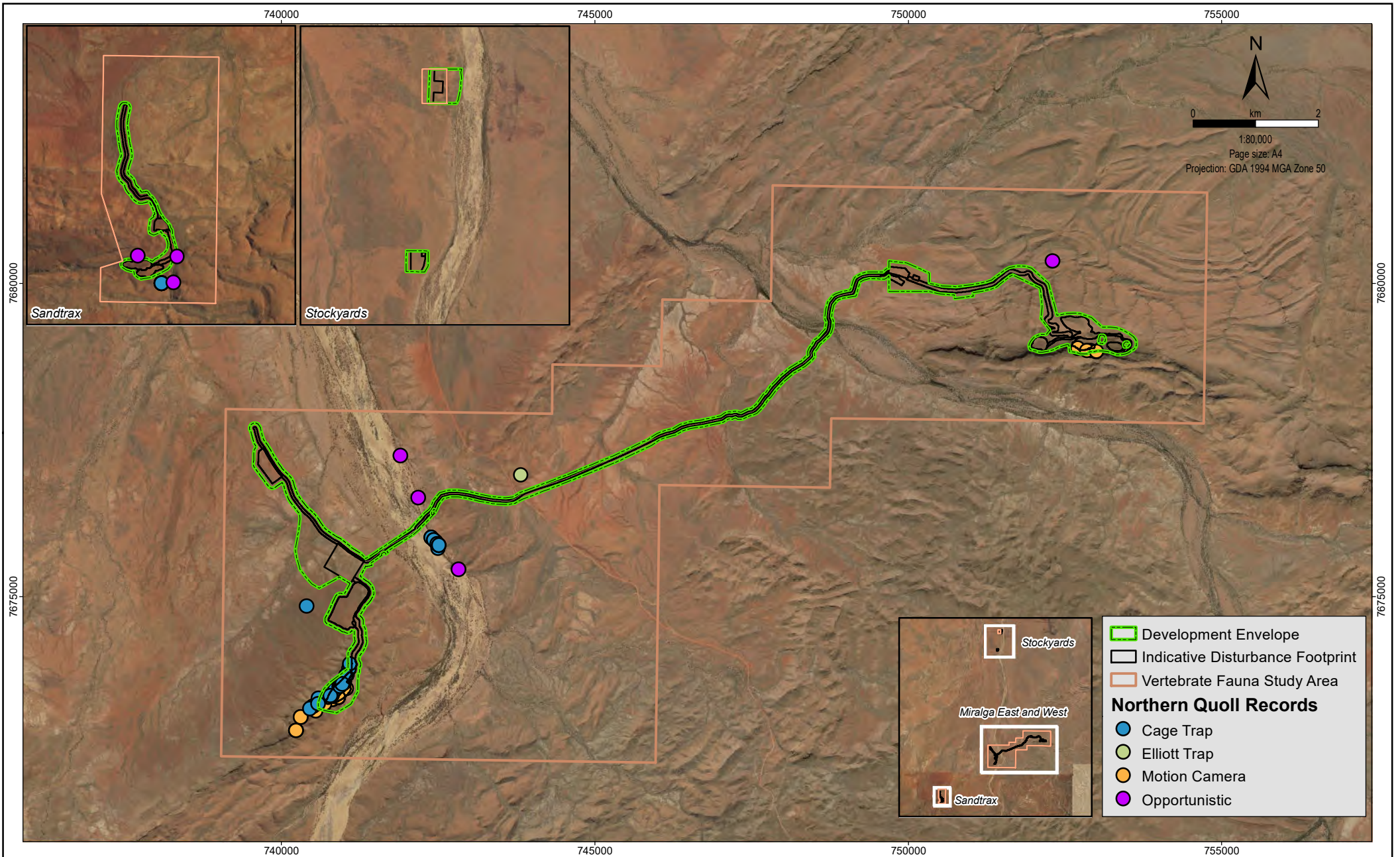
Table 6.6 provides a summary of the species' occurrence in the area and the significance of broad fauna habitats for the species.



Table 6.6 – Summary of Northern Quoll Occurrence and Habitat in Study Area

Site	Habitat	Habitat Significance	Total Captures	No. of Unique Individuals			
				Male	Female	Indet.	Total
VMRC-02	Low Stony Hills	Dispersal (infrequent use of this habitat). Two young males captured - indicative of dispersing individuals, timing of their capture coincides with the early stages of the breeding season for the species, when males are most active and mobile.	1	1	–	–	1
VMRC-04	Sand Plain		1	1	–	–	1
VMRC-99	Hillcrest/ Hillslope	Denning/shelter and foraging. High number of females captured highlights the high value of denning /shelter habitat for breeding females.	25	7	11	–	18
VMRC-110	Major Drainage	Foraging/ dispersing. Individuals possibly moving between areas providing more suitable denning/shelter habitat.	10	2	2	1	5
VMRC-116	Major Drainage		–	–	–	–	0
VMRC-117	Hillcrest/ Hillslope	Denning/shelter and foraging.	–	–	–	–	0
VABY-12 (Abydos monitoring site L)	Gorge/ Gully	Denning/shelter and foraging.	7	1	2	–	3
<b>Total</b>			<b>44</b>	<b>12</b>	<b>15</b>	<b>1</b>	<b>28</b>







### 6.1.5.2 Ghost Bat

The Ghost Bat is listed as Vulnerable under the EPBC Act and BC Act. As reported in Biologic (2020a), Ghost Bats roost in deep, complex caves beneath bluffs of low, rounded hills, granite rock piles and abandoned mines. These features often occur within habitats including Gorge/Gully, Hillcrest/Hillslope and Low Hills.

Ghost Bats are known to require a number of suitable caves throughout their home ranges, due to both temporal factors (i.e. night/feeding roosts for feeding throughout the duration of the night, as well as day roosts for resting) and seasonal factors (use of certain caves as maternity roosts, depending on the right environmental conditions). The presence of day roosts and/or maternity roosts in an area is the most important indicator of suitable habitat for Ghost Bats, and these caves are generally the primary focus of conservation and/or monitoring (Threatened Species Scientific Committee, 2016).

Foraging habitat includes gullies and gorges with vertical vegetation complexity, presence of water including riparian drainage lines that are within a 5 to 10 km radius of roosts. Ghost Bats generally return to the same foraging areas each night. Information on the home ranges of Ghost Bats is limited; however, one report indicates a mean foraging area of 61 ha, centred on average approximately 1.9 km from daytime roosts (Threatened Species Scientific Committee, 2016), with the flight capability to travel up to 25 km in a single night (Bat Call WA, 2020).

Ghost Bats require a number of caves seasonally. They disperse when not breeding, but concentrate in a smaller number of roost sites during the breeding season. Few confirmed breeding sites are currently known. Persistence in the Pilbara is recognised as being dependent upon the presence of day (diurnal) roosts in humid, temperature-stable caves (Threatened Species Scientific Committee, 2016).

In the first stage of assessing the potential for impacts to the Ghost Bat, Atlas Iron commissioned Biologic (2020a) to conduct baseline survey work, and sought additional specific advice from Bat Call WA, commencing in November 2019. This advice has been updated as additional studies and modelling was completed, and culminates in Bat Call WA (2020).

Biologic (2020a) recorded the Ghost Bat across four habitats types in the Study Area:

- Major Drainage
- Hillcrest/ Hillslope
- Gorge/ Gully
- Stony Plain.

They are likely to occur in all six broad habitats in the Study Area as follows (Biologic, 2020a):

- Low Stony Hills – foraging
- Stony Plain – foraging
- Sand Plain – primary foraging
- Major Drainage – foraging / dispersal
- Hillcrest/ Hillslope – foraging / roosting





- Gorge/ Gully – foraging / roosting.

The species was recorded five times from direct observation (individuals observed at night and within or flushed from caves), ten times from ultrasonic call recordings and ten times from secondary evidence (scats). These observations were made at caves and standardised trapping sites (Biologic, 2020a).

Sixteen caves have been recorded in the Study Area, ten of which contained evidence of use by Ghost Bats. Thirteen caves are confirmed or potential roost caves for Ghost Bat. Table 6.7 provides more details on each cave, specific to Ghost Bat use. Bat Call WA (2020) determined there are four groups of caves important for the persistence of the Ghost Bat in the local area, including the Miralga East grouping containing caves CMRC-15 (a category 2 potential maternity roost), CMRC-13 (category 4) and CMRC-14 (category 3).

Timing of calls from most sites were consistent with bats originating from Lalla Rookh (Biologic, 2020a). Lalla Rookh is a permanent bat roost which lies outside of the Development Envelope, approximately 700 m south of the existing ALRE, which runs between Sandtrax and Miralga West. From Lalla Rookh, Sandtrax is approximately 9 km southwest, Miralga West 3 km northeast and Miralga East 19 km northeast.

Ghost Bat breeding populations inhabit a small number of maternity roosts across the Pilbara, with category 1 abandoned mine shafts comprising the largest of these populations (Bat Call WA, 2020). Numbers vary between roosts and over time, ranging from several hundreds to the low thousands (Bat Call WA, 2020). The population of Ghost Bat at the caves nearby the Proposed Action is likely to be an important population of at least 200 individuals that is based at the Lalla Rookh breeding site (Bat Call WA, 2020).

Atlas Iron commissioned the following additional studies to further investigate the potential for impacts to this species:

- Internal LIDAR mapping of CMRC -13, -14 and -15 by Land Surveys.
- Geotechnical assessment (including site visit) of caves CMRC-13, -14 and -15 by Pells Sullivan Meynink (PSM) (PSM, 2019), followed by an assessment of potential mining activities on the structural integrity of those caves (PSM, 2020).
- Assessment of blasting impacts and determination of appropriate blasting parameters to preserve Ghost Bat caves following mining activities (Blast It Global, 2020), which is discussed in more detail in Section 6.3.2.1 in relation to modelled vibration limits.

Throughout the baseline investigation and impact assessment process, Atlas has engaged closely with Bob Bullen, culminating in an overall assessment of impacts to the Ghost Bat (Bat Call WA, 2020), discussed in more detail in Sections 6.4 and 6.5 in relation to management and the anticipated outcome.



Table 6.7 – Ghost Bat Caves Recorded in the Study Area

Cave	Habitat Value To and Use By Ghost Bat	Category <sup>1</sup>				Distance to Nearest Proposed Pit <sup>2</sup>
		1	2	3	4	
<b>Sandtrax</b>						
CMRC-03	Nocturnal roost			✓		185 m
CMRC-07	Diurnal roost			✓		225 m
CMRC-19	Night roost				✓	385 m
<b>Miralga West</b>						
CMRC-02	Potential nocturnal roost				✓	Within pit
CMRC-04	Nocturnal roost				✓	340 m
CMRC-06	Diurnal roost		✓			400 m
CMRC-08	Nocturnal roost			✓		470 m
CMRC-10	Nocturnal roost			✓		450 m
CMRC-12	No usage				✓	340 m
<b>Miralga East (near pits 2 and 3)</b>						
CMRC-01	Nocturnal roost				✓	50 m <sup>3</sup>
CMRC-13	Nocturnal roost				✓	95 m
CMRC-14	Diurnal roost			✓		117 m
CMRC-15	Diurnal roost / possible maternity roost		✓			55 m
<b>Miralga East (west of pits)</b>						
CMRC-16	No usage				✓	~1,000 m
CMRC-17	No usage				✓	~1,000 m
CMRC-18	Potential diurnal roost			✓		~1,000 m

Sources: Biologic (2020a), Bat Call WA (2020).

(1) Cave category definitions (full definitions in Appendix A of Bat Call WA (2020)):

Category 1 – diurnal roosts with permanent occupancy

Category 2 – diurnal roosts with regular occupancy

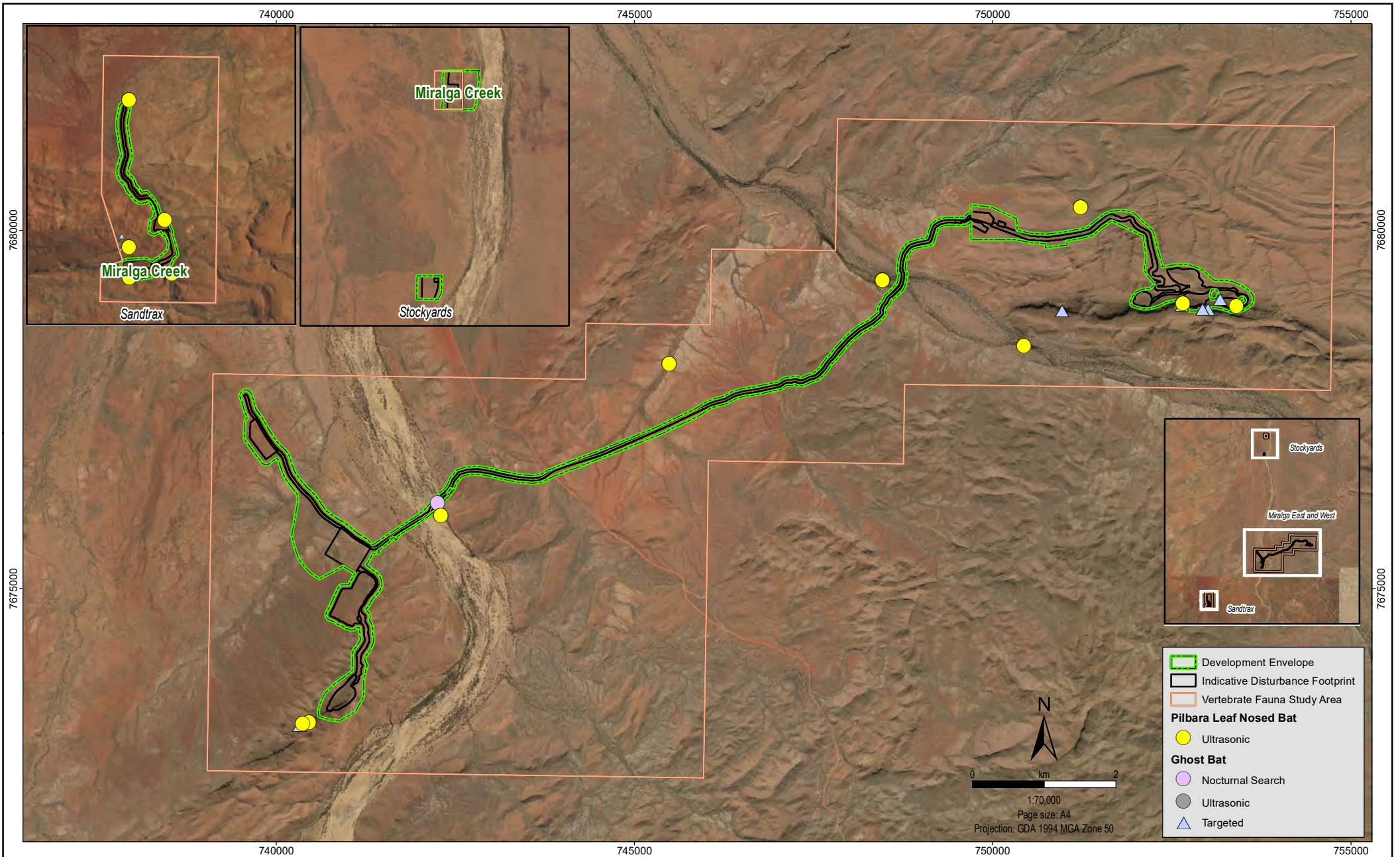
Category 3 – roosts with occasional occupancy


Category 4 – nocturnal roosts with opportunistic usage

(2) Distance is measured from nearest edge of proposed pit disturbance to the cave entrance.

(3) Cave CMRC-01 was previously incorrectly reported as being on the edge of pit 3 at Miralga East. It is actually located midway between pits 2 and 3, approximately 50 m from pit 2 and 100 m from pit 3. See also Section 6.1.3.1.






 GIS\_2763\_MIR\_S38\_Fig6\_6\_GhostBat.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:

## Pilbara Leaf Nosed Bat and Ghost Bat Records

Figure No:  
**6-6**



### **6.1.5.3 Pilbara Leaf Nosed Bat**

The Pilbara Leaf-nosed Bat is listed as Vulnerable under the EPBC Act and BC Act. Pilbara Leaf-nosed Bat roost in undisturbed caves, deep fissures or abandoned mine shafts. The Pilbara Leaf-nosed Bat's limited ability to conserve heat and water means it requires warm (28–32°C) and very humid (85–100%) roost sites in caves and/or mine shafts, as these enable individuals to persist in arid climates by limiting water loss and energy expenditure (Biologic, 2020a). Such caves are relatively uncommon in the Pilbara, which limits the availability of diurnal roosts for this species, and these caves are therefore considered critical habitat (Threatened Species Scientific Committee, 2016).

Foraging habitat is diverse and includes gorges, gullies, water courses, riparian vegetation, hummock grassland and sparse tree and shrub savannah (Department of the Environment and Energy, 2019). Typically, Pilbara Leaf-nosed Bat emerge at dusk from their roosting sites to forage up to 10 km from their roosts.

During the dry season (approximately March to August), Pilbara Leaf-nosed Bat aggregate in colonies within caves that provide a suitably warm, humid microclimate. The species disperses from these main colonies during the wet season (approximately September to February) when suitably humid caves are more widely available (Threatened Species Scientific Committee, 2016).

The population of Pilbara Leaf-nosed Bat in the Pilbara and upper Gascoyne is identified as an important population. It comprises one isolated interbreeding population of national significance, which shows evidence of genetic divergence (Threatened Species Scientific Committee, 2016). The following roosts are defined as critical habitat for the survival of the species (Threatened Species Scientific Committee, 2016):

- Priority 1: Permanent diurnal roosts – occupied year-round and likely utilised for the nine-month breeding cycle
- Priority 2: Non-permanent breeding roosts – used during some part of the breeding cycle, but not occupied year round
- Priority 3: Transitory diurnal roosts – occupied for part of the year, outside of the breeding season and could facilitate long distance dispersal in the region.

Nocturnal refuges (Priority 4) are occupied at night for resting, feeding or other purposes and are not considered critical habitat, but are important for persistence in a local area.

The type and quality of potential foraging habitat surrounding known or suspected roost sites can be critical to the survival of the Pilbara Leaf-nosed Bat. Foraging habitats used by the Pilbara Leaf-nosed Bat are categorised by the Threatened Species Scientific Committee under the EPBC Act:

- Priority 1: Gorges with waterholes
- Priority 2: Gullies
- Priority 3: Rocky outcrop
- Priority 4: Major watercourses
- Priority 5: Open grassland and woodland.





Pilbara Leaf-nosed Bat were recorded a total of 35 times from 14 sites within the Study Area (Biologic, 2020a) (Figure 6.6). All records of the species were identified from ultrasonic call recorders. The species was recorded within all broad fauna habitats mapped within the Study Area. Call recordings suggest the species forages widely throughout the Study Area and is likely to forage nightly within the Study Area (Biologic, 2020a).

The number of Pilbara Leaf-nosed Bat calls at each record site ranged between two and 1,160 calls, with the greatest number of calls recorded at VMRC-106 (located near cave CMRC-15), within the Hillcrest/Hillslope habitat. VMRC-11 (adjacent to an artificial water source) had the second most recorded calls at 416. All other sites recorded less than 100 calls.

No evidence of diurnal roosting by the Pilbara Leaf-nosed Bat was observed within the caves in the Study Area or indicated by ultrasonic call recordings (Biologic, 2020a).

Based on the analysis of call recording data, timing of all the calls are consistent with bats originating from the Lalla Rookh roost located approximately 6 km southwest of Miralga West and 10 km northeast of the Sandtrax deposit (Biologic, 2020a) (Figure 6.6). Data and current survey effort suggest that none of the caves recorded within the Study Area is likely to represent a roosting cave for Pilbara Leaf-nosed Bat. Calls recorded near caves CMRC-15, -04, -11, -03, -07 and -19 are likely to be classed as nocturnal refuges, which are not considered critical habitat for Pilbara Leaf-nosed Bat but are important for their persistence in the local area (Threatened Species Scientific Committee, 2016). Additionally, all broad fauna habitats within the Study Area are likely to provide foraging habitat for the Pilbara Leaf-nosed Bat. This can be summarised as follows:

- Gorge/ Gully – nocturnal refuge and primary foraging habitat
- Hillcrest/ Hillslope – nocturnal refuge and primary foraging habitat
- Major Drainage Line – primary foraging habitat
- Sand Plain – foraging habitat
- Stony Plain – foraging habitat
- Low Stony Plains – foraging habitat.

#### **6.1.5.4 Pilbara Olive Python**

The Pilbara Olive Python is listed as Vulnerable under the EPBC Act and BC Act. The Pilbara subspecies of the Olive Python is endemic to Western Australia and is known only from ranges within the Pilbara region. This species is often associated with drainage systems, including areas with localised drainage and watercourses. In the inland Pilbara, the species is most often encountered near permanent waterholes in rocky ranges or among riverine vegetation (Department of the Environment, Water, Heritage and the Arts, 2008).

Primary threats to the Pilbara Olive Python include predation by feral cats (*Felis catus*) and foxes (*Vulpes vulpes*), particularly of juveniles the predation of food sources (quolls and rock-wallabies) by foxes; and destruction of habitat due to gas and mining development (Department of the Environment, Water, Heritage and the Arts, 2008).

No evidence of Pilbara Olive Python was recorded within the Biologic Study Area during the survey. However, the species is considered likely to occur due to presence of habitats known to support the species in Gorge/Gully, Hillcrest/Hillslope and Major Drainage habitats



mapped within the Study Area and the species' scattered but widespread distribution within the Pilbara region (Biologic, 2020a).

Within the Study Area, the species is likely to occur as a resident, but may also disperse into and from the area via dispersal corridors. Occurrence is likely to be associated with waterbodies, particularly permanent or long-standing waterbodies such as spring-fed systems which occur within Gorge/Gully and Major Drainage habitats. The species may also utilise these habitats as dispersal corridors to other areas within and outside of the Study Area (Biologic, 2020a). The species has previously been recorded multiple times within approximately 11 km southwest of the Study Area (Biologic, 2020a).

#### **6.1.5.5 Grey Falcon**

The Grey Falcon is listed as Vulnerable under the State *Biodiversity Conservation Act 1986* and is not considered to be MNES under the EPBC Act. Its preferred habitat is timbered lowlands, particularly *Acacia* shrublands and along inland drainage systems. It also frequents spinifex and tussock grassland (Burbidge, 2010; Olsen, 1986).

Grey Falcon were recorded three times during the survey, once from direct observation of a group of four individuals (two adults and two young) during the Phase 1 survey and twice during the Phase 2 survey, both times from direct observation of a single individual (Biologic, 2020a) (Figure 6.8).

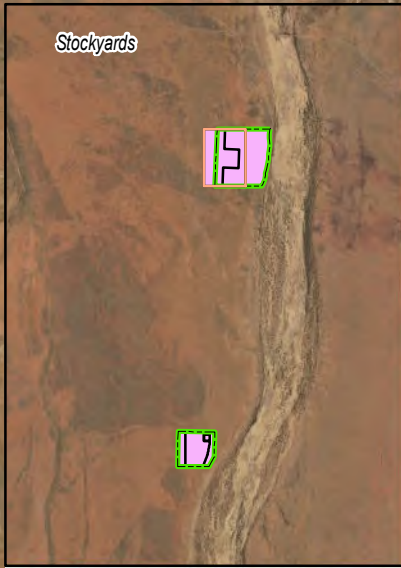
Within the Study Area, all records of Grey Falcon were recorded within or in close proximity to Major Drainage habitat. It is possible the species is nesting within the Study Area within this habitat, particularly where riparian vegetation comprises large tall trees providing suitable nesting opportunities and vantage points for the species (Biologic, 2020a).

The species is likely to occur as a resident within or within a broader area encompassing the Study Area, with nesting potentially occurring within the continuous Major Drainage habitat occurring within the Study Area. Due to the large foraging range of the species, the species is likely to occur within the Study Area to forage, particularly within Sand Plain, Stony Plain and Major Drainage habitats.



725000

750000



0 km 5

Scale 1:178,633

Page size: A4

Projection: GDA 1994 MGA Zone 50

770000

770000

7675000

7675000

-  Indicative Disturbance Footprint
-  Development Envelope
- Pilbara Olive Python Habitat Type**
-  Core
-  Dispersal/Foraging
-  Supporting
-  Vertebrate Fauna Study Area

725000

750000



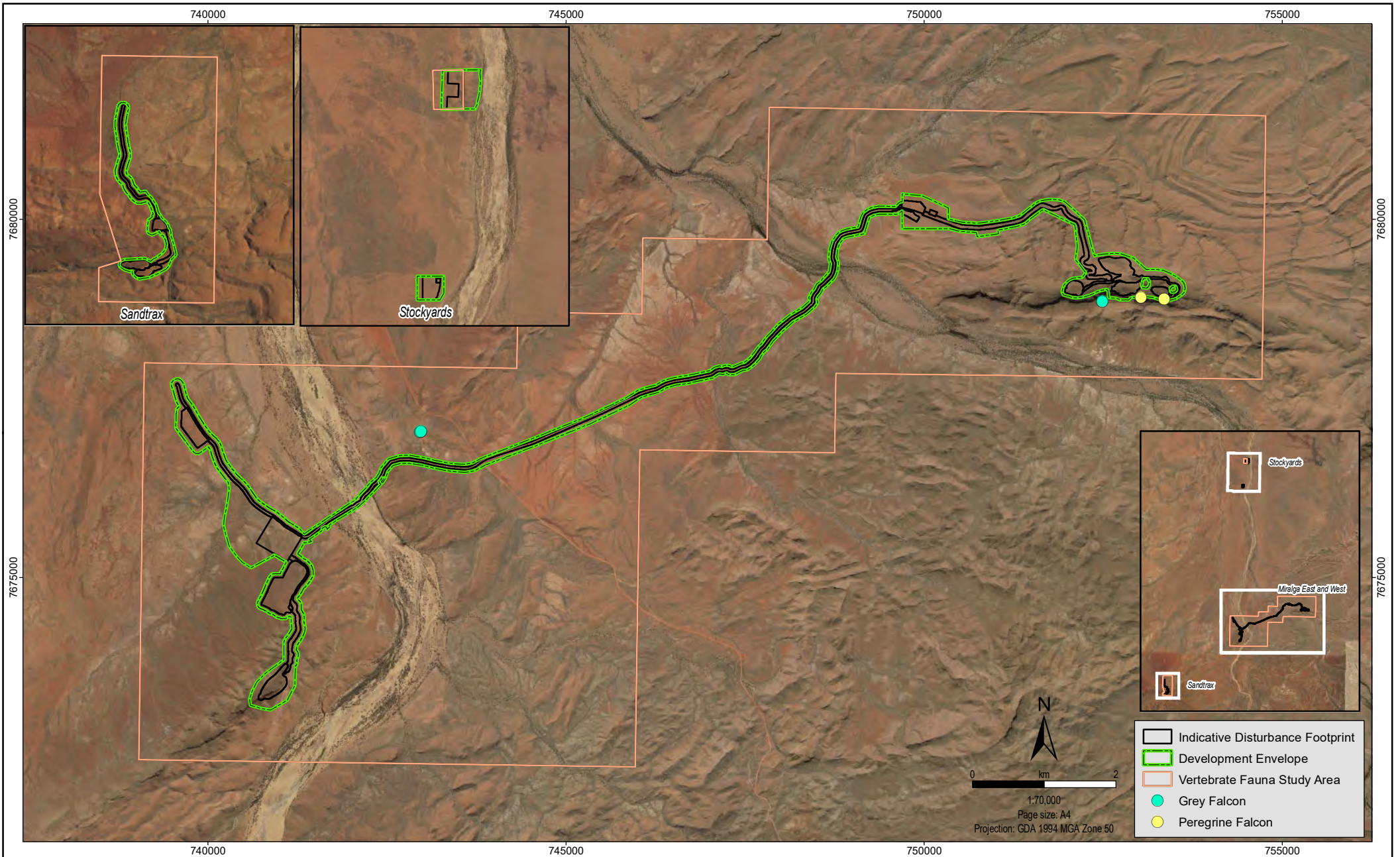
File Name: GIS\_2773\_MIR\_S38\_Fig6\_7\_PilbaraOlivePython.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie


Source & Notes:

### Pilbara Olive Python

Figure No:  
**6-7**






 GIS\_2764\_MIR\_S38\_Fig6\_8\_Grey and PeregrineFalcon.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:

## Peregrine Falcon and Grey Falcon Records

Figure No:  
**6-8**



#### **6.1.5.6 Peregrine Falcon**

The Peregrine Falcon is listed as Other Specially Protected Fauna under the State *Biodiversity Conservation Act 1986* and is not considered to be MNES under the EPBC Act. In arid areas, it is most often encountered along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25 m and 50 m high (Olsen P. D., 1989) (J. Olsen, 2004).

The Peregrine Falcon was recorded once during both phases of the field survey (Biologic, 2020a), both times as a direct observation of a single individual (Figure 6.8).

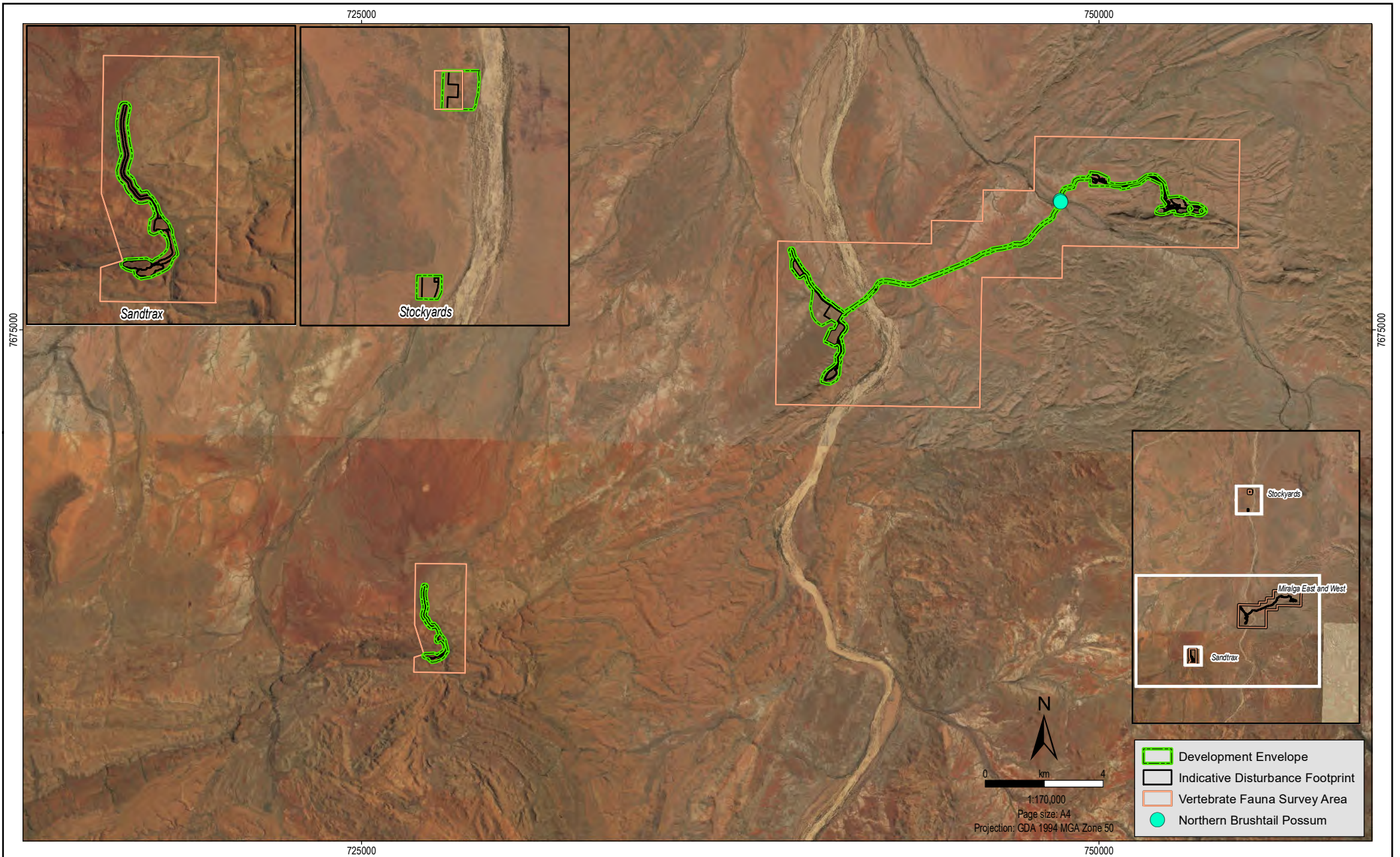
Within the Study Area, cliff areas within the fauna habitat type Hillcrest/ Hillslope may provide potential breeding areas; the habitat types Sand Plain, Major Drainage and Stony Plain provide foraging habitat (Biologic, 2020a).

#### **6.1.5.7 Northern Brushtail Possum**

The Northern Brushtail Possum is listed as Vulnerable under the State *Biodiversity Conservation Act 2016* but is not considered to be MNES under the EPBC Act. Within the Pilbara region the species generally exhibits flexibility in its habitat preferences and occupy an array of habitat types provided enough tree hollows and ground refuges (such as hollow logs, rockpiles and the burrows of other animals) are available (Kerle, 1992). It is largely known from gorges and major drainage lines with Eucalypt woodland (Department of Biodiversity, Conservation and Attractions, undated) (van Dyck, 2008). However, within the Pilbara region, the species is sparsely distributed and often only encountered in low abundance (Department of Biodiversity, Conservation and Attractions, 2019). The nearest record of the species to the Study Area is located approximately 80 km southwest (Department of Biodiversity, Conservation and Attractions, 2019).

A single adult female was recorded twice in cage traps at VMRC-116 along Miralga Creek, near waterhole WMRC-01 (Biologic, 2020a) (Figure 6.9). The individual was trapped in riparian vegetation within Major Drainage habitat with scattered *Eucalyptus* and *Melaleuca* species over a varied understory, often dominated by tussock grasses. Suitable habitat for the species is present within all Major Drainage habitat within the Study Area, in addition to suitable rocky habitat being present within Gorge/Gully habitat. It is unknown if the species occurrence within the Study Area represents a resident individual or population, or a transient individual which may be utilising Major Drainage habitat dissecting the Study Area (Biologic, 2020a).









### 6.1.6 Short-range Endemic Fauna

Endemism refers to the restriction of a species to a particular area, whether it is at the continental, national or local scale, the latter being commonly referred to as short-range endemism (Allen, 2006; Harvey, 2002). Short-range endemism is influenced by several factors including life history, physiology, habitat requirements, dispersal capabilities, biotic and abiotic interactions and historical conditions which not only influence the distribution of a species, but also the tendency for differentiation and speciation (Ponder, 2002).

An increasingly large number of terrestrial invertebrates are discovered to exhibit short-range endemism in Western Australia. While protection for species of conservation significance is provided under the BC Act and EPBC Act, the majority of SRE species and communities are not currently listed. This is due largely to incomplete taxonomic or ecological knowledge. As such, the assessment of conservation significance for SRE is guided primarily by expert advice provided by the Western Australian Museum (WAM) and other taxonomic experts.

The SRE status categories used in Biologic (2020a) is consistent with that usually used in EIA in WA, and broadly follows the WAM's revised categorisation for SRE invertebrates. This system is based upon the 10,000 km<sup>2</sup> range criterion proposed by Harvey (2002), and uses three broad categories to deal with varying levels of taxonomic certainty that may apply to any given taxon (Table 6.8).

**Table 6.8 – SRE Categorisation used by WAM Taxonomists**

Distribution	Taxonomic Certainty	Taxonomic Uncertainty
< 10,000 km <sup>2</sup>	<p>Confirmed SRE:</p> <ul style="list-style-type: none"> <li>A known distribution of &lt;10,000 km<sup>2</sup>.</li> <li>The taxonomy is well known.</li> <li>The group is well represented in collections and/or via comprehensive sampling.</li> </ul>	<p>Potential SRE:</p> <ul style="list-style-type: none"> <li>Patchy sampling has resulted in incomplete knowledge of geographic distribution.</li> <li>Incomplete taxonomic knowledge.</li> <li>The group is not well represented in collections.</li> </ul>
> 10,000 km <sup>2</sup>	<p>Widespread (not an SRE):</p> <ul style="list-style-type: none"> <li>A known distribution of &gt;10,000 km<sup>2</sup>.</li> <li>The taxonomy is well known.</li> <li>The group is well represented in collections and/or via comprehensive sampling.</li> </ul>	<ul style="list-style-type: none"> <li>Category applies where there are significant knowledge gaps.</li> </ul> <p>SRE Sub-categories may apply:</p> <ul style="list-style-type: none"> <li>(a) Data Deficient</li> <li>(b) Habitat Indicators</li> <li>(c) Morphology Indicators</li> <li>(d) Molecular Evidence</li> <li>(e) Research &amp; Expertise</li> </ul>

A desktop study undertaken by Biologic (2020b) identified a total of 668 invertebrate records that belonged to taxonomic groups that are prone to short-range endemism within 40 km of the Biologic Study Area, of these, four are regarded as Confirmed SRE:

- Two millipedes (*Antichiropus apricus* and *Antichiropus forcipatus*) – both recorded within the Development Envelope near Sandtrax
- One pseudoscorpion (*Faella tealei*)



- One gastropod (*Camaenidae* Gen. nov. cf. `Z` n. sp.).

A total of 184 invertebrate fauna specimens were collected within the Study Area Biologic (2020b):

- One mygalomorph spider
- Seven selenopid spiders
- 48 pseudoscorpions
- Eight scorpions
- 90 snails
- 29 isopods.

No Confirmed SRE taxa were recorded during the survey, however 18 Potential SRE taxa were recorded. The following potential SRE species were recorded within the Development Envelope by Biologic (2020a):

- *Karaops* sp. indet.
- *Olpidae* sp. indet.
- *Xenolpium* sp. indet.
- *Buddelundia* 'sp. 11'.

The following sections describe the six species identified in the Development Envelope, either during the field survey, or by others prior to the desktop assessment.

#### **6.1.6.1 *Antichiropus apricus***

There is a single record of this recently described millipede from within the Development Envelope (Car, 2019). It was collected from Drainage Line habitat in the Sandtrax region of the Study Area. However, Biologic (2020b) concluded it was more likely that this individual was dispersing through the drainage lines rather than using them as core habitat. It is likely that the species' preferred habitat is the surrounding more highly suitable habitats, such as Gorge/ Gully and Hillcrest/ Hillslope habitats where more stable, protected leaf litter microhabitats are available (Biologic, 2020b). All *Antichiropus* millipedes described from the Pilbara so far have highly restricted ranges, and all are considered Confirmed SRE. While no other records were found in the database search, *A. apricus* has been recorded from Marble Bar, 55 km to the east of this record (Car, 2019).

This species is a confirmed SRE.

#### **6.1.6.2 *Antichiropus forcipatus***

Similar to the above, there is a single record of this millipede, also recently described (Car, 2019) from the same location in the Sandtrax area. This millipede was not found elsewhere in the Study Area; however, there are 21 records of *A. forcipatus* from the WAM database search at several locations up to 14 km south-west of the Study Area, predominantly from the nearby Abydos minesite (Biologic, 2020b).

This species is a confirmed SRE.



### **6.1.6.3 *Karaops sp. indet.***

Selenopid spiders including those in the genus *Karaops* are generally considered to have a reasonable likelihood of being SRE, due to their habitat specialisation within the cracks and crevices of rocky outcrops. *Karaops sp. indet.*, were collected from two sites within the Development Envelope, a Gorge/ Gully site and a Hillcrest/ Hillslope site. The five specimens collected were juveniles or females and could not be identified to species level.

*Karaops sp. indet.* were also collected outside the Development Envelope, at a Hillcrest/ Hillslope site and a Gorge/ Gully site. There is another record of a *Karaops sp. indet.* from the WAM database at Abydos.

The specimens are classified as Potential SRE, WAM categories 'A' (Data Deficient) and 'E' (Research and Expertise) (Biologic, 2020b).

### **6.1.6.4 *Olpiidae sp. indet.***

There are two records of this taxon from within the Development Envelope in Hillcrest/ Hillslope habitat. These and seven other records of *Olpiidae sp. indet.* from within the Study Area are likely to represent multiple species from the genera of either *Indolpium* or *Euryolpium*, both of which contain Potential SRE taxa (Biologic, 2020b).

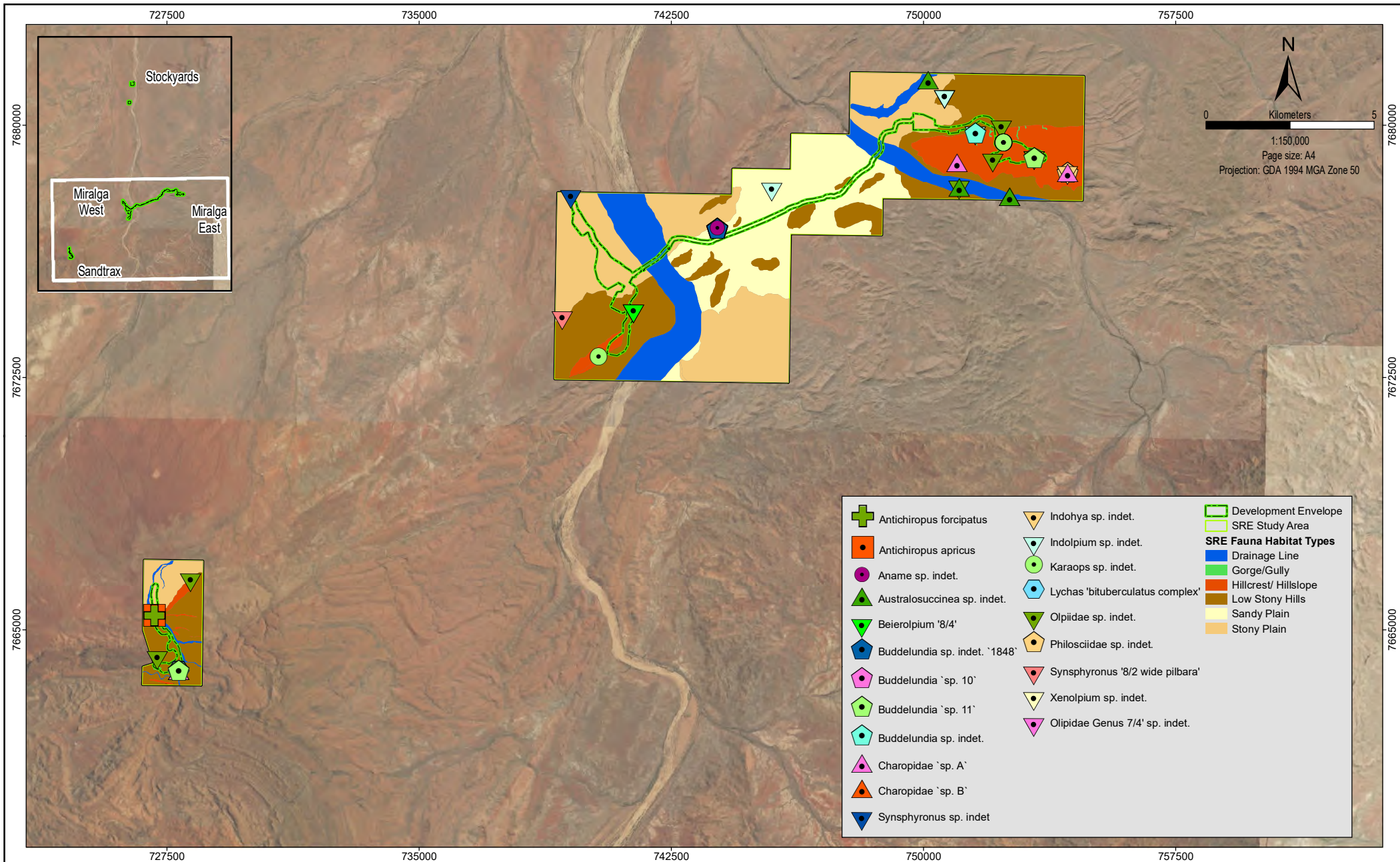
### **6.1.6.5 *Xenolpium sp. indet.***

A single specimen of this taxon was recorded from within the Development Envelope, in Gorge/ Gully habitat (SMRC-021) at Miralga Creek. Two more specimens were collected in Hillcrest/ Hillslope habitat (SMRC-105) within the Study Area. The genus *Xenolpium* is found throughout the Pilbara and is poorly known taxonomically; however, it is regarded as likely to contain SRE species (Biologic, 2020b).

### **6.1.6.6 *Buddelundia 'sp. 11'***

A single female specimen of this taxon was recorded from Hillcrest/ Hillslope habitat within the Development Envelope, and from Gorge/ Gully habitat in the broader Study Area. *Buddelundia 'sp. 11'* is regarded as a species complex containing species with restricted distributions (S. Judd, pers. comm. as reported in Biologic (2020b)). While this taxon is considered a Potential SRE, 36 records of this species complex were found in the WAM database search, from several sites to the south-west of the Study Area (Biologic, 2020b).





File Name: GIS\_2778\_MIR\_S38\_MIR\_Fig6\_10\_FaunaStudyArea.mxd

Date: 2/04/2020

Author: Heath.Maconachie

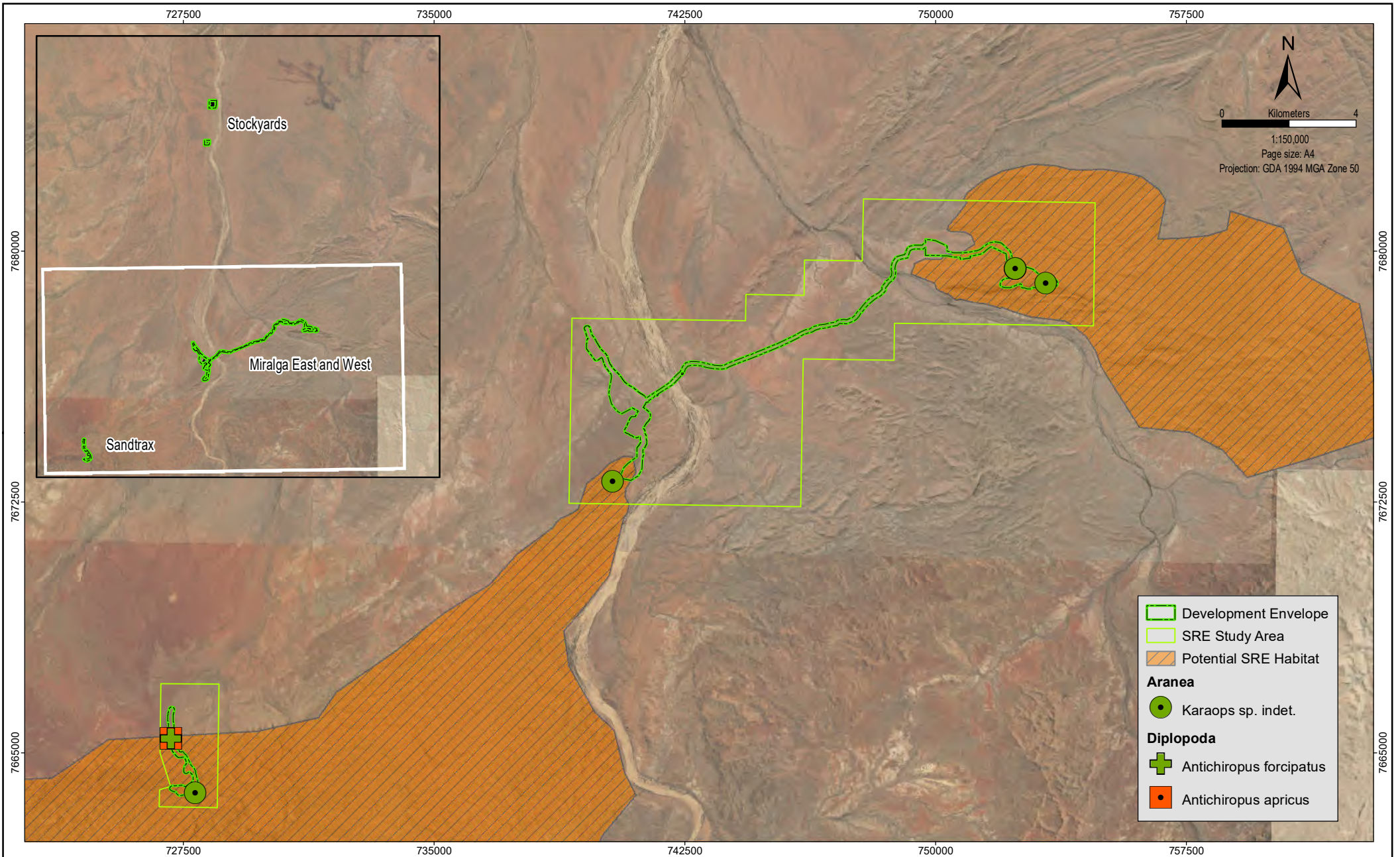
Source & Notes:


## SRE Fauna Records and Habitat Type

Figure No:

6-10






 File Name: GIS\_2776\_MIR\_S38\_MIR\_Fig6\_11\_PotentialSREHabitat.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:

## Extrapolation of Potential SRE Habitat

Figure No:  
**6-11**



### 6.1.7 Introduced Fauna

European Cattle (*Bos taurus*), Camel (*Camelus dromedarius*) and dog/ dingo (*Canis familiaris*) were recorded in the Study Area during the survey (Biologic, 2020a).

## 6.2 Potential Impacts

Biologic was commissioned to undertake separate impact assessments on vertebrate fauna (Biologic, 2020b) (Appendix I) and SRE invertebrate fauna (Biologic, 2020c) (Appendix J), The impact assessment reports considered the entire Development Envelope.

Potential impacts to terrestrial fauna including direct, indirect and cumulative, as discussed by Biologic are:

- Removal, fragmentation or modification of habitat
- Impacts to habitat features
- Introduced species
- Disturbance from artificial lights
- Disturbance from noise and vibration
- Generation of dust
- Altered fire regimes
- Modification of water regimes
- Spills and contamination.

These potential impacts are discussed in detail in Section 6.4.

Potential impacts to Ghost Bats have been the subject of further work. These potential impacts include loss and/or temporary abandonment of caves used as roosts, and are discussed in further detail in Sections 6.3.2.1 and 6.3.4.2.

## 6.3 Assessment of Potential Impacts

### 6.3.1 Removal, Fragmentation and/or Modification of Fauna Habitat

Overall, habitat removal and degradation are considered to be the primary impact to conservation significant fauna within the Study Area, for both vertebrate and invertebrate groups.

Clearing would reduce the size and quality of habitats, through edge effects and habitat fragmentation, and is likely to heighten the effects of other threatening processes such as introduced flora, introduced fauna and altered fire regimes. The impact of clearing is higher when landforms such as caves, cliff lines and overhangs are removed, as there is limited opportunity and ability to recreate and rehabilitate such habitat features post mine closure.

Table 6.9 and Table 6.10 present the impact to each fauna habitat based on the Biologic survey (2020a) which was extrapolated by Biologic (2020b) to cover both northern stockyards.



Table 6.9 – Impacts to Vertebrate Fauna Habitats

Fauna Habitat (Value)	Study Area		Development Envelope <sup>1</sup>	
	Extent (ha)	Proportion of Study area (%)	Extent (ha)	% of Habitat Type in the Development Envelope
Low Stony Hills (Low)	2,586.3	32.8	167.4	26.9
Stony Plain (Low)	2,328.41	29.5	306.5	49.4
Sand Plain (Moderate)	1,535.85	19.5	67.7	10.9
Major Drainage (High)	996.32	12.6	19.6	3.2
Hillcrest/ Hillslope (High)	429.79	5.5	58.9	9.5
Gorge/ Gully (High)	4.58	0.1	0.8	0.1
<b>Total</b>	<b>7,881.25</b>	<b>100</b>	<b>620.9</b>	<b>100</b>

Source: Biologic (2020b)

(1) As noted in Section 5.1.4.1, the Development Envelope was revised down to 621.1 ha to avoid impacts to *Polymeria* sp. These calculations were completed by Biologic prior to the re-design. Numerical impacts are insignificant.

Table 6.10 – Impacts to Invertebrate Fauna Habitats

Fauna Habitat (Value)	Study Area		Development Envelope <sup>1</sup>	
	Extent (ha)	Proportion of Study Area (%)	Extent (ha)	% of Habitat Type in the Development Envelope
Low Stony Hills (Low)	2,213.78	28.09	130.24	20.96
Stony Plain (Low)	2,223.98	28.22	202.93	32.66
Sand Plain (Low-Moderate)	1,640.13	20.81	171.98	27.68
Drainage Line (Moderate)	1,000.13	12.69	19.76	3.18
Hillcrest/ Hillslope (Moderate-High)	791.47	10.04	95.24	15.33





Fauna Habitat (Value)	Study Area		Development Envelope <sup>1</sup>	
	Extent (ha)	Proportion of Study Area (%)	Extent (ha)	% of Habitat Type in the Development Envelope
Gorge/ Gully (High)	11.64	0.15	1.16	0.19
<b>Total</b>	<b>7,881.13</b>	<b>100</b>	<b>621.32</b>	<b>–</b>

Source: Biologic (2020c)

(1) As noted in Section 5.1.4.1, the Development Envelope was revised down to 621.1 ha to avoid impacts to *Polymeria* sp. These calculations were completed by Biologic prior to the re-design. Numerical impacts are insignificant.

Gorge/ Gully, Hillcrest/ Hillslope and Major Drainage habitats were considered to be of high significance for vertebrate fauna as they support species of conservation significance or contain core habitats for such species (Biologic, 2020a).

Biologic (2020b; 2020c) (Appendix I, Appendix J) used the following definition of the magnitude of impacts, and assessed this at the local and regional scale:

- Negligible: Displacement or loss of condition of individual animals.
- Low: Loss of individuals but no measurable change in population size.
- Moderate: Demonstrable change in population.
- High: Population persistence threatened.

Biologic (2020b) determined that the scale of impact to vertebrate fauna habitat within the Development Envelope to be Moderate (i.e. result in a demonstrable change in population) to Low (i.e. loss of individuals, but no measurable change in population size). Moderate impacts were associated with clearing for the pits, stockyard and waste dump; low impacts were associated with the haul road between Miralga West and Miralga East.

In relation to invertebrate fauna, some habitat loss and degradation is likely to occur throughout most of the habitats present (depending on the final footprint). Taking a conservative view and assuming that the entire Development Envelope is cleared (in reality less than half of the Development Envelope will be cleared), a total of 6.44% of the most important SRE habitat would be removed (summation of impacts to Drainage Line, Hillcrest/ Hillslope, Gorge/ Gully). If the entire extent of Hillcrest/ Hillslope habitat within the Development Envelope was cleared, 12.03% of that habitat type would be lost. Similarly, for Gorge/ Gully and Drainage Line the impacts would be 9.97% and 1.98%, respectively. This equates to a Low to Moderate impact at a local scale. However, it is important to note that each of these habitats are connected to similar habitat outside of the Development Envelope, and that none of the habitat types are restricted to the Study Area. On a regional scale, therefore, the impact is considered Negligible to Low.





## 6.3.2 Impacts to Habitat Features

### 6.3.2.1 Caves

#### Direct Impacts

Specific to the integrity of the important cave complex at Miralga East, Blast It Global was engaged to predict the effects of blasting on the structural integrity of caves CMRC-13, -14 and -15. Blast It Global developed a computer model to “study potential ground vibration levels and flyrock impact zones ... to determine a safe set of parameters for drilling and blasting activities” (Blast It Global, 2020; Appendix H). One of the outcomes of this work was that Atlas Iron was able to determine that its standard blasting methodology is appropriate and can be used at Miralga East without the need to mitigate the blasting pattern.

Blast criteria were established to set thresholds of vibration levels experienced at caves. The objective of the blast criteria were to limit vibration levels such that “the caves remain viable as diurnal roosts for Ghost Bats in the future, once mining has finished” (Blast It Global, 2020). In practical terms, this means the blast criteria need to guard against destruction of the cave, complete obstruction of entrances or alteration to the internal microclimate (e.g. through creation of a new entrances allowing through airflow). The criteria do not need to prevent the fall of hanging boulders inside the cave, as this would not change the cave habitat in a way that would affect its long-term viability as a diurnal roost for Ghost Bat (Bat Call, 2020).

Industry standards listed in Hoek and Bray (1981) suggest that a blast vibration criterion of 305 mm/s could be set to achieve the desired outcomes mentioned above. However, to account for the weathering and geological structures in cave CMRC-15 noted by PSM, a more conservative limit of 127 mm/s could be adopted. Accounting for all available information, Blast It Global recommended the following specific vibration criteria to be applied at CMRC-13, -14 and -15:

- All blasts to be designed to achieve 85 mm/s at the cave.
- Blast vibration not to exceed 100 mm/s at the cave.

Blast impacts were then modelled for a range of scenarios, each of which varied blast parameters such as the size and position of charges, detonation sequencing, etc. The blast modelling shows that, using the selected blast parameters, the 100 mm/s blast vibration limit can be achieved even at 23 m from cave CMRC-15 (Blast It Global, 2020). By inference, the vibration limit can be achieved at all caves at Miralga East. Furthermore, Atlas Iron is likely to design blasts at Miralga East with less energy than the scenarios modelled by Blast It Global, which would lead to even lower blast-induced vibration than predicted. The loss of cave CMRC-15 is now considered unlikely (Bat Call WA, 2020).

Cave CMRC-02, a nocturnal roost for Ghost Bat at Miralga West, is located inside the Indicative Disturbance Footprint and will be cleared. As an isolated category 4 cave, this roost is of the least value to Ghost Bat and is not considered important for the long-term presence of the Ghost Bat locally (Bat Call WA, 2020).

#### Indirect Impacts

Thirteen caves are located within 500 m of any pit (refer to Table 6.7). These caves have the potential to be affected by indirect impacts such as increased noise, dust, light and/or a change in microclimate. Any fauna using these caves, including Ghost Bat, may be disturbed



while mining activities are occurring nearby. These impacts are discussed further in Section 6.3.3 and in relation to specific species in Section 6.3.4.

The Proposal is not anticipated to have a significant indirect impact from noise and vibration on the remaining nocturnal refuges for Pilbara Leaf-nosed Bat and/or Ghost Bat, due to the caves' distance from the Proposal (particularly the distance from open pits). Indirect impacts from blasting operations will be further limited to daytime operations. This prediction is based on long term monitoring of a nocturnal roost at Atlas Iron's Mt Dove operation, which was approved to operate within 20 m of a nocturnal refuge for Pilbara Leaf-nosed Bat. Long-term monitoring of the nocturnal refuge at Mt Dove showed that while there was some minor physical damage to the entrance of the cave, mining had little to no negative effect on Pilbara Leaf-nosed Bat visitation (MWH, 2015).

### **6.3.2.2 Water Features**

Any water features near the Proposal, particularly those near the pits, waste dumps and other infrastructure associated with ongoing disturbances, may be affected by decreased water quality due to temporary water run-off (Biologic, 2020b). All water features mapped by Biologic (2020a; 2019) are outside of the Development Envelope and will not be directly impacted by clearing (Figure 6.4). Twenty-three of the water features mapped by Biologic (2020a; 2019) are beyond the 0.2 m modelled drawdowns and are not anticipated to be impacted from water supply activities (nine are approximately within the 0.2 to 0.4 m contours). The two potentially permanent water features (WMRC-14 and -15) will not be impacted by drawdown from the water supply borefields.

Road crossings are planned to be constructed across Miralga Creek and the Shaw River. The construction, maintenance and use of these roads will need to be managed appropriately to avoid impacts to water features located downstream. Providing appropriate controls are in place (e.g. culverts are used to ensure flow is not impeded, or roads are designed to over-top), the impact on water features located downstream is likely to be Low (Biologic, 2020b). If left unmanaged impacts could be Moderate.

### **6.3.3 Indirect Impacts**

Overall, habitat removal and degradation are together considered to be the primary impact to conservation significant fauna within the Study Area (Biologic, 2020b). Potential increases to the abundance of introduced species due to implementation of the Proposal could impact most conservation significant fauna via a range of means including predation, competition for food resources, and further habitat degradation, especially by introduced grazers. Vehicle strike may also have a moderate impact on some species.

It should be noted that, as for all developments, the direct and indirect impact sources that may affect key receptor species can be difficult to quantify and predict in advance of developments occurring (Biologic, 2020b). Although land clearing or degradation may be estimated, the final impact to the local populations or regional distribution of a species is difficult to quantify. The extent and magnitude of other impact sources, such as noise, light, or changed fire regimes, have not been well researched for Pilbara fauna species, so any assessment of impact from these sources is limited in accuracy (Biologic, 2020b). Impacts to vertebrate fauna from indirect sources were determined to be Moderate to Negligible at the local scale, and Low to Negligible at the Regional Scale for conservation significant species; widespread/ common species are anticipated to be impacted in similar way (Biologic, 2020b).



In terms of SRE invertebrate fauna, indirect impacts most likely to have an effect, albeit varied depending on the species, are alteration to surface drainage patterns and alteration to fire regimes (Biologic, 2020c).

### **6.3.3.1 Vehicle Strike**

Vehicle strike is a known threat to conservation significant fauna of the Pilbara, particularly for nocturnal species foraging or travelling near roads. The construction and operation of roads within the Development Envelope poses a risk to fauna through mortalities arising from collisions with vehicles. Mortalities may occur during initial clearing works, particularly for smaller and/or less mobile species that are unable to disperse once construction works have commenced. During operations, collisions with animals along roads are more likely to occur at night (Rowden, 2008). The presence of roadkill also has the potential to attract more species into the area.

### **6.3.3.2 Introduced Species**

Potential increases to the abundance of introduced species due to implementation of the Proposal could impact most conservation significant fauna in the Study Area via a range of means including predation, competition for food resources, and further habitat degradation, especially by introduced grazers.

As mentioned previously, vehicle strike is a known threat to conservation significant fauna of the Pilbara as well as other non-conservation significant fauna. The presence of roadkill has the potential to attract more species and/or individual animals into the area, particularly those using roadkill as food sources.

Introduced species pose a range of potential impact sources to Pilbara fauna. Potential impacts from introduced species include over-grazing and land degradation from introduced herbivores (e.g. camels and goats), competition (e.g. rabbits), habitat degradation from weeds (e.g. Buffel Grass), poisoning from cane toads (Prugh, 2009), disease (e.g. toxoplasmosis (Dickman, 1996)) and, most critically, the introduction of feral predators such as cats and red foxes (Carwardine, 2014). There is ample evidence that predation by introduced species such as feral cats is a primary factor in the decline of numerous taxa (Burbidge A. A., 1989). In addition, management of invasive species using poison (e.g. 1080 poison) is identified as a threat for some mammal species (Woinarski, 2014). Northern Quolls are identified as possibly being more susceptible to the toxin than other dasyurids (Calver, 1989).

Although weeds and feral animals are not a mining specific impact, there is the potential for a range of invasive species to be introduced or attracted to the area as a result of operational activities such as the expanded traffic network and increased traffic movements, waste and water management, and human habitation. Feral predators are considered likely to occur in greater numbers near areas of human settlement and roads.

Buffel grass is listed as high ecological impact and rapid invasiveness (Department of Biodiversity Conservation and Attractions, 2019), and has been previously recorded in the Study Area (Woodman Environmental, 2019a), as has the Cat, European Cattle and the Camel (Biologic, 2020a).



### **6.3.3.3 Disturbance from Artificial Light**

Temporary mobile lighting will be installed in active mine pits and active operational areas. Altered light environments may affect foraging, reproduction, migration, and communication (Longcore, 2004). The most likely disturbance responses of native fauna from increases in light spill are the avoidance of illuminated areas previously used for foraging by light-sensitive species, or changes to prey item aggregation for insectivorous species resulting in changes to foraging behaviour.

### **6.3.3.4 Disturbance from Noise and Vibration**

Species using audible cues for breeding activity, especially birds and amphibians, may experience disruption to breeding cycles or reduced breeding success due to increased noise. For example, traffic noise is thought to negatively impact on bird and amphibian communities by masking territorial or mate attracting calls (Parris, 2009; Shannon, 2014). Other behavioural responses to increased noise levels are reduced foraging time, through minimisation to exposure and by increased vigilance behaviour (Shannon, 2014).

However, there is a lack of research into the impact of these factors on native fauna in the Pilbara. Increased noise and vibration will be associated with all elements of the Project, particularly around the pit area and roads.

Impacts specific to Ghost Bats from drill and blast activities at Miralga East are discussed in more detail in Section 6.3.4.2.

### **6.3.3.5 Generation of Dust**

The development and operation of the Proposal will create dust emissions due to construction, blasting, haulage and general traffic activities, the impacts of which may not be confined to the Development Envelope.

Dust can indirectly affect fauna by altering the structure and composition of native vegetation (Farmer, 1993). Dust interferes with photosynthesis, respiration and transpiration and allows penetration of gaseous pollutants (Farmer, 1993). Most plant communities can be adversely affected by dust deposition, resulting in alteration of plant community structure (Prajapati, 2012). A decline in vegetation quality can impact faunal assemblages by reducing both food and habitat resources. However, no prior studies have been able to detect a significant adverse impact of airborne dust on plant function in the Pilbara (Grierson, 2015; Matsuki, 2016).

Dust may directly pollute water bodies by increasing turbidity or potentially altering water chemistry. Waterholes most at risk include the temporary waterholes to the north of Miralga East given their proximity to the Indicative Disturbance Footprint. This may in turn affect fauna and flora dependent on these waterholes including but not limited to the Pilbara Olive Python, Northern Quoll and Pilbara Leaf-nosed Bat.

Given the duration and size of the Proposal, the Proposal is not anticipated to have a significant impact at a regional level. (Air quality in relation to human exposure is discussed in Chapter 6.6.)





### **6.3.3.6 Altered Fire Regimes**

Fire is a natural process in the Pilbara that commonly arises through lightning strike. However, changes to fire regimes, particularly when fires are too frequent or intense, can have negative ecological impacts (Doherty, 2016). For example, understory growth that provides many reptiles and mammals with protection from predators can be lost when fires are too frequent or intense as can certain food resources, such as seeding grass for graminivorous birds (Carwardine, 2014). The impacts of an altered fire regime can vary between fauna species, and low frequency fires may also have an impact; for example, inhibiting movement through retention of high vegetation cover for Greater Bilbies (Bradley, 2015). Altered fire regimes have been identified as one of the causes of decline or extinction of medium-sized mammals in arid Australia (Burbidge A. A., 1989; Burrows, 2006). For invertebrate SRE fauna, alteration of fire regimes is more likely to affect species within vegetated habitats, or where leaf litter is an important microhabitat for the species; any increase in frequency or intensity of fires is likely to have an impact on species with these habitat requirements (Biologic, 2020c).

Although difficult to predict, it is possible that implementation of the Proposal may increase the frequency of fires due to increased incidences of ignition caused by an expanded traffic network and increased traffic movements or an increase in grassy fuel load. Conversely, implementation may instead reduce the scale/extent of natural wildfires due to infrastructure acting as firebreaks and on-site management (i.e., fire suppression).

### **6.3.3.7 Modification of Water Regimes**

Within the Pilbara, the growth of the mining industry presents new challenges for water management, from alteration of flow regimes and creation of new water sources on the surface (Carwardine, 2014). Without appropriate management, river crossings at the Shaw River and Miralga Creek may impact waterflow along these water courses impacting habitat downstream. However, as water flows are likely to result from post-cyclonic rainfall, impacts would be temporary and negligible in comparison to the volume of water expected.

Altered water regimes (in terms of either quality, quantity, or both) have the potential to impact the availability or nature of dispersal corridors used by SRE invertebrate fauna, mostly in relation to low-lying areas, such as Sand Plains, Drainage Areas/ Floodplain, Mulga Woodland and Major Drainage Line (Biologic, 2020c)

## **6.3.4 Conservation Significant Species**

The following sections summarise the significance of impacts to conservation significant species either recorded within, or considered likely to occur within, the Study Area, further detail is provided in Biologic (2020a). At the local scale, the magnitude of impacts to individual species from the implementation of the Proposal varied from Negligible to Low and Moderate. At the regional scale impacts were considered to be Negligible to Low. No High impacts were identified at either scale (Biologic, 2020b).

### **6.3.4.1 Northern Quoll**

Within the Study Area, high quality denning and foraging habitat for the species is found within the Gorge/ Gully and Hillcrest/ Hillslope habitats and foraging and dispersal habitat is found in the Major Drainage Line habitats. Implementation of the Proposal will result in clearing of up to 59.6 ha of denning and foraging habitat for the Northern Quoll (Biologic, 2020b). At a local scale, the species is likely to experience a Low to Moderate level of



impact, primarily from removal, fragmentation and modification of habitat, but also potentially vehicle strike and the increased threat of introduced species. Low level impacts may also be experienced by increased light and noise and changed fire regimes. At a regional level, impacts are predicted to be Low (Biologic 2020b).

#### **6.3.4.2 Ghost Bat**

Although the majority of habitats occurring within the Study Area would likely be used for foraging and dispersal by the Ghost Bat, roosting caves are restricted to the Hillcrest/Hillslope and Gorge/Gully habitats. The species was recorded 25 times during the most recent fauna survey with eight night roost sites, three confirmed diurnal roosts (of which one is possibly a maternity roost) and two potential diurnal roosts recorded. Of these roosts, four are located within the Development Envelope. Based on the position of the resource and current mine pit design, the Proposal will result in the removal of one nocturnal roost caves (CMRC-02) and will likely cause temporary disruption to other caves close to mine pits during active mining. Any bats exhibiting short-term abandonment from the caves in the Proposal area are expected to use Lalla Rookh as their preferred location (Bat Call WA, 2020).

Any bats exhibiting short-term abandonment from caves within the project area as a result of mining activities are expected to utilise Lalla Rookh as their preferred location (Bat Call WA, 2020). Mining related impacts from the development and operation of the Project are not anticipated at Lalla Rookh (Bat Call WA, 2020).

Longer-term observations have shown that the Ghost Bat congregates at important roosts then disperses, based on seasonal, climatic and other factors (Bat Call WA, 2020). Other roosts surrounding a category 1 roost such as Lalla Rookh support smaller local groups of Ghost Bat but are not occupied consistently (Bat Call WA, 2020). Retention of roost sites (particularly maternity roosts) is required for the persistence of the species in the Pilbara.

Short-term abandonment of caves by Ghost Bats is expected, but will not have an impact on the species long-term. Ghost Bats have a nightly foraging range of 10 km radius, travelling up to 25 km in a single night (Bat Call WA, 2020). All caves that may be impacted by implementation of the Proposal are within 25 km of Lalla Rookh. Given these roosts are used by smaller numbers of Ghost Bat and are not in constant use, individuals are expected to use Lalla Rookh as their preferred roost during mining activities (Bat Call WA, 2020). Although the interior of Lalla Rookh cannot be surveyed for safety reasons, the size of the underground workings is not a limiting factor. The large size of the abandoned underground workings at Lalla Rookh would not be a limitation in the roost site accommodating the small (approximately 10%) increase in Ghost Bat numbers (Bat Call WA, 2020).

Implementation of the Proposal will result in the loss of Gorge/Gully (0.1 ha out of 4.6 ha mapped, 2%) and Hillcrest/Hillslope (30.7 ha out of 495.2 ha mapped, 6%) habitat which provides potential roosting habitat.

The Proposal will result in the clearing of a 284.9 Indicative Disturbance Footprint within a 621.1 ha Development Envelope, the majority of which provides varying levels of foraging and dispersal habitat for the species. All habitats within the Indicative Disturbance Footprint are represented in the wider Study Area and in the Pilbara region with large portions of each habitat remaining outside of the Indicative Disturbance Footprint after clearing. Additionally, the Ghost Bat forages over a wide variety of habitats over 5 to 10 km from roosts when not breeding.



At a local scale, Biologic (2020b) considered the species is likely to experience a Low to Moderate level of impact, primarily from removal, fragmentation and modification of habitat, but also potentially noise, vibration and dust. Low level impacts may also potentially be experienced due to vehicle strike, introduced species and changed fire regimes.

#### **6.3.4.3 Pilbara Leaf-nosed Bat**

All habitat types in the Study Area are used by this species, however, Hillslope/ Hillcrest and Major Drainage Line habitats are especially frequented. The Proposal will result in the removal or significant impact on one nocturnal roost caves (CMRC-02) and will potentially cause disruption to a further eleven due to those caves being located within 500 m of proposed mining pits – including CMRC-15, which appears to be an important nocturnal refuge for the species. However, it is important to note that all caves in the Study Area are considered unlikely to be used for diurnal roosting, based on a lack of evidence that would suggest diurnal roosting was occurring (Biologic, 2020b). Further, the assessment of potential impacts against the MNES significant impact criteria for this species (see also Chapter 9) was low or negligible. The impacts considered to be of most significance for this species is habitat loss and degradation as well as potentially vehicle strike.

Impacts are considered unlikely to extend beyond the Study Area to the regional level (Biologic, 2020b).

#### **6.3.4.4 Pilbara Olive Python**

Major Drainage, Gorge/ Gully and Hillcrest/ Hillslope are key habitat types for this species. At a local level the species will be subject to Low to Moderate impacts, primarily from removal, fragmentation and modification of habitat and potential modification of the water regime. Moderate level impacts are unlikely to extend beyond the Study Area to the regional level.

Overall the Proposal is not likely to have a significant impact on the species on a local or regional scale (Biologic, 2020b).

#### **6.3.4.5 Grey Falcon**

This species uses all habitat types in the Study Area and the Major Drainage Line provides nesting habitat. At a local scale the species is likely to experience a Low to Moderate level of impact, primarily from removal, fragmentation and modification of habitat, but also potentially vehicle strike, the increased threat of introduced species and increased levels of light. Low level impacts may also be experienced due to increased levels of noise, dust and changed fire regimes.

Moderate level impacts are unlikely to extend beyond the Study Area to the regional level and the Proposal is not likely to have a significant impact on the species (Biologic, 2020b).

#### **6.3.4.6 Peregrine Falcon**

Potential nesting habitat for the Peregrine Falcon is present within Hillcrest/ Hillslope, Gorge/ Gully and Major Drainage Line habitat. The impact considered to be of most significance for this species is loss of a portion of habitat.

Overall the Project is not likely to have a significant impact on the species on a local or regional scale (Biologic, 2020b).



#### 6.3.4.7 Northern Brushtail Possum

The habitat types in the Study Area most suitable to support this species is the Major Drainage Line habitat, as well as other habitat that provides tree hollows and denning sites, such as the Gorge/Gully habitat. The impact considered to be of most significance for this species is habitat loss and degradation.

Overall the Proposal is not likely to have a significant impact on the species on a local or regional scale (Biologic, 2020b).

#### 6.3.4.8 SRE Invertebrates

The removal of habitat, including native vegetation, topsoil and landforms associated with ground disturbance and vegetation-clearing activities is considered the most significant impact of this Proposal. The Indicative Disturbance Footprint for the Project is estimated to be approximately 285 ha. The main areas of direct land disturbance are associated with the construction of a Waste Rock Dump (40.69 ha), and a Mining Pit (27.83 ha).

Some habitat loss and degradation will be expected to occur throughout most of the habitats present, including those considered of high to moderate significance, namely Gorge/ Gully, Hillcrest/ Hillslope and Major Drainage (9.97%, 12.03% and 0.7% of the total area of habitat type in the Study Area impacted, respectively). The Hillcrest/ Hillslope habitat has the largest proportion (12.03%) within the Study Area which will be impacted by the development, followed by the Sandy Plain habitat (10.49%). However, there is habitat connectivity outside of the Development Envelope in the Study Area and beyond. In addition, none of the habitat types are restricted to the Study Area. For most Potential SRE taxa present, the habitats within the Study Area represent only a portion of their wider extent in the region.

Biologic (2020b) assessed the significance of impacts to Potential SREs found within the Development Envelope and determined the following:

- The known SRE species *Antichiropus apricus* and *A. forcipatus* were found within the Development Envelope and are likely to occur throughout the local extent of connected Gorge/ Gully and Hillcrest/ Hillslope habitat where other records are known. As such, they are considered to be at low risk of impact by the current Proposal (Figure 6.11).
- The Potential SRE species *Karaops* sp. indet. is regarded as being at moderate risk of impact from the current Proposal as it was only recorded within the Development Envelope in the 2019 study, (in Gorge/ Gully and Hillcrest/ Hillslope habitat). In the absence of molecular studies to demonstrate the species presence beyond the Study Area a conservative approach has been undertaken, assuming that this taxon is limited to the Study Area. If this is the case, the removal of habitat from clearing and mining activities would be considered to have a Moderate impact. If its presence beyond the Study Area was confirmed in the future this assessment may reduce to Low impact, as was the case for both *Antichiropus* species. Indirect impacts from changes to surface hydrology, exotic pests, weeds, increased fire incidents, and spills/ contamination would be expected to be low and would be managed by current and proposed environmental management procedures.

The millipede species *Antichiropus apricus* and *Antichiropus forcipatus*, both Confirmed SREs, were found within the Development Envelope and are likely to occur throughout the local extent of connected Gorge/ Gully and Hillcrest/ Hillslope habitat where other records are known. As such, they are considered to be at low risk of impact by the current Proposal.





All three taxa of conservation significance have a potential range of connected habitat that extends well beyond the Development Envelope and the Study Area.

## 6.4 Mitigation

Atlas Iron has in place a HSEMS supported by an Environmental Management Plan (EMP), which defines Atlas Iron's approach to environmental management and integrates regulatory and HSEMS requirements. Atlas Iron has been operating iron ore mines in the Pilbara since 2008. During this time, Atlas Iron has developed, implemented and refined its Environmental Management Plans and Procedures.

The mitigation hierarchy (avoid, minimise and rehabilitate) has been applied during Proposal design to reduce the Proposal's potential impacts to terrestrial fauna. Table 6.11 summarises the mitigations that will be applied during construction and operation of the Proposal.

Due to the importance of the cave complex at Miralga East for Ghost Bats (centred on CMRC-15), a specific discussion of mitigations is provided here, in addition to the summary in Table 6.11.

Management measures and monitoring were recommended by Blast It Global (2020) to validate predicted vibration and measure vibration received at caves. Atlas Iron will adopt the recommendations to ensure that blasting is carried out appropriately. Key measures include:

- Design blasts to perform to the blast criteria (i.e. limit to 100 mm/s but design to achieve 85 mm/s) using the reference values set out in Blast It Global (2020).
- Establish vibration monitors in the nearest cave to all blasting at Miralga East pits 2 and 3.
- Avoid blasting within 100 m of a cave until the results of monitoring validate predictions with a reasonable degree of confidence.
- If vibration exceeds 100 mm/s, blasting should cease until the cause has been determined and steps to prevent a reoccurrence have been taken. A cave inspection is required to assess any impacts.
- Periodically inspect caves to confirm the vibration limits are fit for purpose.

The measures outlined above apply to caves CMRC-13, -14 and -15 at Miralga East.

Refer to Appendix H for the full blast impact assessment and further details on blast management to be adopted.

Bat Call WA (2020) included a number of recommendations to support the persistence of Ghost Bat in the Miralga Creek/ Lalla Rookh area. Atlas Iron will:

- Avoid direct disturbance of all caves except the category 4 cave CMRC-02 at Miralga West.
- Establish suitable exclusion zones around all remaining caves to prevent direct disturbance from the Proposed Action.
- Restrict personnel from entering any category 2 or 3 cave, except for survey personnel in accordance with the protocol outlined in Appendix B of Bat Call WA (2020).
- Monitor Ghost Bat usage of the category 2 caves CMRC-06 and -15 annually during operations and for one year following operations.



- Limit blasting vibrations at caves CMRC-13, -14 and -15 as per the recommendations of Blast It Global (2020).

Atlas Iron will establish exclusion zones to prevent direct disturbance of all caves surveyed (except for the category 4 cave, CMRC-02 which will be directly impacted by mining). Most caves are already excluded from both the Indicative Disturbance Footprint and the Development Envelope and will not be disturbed. Caves CMRC-14 and -15 are excluded from the Indicative Disturbance Footprint and will have exclusion zones established to avoid disturbance by the proposed activities. Additionally, personnel will be restricted from entering any category 2 or 3 caves unless undertaking survey activities in accordance with a disruption protocol (refer to Appendix B of Bat Call WA (2020)). Blast management as described in Sections 2.2.3 and 2.2.4 will protect the structural integrity of cave CMRC-15 and therefore maintain its viability as a potential maternity roost (as well as nearby supporting caves CMRC-13 and -14) for reoccupation following the cessation of mining activities.

It is considered unlikely that implementation of the Proposal will lead to a long term decrease in the size of the population given the following:

- Suitable habitat for the species (foraging, dispersal and roosting) will remain in the Development Envelope and wider area.
- The long term availability of potential roost caves.
- There is evidence of persistence of the Ghost Bat population persisting in the Pilbara region concurrent with mining operations (Biologic, 2020b; TSSC, 2016).

**Table 6.11 – Mitigation of Risks to Terrestrial Fauna**

	Mitigations to be Applied
<b>Avoidance</b>	<ul style="list-style-type: none"> <li>• The Proposal has avoided the need to clear additional fauna habitat by using the existing camp, Abydos Link Road (haul road; ALRE) and borefield infrastructure associated with Atlas Iron's Abydos Project.</li> <li>• The Proposal has been designed to avoid direct impacts to 15 out of the 16 caves in the Study Area, as well as the significant Lalla Rookh maternity cave which lies outside of the Development Envelope.</li> <li>• The Development Envelope has been designed to avoid the majority of mapped area of fauna habitats of most significance: <ul style="list-style-type: none"> <li>– In relation to the three most significant habitat types for vertebrate fauna: Approximately 99% of Gorge/ Gully habitat, 90% of Hillcrest/ Hillslope habitat and 96% of Major Drainage Line will be retained outside of the Development Envelope. It is likely that additional parts of these habitat types will be retained in the final layout of the Disturbance Footprint.</li> <li>– In relation to the two most significant habitat types for invertebrate fauna: Approximately 10 ha of Gorge/ Gully habitat and 696 ha of Hillcrest/ Hillslope habitat will be retained outside of the Development Envelope. It is likely that additional parts of these habitat types will be retained in the final layout of the Disturbance Footprint.</li> <li>– All known permanent waterholes are outside of the Development Envelope.</li> </ul> </li> </ul>



Mitigations to be Applied	
<b>Minimisation</b>	<p>The following plans and procedures will be implemented to assist in minimising impacts to fauna and fauna habitat:</p> <ul style="list-style-type: none"> <li>• GDP Procedure (950-HSE-EN-PRO-0001).</li> <li>• Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).</li> <li>• Fauna Management Procedure (950-HSE-EN-PRO-0012).</li> <li>• Landfill Management Procedure (950-HSE-EN-PRO-0020).</li> <li>• Waste Management Procedure (950-HSE-EN-PRO-0023).</li> <li>• Introduced Fauna / Pest Control Procedure (950-HSE-EN-PRO-0022).</li> <li>• Significant Species Management Plan (Appendix K).</li> </ul> <p>Key management measures contained in these plans include:</p> <ul style="list-style-type: none"> <li>• No more than 284.9 ha of vegetation/habitat within the 621.1 ha Development Envelope will be cleared/disturbed.</li> <li>• Clearing will occur in accordance with Atlas Iron's Ground Disturbance Permit Procedure (GDP). No clearing will occur without prior authorisation from Atlas Iron's Ground Disturbance Permitting System. This will ensure that clearing does not occur outside the Development Envelope or exceed 284.9 ha.</li> <li>• Clearing in/ of sensitive habitats including caves, gorges and drainage lines will be kept to the minimum necessary for safe construction and operation of the Proposal.</li> <li>• Atlas Iron will abstract water in accordance with 5C Licences to take groundwater, a Water Management Plan and Site Water Operating Plan in accordance with the Department of Water and Environmental Regulations requirements.</li> <li>• Turkey's nests will be constructed to ensure a point of fauna ingress/egress.</li> <li>• Borrow pits will be designed and constructed to permit egress of fauna.</li> <li>• Speed limits will be enforced across the site.</li> <li>• Off-road driving will be prohibited unless otherwise authorised by senior management to minimise potential vehicle strikes.</li> <li>• Night-time vehicle movements will be restricted where possible to minimise potential vehicle strikes.</li> <li>• All bins storing putrescible waste will have tightly secured lids to avoid fauna attraction and entry.</li> <li>• The landfill will be operated and managed in accordance with the Environmental Protection (Rural Landfill) Regulations 2002. This will include fencing to reduce the potential for attracting fauna.</li> <li>• Blasting operations will be limited to daytime only to limit disturbance to fauna including bats.</li> <li>• Noise, dust and light emissions will be controlled where possible to avoid excessive disturbance to native fauna, including directing lights to working areas, shielding lights to reduce glow, and using conventional dust suppression techniques (i.e. water trucks).</li> <li>• Awareness training will identify conservation significant fauna and habitat and discuss relevant management measures, personnel/contractor responsibilities, and incident reporting requirements (i.e. reporting of fauna observations and/or incidents).</li> <li>• All fauna mortalities and injuries will be reported to the Miralga Creek Environmental Advisor within 24 hours and recorded within Atlas Iron's incident reporting system.</li> </ul>



Mitigations to be Applied	
	<ul style="list-style-type: none"> <li>• All sightings of conservation significant fauna will be reported to the Miralga Creek Environmental Advisor.</li> <li>• Where required, fauna will be handled and transported in accordance with the procedures outlined in the DBCA Standard Operating Procedure Transport and Temporary Holding of Wildlife (Department of Biodiversity, Conservation and Attractions, 2017).</li> <li>• Interactions with fauna (e.g. feeding, harassment, capture, killing) are not permitted unless specifically authorised by the Senior Environmental Advisor.</li> <li>• The Miralga Creek Environmental Advisor will report all conservation significant fauna injuries and mortalities to DBCA within one week.</li> <li>• Domestic pets are prohibited to avoid interactions with or disturbance to conservation significant fauna.</li> <li>• Implementation of Atlas Iron' Introduced Fauna / Pest Control Procedure (950-HSE-EN-PRO-0022), including recording all introduced fauna sightings and the implementation of a feral animal control program, as required (i.e., where sightings are regular and/or if nuisance or dangerous individuals are recorded).</li> <li>• In addition to the GDP, implementation of the following procedures to ensure weeds are controlled, as far as practicable: <ul style="list-style-type: none"> <li>– Flora Management Procedure (950-HSE-EN-PRO0010).</li> <li>– Weed Hygiene Procedure (950-HSE-EN-PRO-0002).</li> </ul> </li> </ul> <p>Specific to the management of cave CMRC-15:</p> <ul style="list-style-type: none"> <li>• Blasting will be undertaken in accordance with the recommendations contained in Blast It Global (2020) and detailed in the SSMP</li> <li>• Recommendation provided in Bat Call WA (2020) will be followed and included in the SSMP</li> </ul>
<b>Rehabilitation</b>	<ul style="list-style-type: none"> <li>• All areas of the Indicative Disturbance Footprint (except for open pits) will be progressively rehabilitated as soon as practicable and as required by the MCP.</li> <li>• A MCP will be updated triennially or as required when significant changes are made to the Proposal. A detailed MCP, which will contain further information on rehabilitation works, will be prepared approximately one year to six months prior to the cessation of mining as stated in the MCP.</li> <li>• Rehabilitation works are expected to return disturbed areas (other than pits) to a stable and vegetated state. Revegetation is expected to provide some value for fauna although it is acknowledged that fauna habitats will not be restored to their pre-disturbance state.</li> </ul>
<b>Offset</b>	A contribution to the Pilbara Environmental Offset Fund is expected to be made based on the number of hectares of clearing in the Chichester subregion as detailed in Chapter 8.

## 6.5 Predicted Outcome

The predicted impacts to Terrestrial Fauna from the Proposal after applying the mitigation hierarchy (avoid, minimise, rehabilitate) are:

- Potential clearing of up to 59.6 ha of high quality denning and foraging habitat for the Northern Quoll (Gorge/ Gully and Hillcrest/ Hill Slope habitat mapped within the Development Envelope).





- Potential clearing of up to 59.6 ha roosting habitat for the Ghost Bat (Gorge/ Gully and Hillcrest/ Hill Slope habitat mapped within the Development Envelope).
- Loss of one occasional nocturnal roost for the Ghost Bat (the category 4 cave CMRC-02).
- Potential temporary abandonment of caves close to the mining areas by Ghost Bat.
- Increased reliance by Ghost Bat on Lalla Rookh and other nearby roosts as refuges during mining.
- Retention of 15 of 16 known caves post-mining, including the category 2 potential maternity roost CMRC-15.
- No direct impact to any permanent waterholes within or directly adjacent to the Development Envelope.
- No significant impact to SRE fauna or habitat.

The Proposal's most significant pre-mitigation impact is predicted to be impacts to the Ghost Bat cave grouping associated with CMRC-15. Atlas Iron has invested substantial effort into identifying and modelling impacts and seeking expert advice on this matter. This has resulted in the following conclusions being made:

- Bat Call WA's (2020) conclusion regarding risk of impact to the species aligns with the assessment in the vertebrate fauna impact assessment (Biologic, 2020b), which assessed the impact against all significant impact criteria as "unlikely" if cave CMRC-15 is retained without collapse and without alteration of its microclimate (Biologic, 2020b).
- Work completed by Blast It Global (2020) determined that drill and blast activities can be conducted, using the blast parameters modelled in their report, to within close proximity of the cave complex without resulting in significant vibration, damage to or collapse of the caves, nor adverse impacts from blast fume or dust. This applies to blasting up to the closest planned point, within 23 m of cave CMRC-15 (Blast It, 2020).

After the application of mitigation hierarchy (i.e., avoidance, minimisation and rehabilitation measures) and application of the offset package, Atlas Iron expects that the EPA's objective for Terrestrial Fauna can be met.

## 6.6 Terrestrial Fauna Summary

A summary of for this factor is provided in Table 6.12. Further details are provided in the remainder of this section.

**Table 6.12 – Terrestrial Fauna Summary**

Factor	Terrestrial Fauna Summary
<b>EPA Objective</b>	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
<b>Policy and Guidance</b>	<p>The EPA has published a number of guidelines for the Terrestrial Fauna factor. Guidance relevant to the Proposal includes:</p> <ul style="list-style-type: none"> <li>• Environmental Factor Guideline: Terrestrial Fauna</li> <li>• Technical Guidance: Sampling methods for terrestrial vertebrate fauna (Environmental Protection Authority, 2010).</li> </ul>



Factor	Terrestrial Fauna Summary
	<ul style="list-style-type: none"> <li>• Technical Guidance: Terrestrial Fauna Surveys (Environmental Protection Authority, 2004).</li> <li>• Technical Guidance: Sampling of short range endemic invertebrate fauna (Environmental Protection Authority, 2009).</li> </ul> <p>Several guidelines published by the DAWE, DBCA and their predecessors are also of relevance for species listed under the EPBC Act, including:</p> <ul style="list-style-type: none"> <li>• Survey Guidelines for Australia's Threatened Bats (DEWHA, 2010a).</li> <li>• Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010b).</li> <li>• Survey Guidelines for Australia's Threatened Mammals (DSEWPAC, 2011a).</li> <li>• Survey Guidelines for Australia's Threatened Reptiles (DSEWPAC, 2011b).</li> <li>• EPBC Act referral guideline for the endangered northern quoll <i>Dasyurus hallucatus</i> (Department of the Environment, 2016).</li> <li>• Interim guideline for preliminary surveys of night parrot (<i>Pezoporus occidentalis</i>) in Western Australia (Department of Parks and Wildlife, 2017).</li> <li>• Conservation Advice, <i>Macroderma gigas</i>, Ghost bat (Threatened Species Scientific Communittee, 2016).</li> </ul>
<b>Receiving Environment</b>	<p>Six fauna habitat types mapped, being Hillcrest/ Hillslope, Low Stony Hills, Major Drainage Line, Sand Plain, Stony Plain and Gorge/ Gully.</p> <p>Sixteen caves known to support the Ghost Bat and/or Pilbara Leaf-nosed Bat, including potential Ghost Bat maternity roost CMRC-15.</p> <p>No perennial waterholes of value for fauna.</p> <p>Seven conservation significant fauna were confirmed present including the Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Peregrine Falcon, Northern Brush-tailed Possum and Grey Falcon.</p>
<b>Potential Impacts</b>	<ul style="list-style-type: none"> <li>• Loss and/or degradation of fauna habitat, particularly for conservation significant fauna.</li> <li>• Loss and/or degradation of terrestrial fauna habitat due to increased presence of weed species.</li> <li>• Injuries to and mortalities of fauna caused by interactions with vehicles, infrastructure, machinery and the workforce.</li> <li>• Reduced diversity or abundance of foraging resources due to altered hydrological regimes.</li> <li>• Alteration in behaviour of fauna due to noise, vibration, artificial light emissions and dust.</li> <li>• Increased presence of non-indigenous fauna species.</li> <li>• Alteration to fire regimes.</li> </ul>
<b>Mitigation</b>	<p><b>Avoidance:</b></p> <ul style="list-style-type: none"> <li>• The Proposal has avoided the need to clear additional fauna habitat by using the existing camp, Abydos Link Road (haul road; ALRE) and borefield infrastructure associated with Atlas Iron's Abydos Project.</li> <li>• The Proposal has been designed to avoid direct impacts to 15 out of the 16 caves in the Study Area, as well as the significant Lalla Rookh maternity cave which lies 3 km outside of the Development Envelope.</li> </ul>



Factor	Terrestrial Fauna Summary
	<ul style="list-style-type: none"> <li>• The Development Envelope has been designed to avoid the majority of mapped area of fauna habitats of most significance: <ul style="list-style-type: none"> <li>– In relation to the three most significant habitat types for vertebrate fauna: Approximately 99% of Gorge/ Gully habitat, 90% of Hillcrest/ Hillslope habitat and 96% of Major Drainage Line will be retained outside of the Development Envelope. It is likely that additional parts of these habitat types will be retained in the final layout of the Disturbance Footprint.</li> <li>– In relation to the two most significant habitat types for invertebrate fauna: Approximately 10 ha of Gorge/ Gully habitat and 696 ha of Hillcrest/ Hillslope habitat will be retained outside of the Development Envelope. It is likely that additional parts of these habitat types will be retained in the final layout of the Disturbance Footprint.</li> <li>– All known permanent waterholes are outside of the Development Envelope.</li> </ul> </li> </ul> <p><b>Minimisation and management:</b></p> <p>The following plans and procedures will be implemented to assist in minimising impacts to fauna and fauna habitat:</p> <ul style="list-style-type: none"> <li>• GDP Procedure (950-HSE-EN-PRO-0001).</li> <li>• Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).</li> <li>• Fauna Management Procedure (950-HSE-EN-PRO-0012).</li> <li>• Landfill Management Procedure (950-HSE-EN-PRO-0020).</li> <li>• Waste Management Procedure (950-HSE-EN-PRO-0023).</li> <li>• Introduced Fauna / Pest Control Procedure (950-HSE-EN-PRO-0022).</li> <li>• Significant Species Management Plan (Appendix K).</li> <li>• Water Management Plan and Site Water Operating Plan (<i>in preparation</i>).</li> </ul> <p>Key management measures contained in these plans include:</p> <ul style="list-style-type: none"> <li>• No more than 284.9 ha of vegetation/habitat within the 621.1 ha Development Envelope will be cleared/disturbed.</li> <li>• Clearing in/of sensitive habitats including caves, gorges and drainage lines will be kept to the minimum necessary for safe construction and operation of the Proposal.</li> <li>• Speed limits will be enforced across the site.</li> <li>• Off-road driving will be prohibited unless otherwise authorised by senior management to minimise potential vehicle strikes.</li> <li>• Night-time vehicle movements will be restricted where possible to minimise potential vehicle strikes.</li> <li>• All bins storing putrescible waste will have tightly secured lids to avoid fauna attraction and entry.</li> <li>• The landfill will be operated and managed in accordance with the Environmental Protection (Rural Landfill) Regulations 2002. This will include fencing to reduce the potential for attracting fauna.</li> <li>• Blasting operations will be limited to daytime only to limit disturbance to fauna including bats.</li> <li>• Noise, dust and light emissions will be controlled where possible to avoid excessive disturbance to native fauna, including directing lights to working areas, shielding lights to reduce glow, and using conventional dust suppression techniques (i.e. water trucks).</li> </ul>



Factor	Terrestrial Fauna Summary
	<ul style="list-style-type: none"> <li>• Clearing will occur in accordance with Atlas Iron's Ground Disturbance Permit Procedure. No clearing will occur without prior authorisation from Atlas Iron's Ground Disturbance Permitting System. This will ensure that clearing does not occur outside the Development Envelope or exceed 284.9 ha.</li> <li>• Atlas Iron will abstract water in accordance with 5C Licences to take groundwater, a Water Management Plan and Site Water Operating Plan in accordance with the Department of Water and Environmental Regulations requirements.</li> </ul> <p>Specific to the management of cave CMRC-15:</p> <ul style="list-style-type: none"> <li>• Blasting will be undertaken in accordance with the recommendations contained in Blast It Global (2020) and detailed in the SSMP. Key measures include: <ul style="list-style-type: none"> <li>– Design blasts to perform to the blast criteria (i.e. limit to 100 mm/s but design to achieve 85 mm/s) using the reference values set out in Blast It Global (2020).</li> <li>– Establish vibration monitors in caves CMRC-13, -14 and -15 for blasting at Miralga East pits 2 and 3.</li> <li>– Avoid blasting within 100 m of a cave until the results of monitoring validate predictions with a reasonable degree of confidence.</li> <li>– If vibration exceeds 100 mm/s, blasting should cease until the cause has been determined and steps to prevent a reoccurrence have been taken. A cave inspection is required to assess any impacts.</li> <li>– Periodically inspect caves to confirm the vibration limits are fit for purpose.</li> </ul> </li> <li>• Recommendations provided in Bat Call WA (2020) will be followed and included in the SSMP.</li> </ul> <p><b>Rehabilitation:</b></p> <ul style="list-style-type: none"> <li>• All areas of the Indicative Disturbance Footprint (except for open pits) will be progressively rehabilitated as soon as practicable and as required by the MCP.</li> <li>• A MCP will be updated triennially or as required when significant changes are made to the Proposal. A detailed MCP, which will contain further information on rehabilitation works, will be prepared approximately one year to six months prior to the cessation of mining as stated in the MCP.</li> <li>• Rehabilitation works are expected to return disturbed areas (other than pits) to a stable and vegetated state. Revegetation is expected to provide some value for fauna although it is acknowledged that fauna habitats will not be restored to their pre-disturbance state.</li> </ul> <p><b>Offset:</b></p> <ul style="list-style-type: none"> <li>• A contribution to the Pilbara Environmental Offset Fund is expected to be made based on the number of hectares of clearing in the Chichester subregion as detailed in Chapter 8.</li> </ul>
<b>Predicted Outcome</b>	<ul style="list-style-type: none"> <li>• Potential clearing of up to 59.6 ha of high quality denning and foraging habitat for the Northern Quoll (Gorge/ Gully and Hillcrest/ Hill Slope habitat mapped within the Development Envelope).</li> <li>• Potential clearing of up to 59.6 ha roosting habitat for the Ghost Bat (Gorge/ Gully and Hillcrest/ Hill Slope habitat mapped within the Development Envelope).</li> <li>• Loss of one occasional nocturnal roost for the Ghost Bat (the category 4 cave CMRC-02).</li> <li>• Potential temporary abandonment of caves close to the mining areas by Ghost Bat.</li> </ul>





Factor	Terrestrial Fauna Summary
	<ul style="list-style-type: none"><li>• Increased reliance by Ghost Bat on Lalla Rookh and other nearby roosts as refuges during mining.</li><li>• Retention of 15 of 16 known caves post-mining, including the category 2 potential maternity roost CMRC-15.</li><li>• No direct impact to any permanent waterholes within or directly adjacent to the Development Envelope.</li><li>• No significant impact to SRE fauna or habitat.</li></ul>



## 7. Other Environmental Factors

In addition to the key environmental factors discussed in previous sections, the Proposal has the potential to interact with several other environmental factors considered by the EPA, including:

- Subterranean Fauna
- Landforms
- Terrestrial Environmental Quality
- Inland Waters
- Air Quality
- Social Surroundings.

Given the Proposal's location, and in the absence of asbestiform and radioactive material, the marine factors and Human Health factor are not considered relevant to this Proposal.

Atlas Iron anticipates that the EPA's objectives for the above listed factors will be met, given the low level of impact anticipated and the application of proposed mitigation measures and other regulatory mechanisms.

Table 7.1 presents a brief overview of each of these other environmental factors.

**Table 7.1 – Other Environmental Factors**

Item	Details
<b>Subterranean Fauna</b>	
<b>EPA objective</b>	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.
<b>Policy and guidance</b>	<ul style="list-style-type: none"> <li>• Environmental Factor Guideline: Subterranean Fauna (EPA, 2016g)</li> <li>• Technical Guidance: Subterranean Fauna Survey (EPA, 2016h)</li> <li>• Technical Guidance: Sampling Methods for Subterranean Fauna (EPA, 2016i)</li> </ul>
<b>Studies</b>	<ul style="list-style-type: none"> <li>• Miralga Creek: Subterranean Fauna Assessment (Biologic, 2020d) (Appendix L)</li> </ul>
<b>Receiving Environment</b>	<p>Prior to the two-season Level 2 subterranean fauna undertaken by Biologic (2020c) no previous subterranean fauna sampling had been undertaken within the area around the Miralga Creek Project. The nearest subterranean fauna survey had been conducted 4 km south-east of the Proposal at Sulphur Springs where a diverse stygofauna assemblage but depauperate troglofauna assemblage was identified.</p> <p>Database searches revealed seven troglofauna (including potential troglofauna) and 55 stygofauna (including potential stygofauna) taxa within 40 km of the Proposal. None of the troglofauna or stygofauna taxa recorded from the database searches were recorded during field sampling for the Proposal.</p> <p>Field sampling involved 148 bores and holes throughout subterranean Study Area, resulting in 292 troglofauna samples and 110 stygofauna samples. A total of 5,266 subterranean fauna specimens were recorded, comprising approximately 96% stygofauna and 4% troglofauna.</p>



Item	Details
	<p>25 morphospecies of troglofauna (including potential troglofauna) taxa were identified:</p> <ul style="list-style-type: none"> <li>• Two taxa were known to be widespread in the Pilbara</li> <li>• Six taxa were recorded from multiple locations within the Study Area</li> <li>• Fourteen troglofauna taxa were singleton records or taxa known only from single sites</li> <li>• The remaining three groups represented indeterminate taxa that could not be resolved to species-level due to specimens being immature, in poor/damaged condition or the wrong sex for species-level identifications.</li> </ul> <p>Taxonomic identifications of stygofauna (including potential stygofauna) revealed 60 morphospecies and 22 indeterminate:</p> <ul style="list-style-type: none"> <li>• 19 were widespread taxa known to occur regionally or throughout the Pilbara</li> <li>• 16 taxa were recorded from multiple locations within the Study Area, of these: <ul style="list-style-type: none"> <li>– 13 taxa were recorded more widely throughout the Study Area, with linear ranges ranging from 15 to 49 km</li> <li>– The remaining three taxa recorded from multiple locations had more restricted distributions, with linear ranges ranging from 0.2 to 10 km.</li> </ul> </li> <li>• Twenty-two stygofauna taxa were singleton records or taxa known only from single sites</li> <li>• Three taxa represented unique higher-level taxa that could not be identified to species level.</li> </ul>
<p><b>Potential impacts</b></p>	<p>The risk assessment for subterranean fauna was based on current taxonomic and ecological information, available habitat information (including three dimensional habitat modelling based on detailed drill log data) and the likelihood that any species of troglofauna or stygofauna would be limited to habitats directly impacted by the proposed development. Impact areas were considered to be (Biologic, 2020d):</p> <ul style="list-style-type: none"> <li>• Troglofauna: the direct impact area comprised the proposed pit boundaries. Although indirect impacts such as shock and vibration from blasting, changes to infiltration beneath stockpiles and waste dumps, and habitat desiccation from pit walls or groundwater drawdown may extend beyond the pit boundaries, these risks are generally considered minor, manageable, and/or difficult to measure and assess, therefore Biologic's (2020c) impact assessment has focussed on the direct impacts of mining.</li> <li>• Stygofauna: the impact area comprised the estimated groundwater drawdown from the existing, licensed borefields.</li> </ul> <p>Six troglofauna taxa are currently known only from the direct impact areas of the proposed development. The potential risks to these taxa from mining were characterised using a five-point risk classification system (i.e. high, moderate-high, moderate, low-moderate, or low risk) as follows:</p> <ul style="list-style-type: none"> <li>• Low risk (4 taxa): <i>Dodecastyla</i> sp. indet., <i>Nocticola currani</i> s.l., <i>Phaconeura</i> sp. indet. and <i>Phalangodidae</i> sp. indet. These taxa were assessed as 'low risk' due to current knowledge of taxonomy and because their known records were located in Cleaverville formation BIF habitat which extends extensively beyond impact areas.</li> <li>• Low-moderate risk (2 taxa): <i>Tyrannochthonius</i> `BPS228` and <i>Tyrannochthonius?</i> sp. indet. (Sandtrax). These taxa were assessed 'as low-moderate' risk as they are more likely to represent troglobitic SRE fauna and stem from groups more prone to have small distributions, although their habitat is modelled to continue well beyond impact areas.</li> </ul> <p>Twelve stygofauna taxa recorded during the current survey of the Study Area are known only from within the estimated groundwater drawdown. Based on current taxonomic and ecological information, modelling of groundwater drawdown and the likely extent of suitable habitats for stygofauna beyond the modelled extent of drawdown, all twelve taxa were</p>



Item	Details
	<p>assigned as being at 'low risk' from the Proposal due to current knowledge of taxonomy, the minimal predicted depth (1.6 m) of the groundwater drawdown, and the likely extent of suitable stygofauna habitats (both within alluvials as well as fractured rock aquifers) beyond drawdown impacts:</p> <ul style="list-style-type: none"> <li>• Low risk (12 taxa): <i>Wandesia</i> sp. indet., Candonidae `BOS1332`, <i>Ilyodromus</i> sp. indet., <i>Pescecylops</i> `BCY065`, <i>Parastenocaris</i> `BHA266`, <i>Bathynellidae</i> sp. VLS, nr <i>Billibathynella</i> sp. indet., nr <i>Hexabathynella</i> sp. indet., <i>Bogidiellidae</i> sp. indet., <i>Melitidae</i> `BAM160` (sp. 1 group), Paramelitidae `BAM162`, and Paramelitidae Genus 2 `BAM164`.</li> </ul>
<b>Mitigation</b>	<p><b>Minimisation and management:</b></p> <p>The following plans and procedures will be implemented to assist in minimising impacts to significant fauna and flora habitat and associated landforms:</p> <ul style="list-style-type: none"> <li>• Ground Disturbance Permit.</li> <li>• Clearing and Grubbing Procedure.</li> </ul> <p>Key management measures contained in these plans include:</p> <ul style="list-style-type: none"> <li>• No more than 284.9 ha of vegetation/habitat within the 621.1 ha Development Envelope will be cleared/disturbed.</li> </ul> <p>In addition, Atlas Iron will manage water abstraction from the existing bores in accordance with 5C Licence requirements to take groundwater granted under the RIWI Act and associated Water Management Plan and Site Water Operating Plan. This will limit water abstraction, preserving aquifers for use by stygofauna, and preserving the humidity of habitats for troglofauna.</p>
<b>Predicted Outcome</b>	<p>Biologic (2020c) consider the Proposal poses only:</p> <ul style="list-style-type: none"> <li>• a low risk to all sampled stygofauna</li> <li>• a low-moderate risk for two troglofauna taxa (<i>Tyrannochthonius</i> `BPS228` and <i>Tyrannochthonius?</i> sp. indet. (Sandtrax))</li> <li>• a low risk for an additional four troglofauna taxa.</li> </ul> <p>With management to minimise impacts in place, this Proposal is expected to meet the EPA's objective for Subterranean Fauna.</p>
<b>Landforms</b>	
<b>EPA objective</b>	To maintain the variety and integrity of significant physical landforms so that environmental values are protected.
<b>Policy and guidance</b>	<ul style="list-style-type: none"> <li>• Environmental Factor Guideline: Landforms (Environmental Protection Authority, 2018).</li> </ul>
<b>Studies</b>	<ul style="list-style-type: none"> <li>• Miralga Creek Baseline Soil Assessment (Mine Earth, 2019) (Appendix M)</li> <li>• Miralga Creek Iron Ore Project: Detailed Flora and Vegetation Survey 2019 (Woodman Environmental, 2019a) (Appendix A)</li> </ul>
<b>Receiving Environment</b>	<p>As discussed in Section 5.1.2.1, ten land systems occur within the Woodman Environmental Study Area Development Envelope (Woodman Environmental, 2019a). In order of size (across Western Australia, most common to least) these are Rocklea, Macroy, Boolgeeda, Uaroo, Capricorn, River, Mallina, Platform, Calcrete and Satirist. Eight of these regional Land Systems fall within the Development Envelope:</p> <ul style="list-style-type: none"> <li>• Boolgeeda – 40.36 ha within the Development Envelope, 0.01% of the total extent</li> </ul>





Item	Details
	<ul style="list-style-type: none"> <li>• Capricorn – 304.13 ha, 0.06%</li> <li>• Macroy – 6.23 ha, 0.0005%</li> <li>• Platform – 22.3 ha, 0.01%</li> <li>• River – 44.57 ha, 0.01%</li> <li>• Rocklea – 1.82 ha, 0.0001%</li> <li>• Satirist – 121.31 ha, 0.32%</li> <li>• Uaroo – 80.58 ha, 0.01%.</li> </ul> <p>Less than 0.4% of each of these land systems falls within the Development Envelope, as the Indicative Disturbance Footprint as smaller than the Development Envelope it is clear that the Proposal will only have a very small impact on the extent of each impacted Land System.</p> <p>Landform association mapping was undertaken over a 2,600 ha Study Area covering Miralga East, Miralga West, Sandtrax, and both stockyard areas. Field observations of morphological differences between soil profiles and their occurrence within different landscapes were used to define landform units. Five soil-landform associations were identified:</p> <ul style="list-style-type: none"> <li>• Ridgelines/ rocky outcrops</li> <li>• Low hills/ scree slopes</li> <li>• Stony plains</li> <li>• Sandy plains</li> <li>• Drainage lines (Mine Earth, 2019).</li> </ul> <p>The Development Envelope is dominated by the following landform associations (Mine Earth, 2019):</p> <ul style="list-style-type: none"> <li>• Low hills/ scree slopes</li> <li>• Stony plain</li> <li>• Sandy plain.</li> </ul> <p>None of these landforms are restricted to the Development Envelope or Study Area.</p>
<b>Potential impacts</b>	<p>Removal or degradation of landforms resulting in:</p> <ul style="list-style-type: none"> <li>• Reduced landform diversity.</li> <li>• Reduced landform integrity.</li> <li>• Loss or degradation of associated ecological and social values.</li> </ul>
<b>Mitigation</b>	<p><b>Null impact:</b></p> <p>The Development Envelope avoids significant landforms.</p> <p><b>Minimisation and management:</b></p> <p>The following plans and procedures will be implemented to assist in minimising impacts to significant fauna and flora habitat and associated landforms:</p> <ul style="list-style-type: none"> <li>• Ground Disturbance Permit.</li> <li>• Clearing and Grubbing Procedure.</li> </ul> <p>Key management measures contained in these plans include:</p> <ul style="list-style-type: none"> <li>• No more than 284.9 ha of vegetation/habitat within the 621.1 ha Development Envelope will be cleared/disturbed.</li> <li>• Clearing in/ of sensitive habitats including caves, gorges and drainage lines will be kept to the minimum necessary for safe construction and operation of the Proposal.</li> </ul>



Item	Details
	<ul style="list-style-type: none"> <li>Accurate delineation of the GDP boundary in the field prior to any works commencing, including all buffers and values to be avoided.</li> </ul> <p><b>Rehabilitation:</b></p> <ul style="list-style-type: none"> <li>All areas of the Indicative Disturbance Footprint (except for open pits) will be progressively rehabilitated as soon as practicable and as required by DMIRS under the <i>Mining Act 1978</i> and current Mine Closure Guidelines (Department of Mines, Industry Regulation and Safety, 2020). Rehabilitation works are expected to return disturbed areas to a safe, stable, non-polluting and vegetated state.</li> <li>A MCP will be developed according to the current Mine Closure Guidelines and updated at least every three years. MCP are required to become more detailed with each review. A detailed MCP, which will contain further information on rehabilitation works, will be prepared approximately one year to six months prior to the cessation of mining.</li> <li>During ground disturbance and clearing, topsoil will be separately stockpiled for future use in rehabilitation: <ul style="list-style-type: none"> <li>Low hills / scree slopes together with Ridgelines/ Rocky outcrops can be stockpiled together for future use on rehabilitated slopes</li> <li>Stony plain and Sandy plain material are suitable only for flat areas of the rehabilitated land form.</li> </ul> </li> </ul>
<b>Predicted Outcome</b>	<p>As the landforms and land systems within the Disturbance Envelope are widely distributed in the region, and impacts to a very minor (less than 0.4% of each land system will be disturbed) the other criteria for assessing the importance of this factor are not considered to be significant (Variety, Integrity, Scientific importance and Rarity).</p> <p>This Proposal is expected to meet the EPA's objective for Landforms.</p>
<b>Terrestrial Environmental Quality</b>	
<b>EPA objective</b>	To maintain the quality of land and soils so that environmental values are protected.
<b>Policy and guidance</b>	<ul style="list-style-type: none"> <li>Environmental Factor Guideline Terrestrial Environmental Quality (Environmental Protection Authority, 2016).</li> <li>National Environment Protection (Assessment of Site Contamination) Measure (NEPM, 2013).</li> </ul>
<b>Studies</b>	<ul style="list-style-type: none"> <li>Miralga Creek Baseline Soil Assessment (Mine Earth, 2019) (Appendix M)</li> <li>Miralga Creek Project Mine Waste Characterisation Assessment (Mine Earth, 2020) (Appendix N)</li> </ul>
<b>Receiving Environment</b>	<p>As identified above under the Landforms factor, landform association mapping has been undertaken based on field observations of morphological differences between soil profiles and their occurrence within different landscapes (Mine Earth, 2019).</p> <p>Soils within the Study Area are broadly characterised as follows (Mine Earth, 2019):</p> <ul style="list-style-type: none"> <li>There was an overall, general consistency in the soil characteristics within the three mining areas; soils at the stockyard were the most consistently different from the other samples for a number of measured factors.</li> <li>The major differences in the soils from the various soil-landform associations were: <ul style="list-style-type: none"> <li>The depth of soil present over partially weathered or competent rock</li> <li>The amount of coarse rock fragments (&gt;2 mm) present within the soil materials.</li> </ul> </li> </ul>



Item	Details
	<ul style="list-style-type: none"> <li>• Many of the chemical and physical characteristics of the surface soils across the study area were relatively similar, with little consistent correlation with soil-landform association, or sample depth. All soils sampled were relatively coarse grained, with generally low clay contents (minor increase in clay with depth), were non-saline, partially dispersive upon severe disturbance, free draining (moderate hydraulic conductivity) and were typically low in organic carbon and plant-available nutrients.</li> </ul> <p>Five soil-landform associations were identified (Mine Earth, 2019):</p> <ul style="list-style-type: none"> <li>• Ridgelines/ Rocky outcrops</li> <li>• Low hills/ Scree slopes</li> <li>• Stony plains</li> <li>• Sandy plains</li> <li>• Drainage lines.</li> </ul> <p>Surface soils (0 to 0.2 m) from the Low hills/ Scree slopes and Ridgelines / Rocky outcrops landforms are considered to be a valuable resource for rehabilitation material, and generally have a high coarse rock fragment content, moderately rapid hydraulic conductivity, and are predominately non-saline and non-sodic, indicating a low inherent potential for erosion (Mine Earth, 2019).</p> <p>As outlined in Section 2.3.4, the vast majority of waste rock material has moderate to high resistance to erosion, with the exception of a small proportion of shale found only in the Miralga West pit (Mine Earth, 2020). All mine waste types within the planned pit shells and within a 10 m buffer outside the pit shells were classified as NAF and all mine waste types from all deposits are expected to release only negligible metals/ metalloids during weathering. (Mine Earth, 2020).</p>
<b>Potential impacts</b>	<ul style="list-style-type: none"> <li>• Inappropriate transport, handling and storage of hydrocarbons and chemicals resulting in soil contamination.</li> <li>• Poor management of problematic waste rock material (limited to shale), resulting in erodible waste dump surfaces.</li> <li>• Ground disturbance, resulting in changes to soil quantity, quality and structure.</li> <li>• Inadequate surface water management, resulting in accelerated soil erosion.</li> </ul>
<b>Mitigation</b>	<p><b>Minimisation and management:</b></p> <p>The following procedures will be implemented to reduce impacts to soils and to ensure impacted soils are appropriately salvaged and managed for use in rehabilitation:</p> <ul style="list-style-type: none"> <li>• GDP Procedure (950-HSE-EN-PRO-0001).</li> <li>• Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).</li> <li>• Weed Hygiene Procedure (950-HSE-EN-PRO-0002).</li> <li>• Hydrocarbon Management Procedure (950-HSE-EN-PRO-0005).</li> <li>• Hydrocarbon (and Chemical) Spill Management Procedure (950-HSE-EN-PRO-0007).</li> <li>• Bioremediation Management Procedure (950-HSE-EN-PRO-0013).</li> <li>• MCP (once approved by DMIRS).</li> </ul> <p>In relation to soil management, the following key management measures will be employed:</p> <ul style="list-style-type: none"> <li>• No more than 284.9 ha of land within the 621.1 ha Development Envelope will be cleared/disturbed.</li> <li>• Restricting clearing to the minimum necessary for safe construction and operation of the Proposal and to within approved areas through internal GDP Procedure.</li> </ul>



Item	Details
	<ul style="list-style-type: none"> <li>• Where practicable, topsoil shall be stripped to a minimum depth of 200 mm below the natural surface unless otherwise stated in GDP conditions.</li> <li>• Topsoil stripping shall only be undertaken in dry conditions to prevent compaction and poor seed viability.</li> <li>• Topsoil shall paddock dumped into stockpiles not exceeding 2 m in height.</li> <li>• The use/placement of the salvaged topsoil on waste rock landforms will be strategic in that it will only occur in areas likely to be successful in vegetation establishment in the long term.</li> <li>• Surface soils (0 to 0.2 m) from the Low hills/ scree slopes and Ridgelines / Rocky outcrops should be stockpiled together and preferentially used in the rehabilitation of slopes. Surface soils from other landforms should only be used on flat surfaces.</li> <li>• Surface soils from the stockyard areas should not be used in rehabilitation at the mining areas without treatment to ameliorate its higher level of dispersivity</li> <li>• All areas of the Indicative Disturbance Footprint (except for open pits) will be progressively rehabilitated as required by the MCP. Rehabilitation works are expected to return disturbed areas to a stable and vegetated state.</li> <li>• Ripping of the surface of the waste rock dumps will follow redeployment of topsoil to improve rainfall infiltration and increase root penetrability.</li> <li>• A MCP will be updated triennially or as required when significant changes are made to the Proposal. A detailed MCP, which will contain further information on rehabilitation works, will be prepared approximately one year to six months prior to the cessation of mining as stated in the MCP. Weeds and weed-contaminated topsoil will be cleared, handled and stockpiled separately to native vegetation and 'clean' topsoil.</li> <li>• Containment of hydrocarbons in accordance with AS 1940:2004 – <i>The Storage and Handling of Flammable and Combustible Liquids</i>, this includes siting and bunding/containment restrictions, provision and maintenance of relevant MSDS and regular inspections.</li> <li>• Refuelling procedures, including the provision of a spill kit at all refuelling stations.</li> <li>• Spill recovery and clean up materials maintained at all hazardous material storage areas. Relevant employees and contractors will be trained in the use of this equipment.</li> <li>• All spills, irrespective of volume, will be reported internally through the INX system. Spills to ground / outside of a bund are reported as an environmental incident and cleaned up appropriately. Spills inside a bund are reported as a hazard and cleaned up appropriately.</li> <li>• Contaminated soil shall be taken to the site bioremediation facility (where present), or stockpiled for removal offsite by a licenced controlled waste contractor.</li> </ul> <p>Atlas Iron will ensure appropriate surface water management is incorporated into the final mine design, in general accordance with the following objectives and design principles:</p> <ul style="list-style-type: none"> <li>• Diverting naturally occurring local surface water around mine infrastructure by means of drainage channels, earth bunds, and road culverts with adequate scour protection where necessary. Note Atlas Iron will not be actively diverting clean runoff around pits, instead allowing surface water flows to drain into and collect within pit (where not diverted by safety bunds/windrows).</li> <li>• Isolating the waste rock dump areas from external runoff (i.e., clean stormwater) by bunding around the perimeter and encouraging the minimal internal flows to be retained and infiltrate and/or evaporate. Internal flows will otherwise be directed to a sedimentation pond, where the bulk of the suspended material will be settled out prior to any discharge to the downstream environment.</li> </ul>





Item	Details
	<ul style="list-style-type: none"> <li>Waste rock dumps will be designed to resist erosion and sediment migration to the downstream environment, shale from the Miralga West pit will not be used on the final surface of the waste dump.</li> </ul>
<b>Predicted Outcome</b>	<p>The risk of significant contamination from hydrocarbon and/or chemical spills and the handling of problematic waste material is considered low with the implementation of the above hydrocarbon and waste rock management.</p> <p>Atlas Iron expects that the EPA's objective for Terrestrial Environmental Quality can be met.</p>
<b>Inland Waters</b>	
<b>EPA objective</b>	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected (Environmental Protection Authority, 2018).
<b>Policy and guidance</b>	<ul style="list-style-type: none"> <li>Environmental Factor Guideline: Inland Waters (Environmental Protection Authority, 2018)</li> <li>Western Australian water in mining guideline (Department of Water, 2013)</li> </ul>
<b>Studies</b>	<ul style="list-style-type: none"> <li>Miralga Creek Project Water Management Assessment (Atlas Iron Pty Ltd, 2020) (Appendix O)</li> <li>Miralga Creek Project Surface Water Assessment (RPS, 2019)</li> <li>Abydos East Haul Road - Mining Proposal: Hydrology and Hydrogeology Impact Assessment (MWH, 2012)</li> </ul>
<b>Receiving Environment</b>	<p><b>Surface Water</b></p> <p>Major surface drainage in the area generally trends north, through dryland tributaries/ creeks (including Miralga Creek), into either the Shaw River or Strelley River (RPS, 2019). Both rivers join the De Grey River system to the north. The De Grey River Basin covers an area of 56,890 km<sup>2</sup> (Ruprecht, 2000) with its major tributaries being the Strelley, Shaw, Coongan, Oakover and Nullagine Rivers (Figure 2.9).</p> <p>Surface flow in the region occurs almost exclusively as a direct response to rainfall and is highly skewed to summer events (December to March). Flow in the smaller channels is typically of short duration and ceases soon after the rainfall event passes. In the larger river channels, which drain the larger catchments, runoff can persist for several weeks and possibly months following major rainfall events such as tropical cyclones. Surface water can persist throughout the year in waterholes along the main rivers and creeks (RPS, 2019).</p> <p>Miralga East is located in the Miralga Creek catchment, a sub-component of the larger Shaw River Catchment. Miralga West and both stockyards are located in the Shaw River Catchment. Sandtrax lies within the separate Strelley River catchment. No perennial streams occur in the immediate vicinity of the Proposal.</p> <p>The Miralga East mining area runs along the northern side of Miralga Creek. A number of pools are evident within the creek and are likely maintained by saturated alluvials within drainage channel.</p> <p>Four large pools were mapped by Biologic and at the time were considered to be permanent (WMRC-01, -02, -14 and -15; Figure 6.4). Additional site visits have determined that only two have potential to be permanent (WMRC-14, -15; Appendix D). Several smaller, non-permanent pools are located across the area (Biologic, 2020a; Atlas Iron Pty Ltd, 2020). All water features mapped and investigated by consultants as part of the baseline surveys are located outside of the Development Envelope. Both potentially permanent pools are outside of the drawdown contours for the borefield.</p> <p>Drainage from the Miralga West ridge flows both to the south, directly to the Shaw River, and along some minor drainage lines which flow to the north and north-west before intersecting a</p>



Item	Details
	<p>minor tributary of the Shaw River some 1.5 km north of the mining area (Atlas Iron, 2019). Several pools were identified within 2.5 to 3.5 km of a pit and 650 to 850 m from the new haul road (WMIR-6, -7, -8, -9 and -11; Appendix D; Figure 6.4) (Biologic, 2019). All are located outside of the Development Envelope and are approximately 3.8 to 5.3 km away from the 0.5 m groundwater drawdown contour associated with the water supply borefield.</p> <p>Runoff from the Sandtrax mining area and waste dump flows down a narrow valley, before intersecting a drainage which flows to the east to intersect with the north-flowing Sulphur Springs Creek and eventually discharges into the Shaw River (Atlas Iron, 2020). Six pools were surveyed during Biologic (2020a) and/or Biologic (2019). None are considered to be permanent (Appendix D), and all were within the 0.3 to 0.4 m groundwater drawdown contours associated with the water supply borefield.</p> <p>The dominant water feature at the stockyards is the ephemeral Shaw River. Biologic (2019) recorded eight pools in the river channel (Figure 6.4):</p> <ul style="list-style-type: none"> <li>• WMIR-10, -13 and -15 near the existing Marble Bar Road</li> <li>• WMIR-12, -14, -16, -17 and -18 to the south of the southern stockyard.</li> </ul> <p>WMIR-10, -13 and -15 were all considered to be semi-permanent and supported <i>Melaleuca argentea</i>. Several of these supported groundwater dependent vegetation (discussed previously in Chapter 5). All of pools in the stockyards area are beyond the 0.5 m drawdown contours; three are on or just within the modelled 0.4 m contour (two of which supported <i>M. argentea</i>) and two are beyond the 0.2 m contour (one of which supported <i>M. argentea</i>) (Biologic, 2019).</p> <p>As all of the proposed mining areas are located atop high, narrow ridges, surface runoff into the pits will be minimal. The narrow ridges would also be unlikely to support infiltration of significant amounts of surface water, so any mounding of the underlying local water table would likely be subdued.</p> <p><b>Groundwater</b></p> <p>The Proposal is located in the Proclaimed Pilbara Groundwater Area. Groundwater in the area is available in the following primary aquifers (MWH, 2012):</p> <ul style="list-style-type: none"> <li>• Alluvial Aquifers: Generally, alluvial aquifers are associated with alluvial deposits along coastal plains and within the valleys associated with the drainage lines.</li> <li>• Fractured Rock Aquifers: Fractured rock aquifers are the predominant type within and around the Development Envelope; they are likely to underlie alluvial aquifers. Fractured rock aquifers are generally associated within structural fracture zones or faulting, igneous intrusions, sedimentary rocks and banded iron formations.</li> </ul> <p>Groundwater quality within and adjacent to the Development Envelope is Fresh to Marginal:</p> <ul style="list-style-type: none"> <li>• ALPB05, ALPB04, ALPB02 and ALB0066 were quite consistent with salinity &lt;1,000 mg/L (i.e. marginal) and near neutral (field pH 7.38–7.66) (Chemcentre data, May 2019)</li> <li>• Groundwater sampled from the Venturex borefield had a salinity concentration in the range of 308 to 764 mg/L of TDS (fresh to marginal). The sampled water also has pH values close to neutral. (URS, 2007, as reported in (2012)).</li> <li>• At the Abydos minesite, groundwater hydrochemistry ranges from near potable to brackish in nature (MWH, 2012).</li> </ul> <p>Groundwater levels in the existing ALRE borefield (ALPB01, 03, 04, 05, and ALB0066) range in depth from 13.98 to 16.84 mbgl. Groundwater levels range from 7.51 to 9.55 mbgl in the existing Venturex borefield (SSWB36, 38, 40). All bores are at low points in the local topography.</p> <p>A review of the Atlas Iron drill-hole database, investigating 180 Reverse Circulation (RC) holes, showed no water intersections during the mineral exploration program which was</p>



Item	Details
	<p>focused on pit areas. Follow up interviews with the project geologist confirmed the lack of water, so the expectation is that all pits would be well above the groundwater table and that no dewatering would be required.</p> <p>To further investigate groundwater levels across the Proposal, a broad range of existing and open RC holes were checked for water during the site visit 29 and 30 May 2019. All but one drill hole (MRRC0116) assessed during the site visit were dry. A small amount of water was noted in MRRC0116 at Miralga East at the very base of the hole. This is a shallow hole (30 m) at a somewhat elevated part of the ridge so the small amount of water is most likely remnant drill fluid (drilled in 2019, prior to the site visit), or surface runoff which has seeped down the outside of the surface casing. MRRC0116 is located over 150 m away from the Miralga East pit 1 and pit 2, along the inter-pit haul road.</p> <p>In addition to the site observations described above, below is a summary of knowledge of pit floors versus natural groundwater levels:</p> <ul style="list-style-type: none"> <li>• Miralga East: In the absence of drilling intercepts with groundwater during exploration and the absence of water from in-pit drill-holes observed in May 2019, the nearest assumed groundwater levels are two pools located to the south of the pits within Miralga Creek. These pools are within approximately 1 to 3 km of the Miralga East pits and were considered to be permanent by Biologic (2019) (pools WMRC-14 and -15). The surface elevations of these pools are 125 to 128 mRL. This represents a gap of over 90 m between the deepest planned point in any of the three Miralga East pits and groundwater.</li> <li>• Miralga West: The maximum planned pit depth is 156 mRL, approximately 20 to 30 m above the relative level of the plains to the west and north, and of the Shaw River to the east. Assuming as a worst case that the water table is at or near the elevation of the Shaw River bed, the pit floor will be a minimum of 30 m above the groundwater level.</li> <li>• Sandtrax: SSWB40 is located approximately 1 km to the north and has a standing water level in the order of 185 mRL, approximately 70 m below the planned pit depth. If it is assumed that at its shallowest the water level in the Sulphur Springs Creek sediments 500 m to the east of the mining area is at the approximate elevation of the creek bed, it would be in the order of 203 to 205 mRL. This represents a minimum a 50 m gap between the base of the planned Sandtrax pit and the surrounding groundwater level.</li> </ul> <p>Based on the above information, all pits will have at least a 30 m gap to groundwater at the completion of mining.</p>
<p><b>Potential impacts</b></p>	<ul style="list-style-type: none"> <li>• The largest surface water impact is anticipated to be from sediment laden runoff from waste landforms and stockpiles entering waterways (RPS, 2019). Runoff in the Pilbara is often high in sediment because of the rapid rainfall events and lack of ground cover.</li> <li>• Surface water run-off into pits during/after rainfall, potentially leading to water mounding beneath the pits.</li> <li>• Storage and spillage of chemicals and hydrocarbons, leading to potential contamination of surface and or groundwater resources.</li> <li>• Loss of catchment, leading to lower water volumes downstream. The total loss of catchment due to the five pits is estimated at 0.5 km<sup>2</sup> at closure. This is approximately 0.1% of the 480 km<sup>2</sup> catchment of Miralga Creek, and less than 0.01% of the 6,827 km<sup>2</sup> Shaw River Catchment (RPS, 2019).</li> <li>• Altered flow paths resulting in drainage shadowing/ponding at the intersections of the proposed haul road with Miralga Creek and Shaw River.</li> <li>• Interaction between groundwater and mine pits.</li> <li>• Impacts to environmental receptors due to groundwater drawdown are not considered to be significant, and are discussed in the following sections:</li> </ul>



Item	Details
	<ul style="list-style-type: none"> <li>- GDV – refer to Chapter 5</li> <li>- Subterranean fauna – refer to Chapter 6.6.</li> <li>• Reduced groundwater availability.</li> <li>• Loss of permanent surface water values.</li> </ul>
<b>Mitigation</b>	<p><b>Avoidance:</b></p> <ul style="list-style-type: none"> <li>• No re-routing of drainage lines is proposed for the Proposal.</li> <li>• All water features mapped by Biologic (2020a; 2019) are outside of the Development Envelope and will not be directly impacted</li> <li>• 23 of the water features mapped by Biologic (2020a; 2019) are beyond the 0.2 m modelled drawdowns and are not anticipated to be impacted from water supply activities (9 are approximately within the 0.2 to 0.4 m contours)</li> <li>• Initially, the Proposal's supporting infrastructure (e.g. ROM) were located within the Sulphur Springs Creek drainage, where they would likely be significantly affected during flow events, particularly larger events associated with cyclones (Atlas Iron Pty Ltd, 2020). The site layout has since been revised to move these aspects to the west.</li> </ul> <p><b>Minimisation and management:</b></p> <ul style="list-style-type: none"> <li>• The river crossing at Shaw River will be designed and constructed to over-top during periods of major stream flow. This will enable water flow past the crossing points and prevent significant amounts of water ponding up-stream, as well as prevent water shadow effects downstream.</li> <li>• The haul road crossing at Miralga Creek will be designed and constructed to enable water flow past the crossing point and prevent significant amounts of water ponding up-stream, as well as prevent water shadow effects downstream. This will be enabled through an over-topping design, or the installation of appropriate under-road drainage.</li> <li>• Bunding and diversions to protect downstream environments</li> <li>• Sump pumping to remove incident rainfall accumulation from within the pit boundaries will be required from time to time.</li> <li>• Diverting upstream surface flows around structures and into downstream water courses</li> <li>• Stormwater will be directed around pits to avoid excess water entering the pits and preserve pre-development flows. This will remain in place post-closure.</li> <li>• Monitoring during the life of mine will ensure the proposed surface water management measures are effective in maintaining the hydrological regimes in the downstream environment</li> <li>• Minimising disturbance in general by using existing tracks and keeping vehicle movements to a minimum</li> <li>• Limiting clearing and retain adequate buffer zones between disturbed areas and natural flow paths</li> <li>• Storage areas (chemicals, hydrocarbons, etc.) will be located away from, or bunded off from, external surface water flows</li> <li>• Sediment laden surface runoff from disturbed (operational) areas will be captured by bunding the perimeter of these areas and directing run-off to sedimentation basins (placed downstream of all disturbed areas). Water from these basins can be discharged once the sediment has been deposited.</li> <li>• Access roads will be constructed with a camber, side drains and regular 'turnouts' or mitre drains to discharge runoff into the surrounds</li> </ul>





Item	Details
	<ul style="list-style-type: none"> <li>• Atlas Iron will abstract water in accordance with 5C Licences to take groundwater, a Water Management Plan and Site Water Operating Plan in accordance with the Department of Water and Environmental Regulations requirements.</li> <li>• The following plans and procedures will be implemented to assist in minimising impacts to flora and vegetation:               <ul style="list-style-type: none"> <li>– Ground Disturbance Permit (GDP) Procedure (950-HSE-EN-PRO-0001).</li> <li>– Water Management Plan and Site Water Operating Plan (<i>in preparation</i>).</li> </ul> </li> </ul> <p><b>Rehabilitation:</b></p> <ul style="list-style-type: none"> <li>• All disturbed areas except for pits will be rehabilitation in accordance with the MCP. This will result in reduced erosion from disturbed surfaces.</li> </ul>
<b>Predicted Outcome</b>	<p>Given this typical sediment load (in the Pilbara) and the surface area of these structures, it is not anticipated that significant change in surface water quality will occur.</p> <p>Alteration of groundwater quality is not anticipated to occur as a result of this Proposal. Waste rock is benign (Section 2.3.4) and mining is above the water table only. Chemical storage and use will be limited to fuels and oils for plant and vehicle use. While spills may occur, significant impacts to water quality (surface and ground) are not anticipated.</p> <p>At closure, the approximate volume of run-off lost from the development of the Proposal will be equivalent to only approximately 0.5 km<sup>2</sup>, this is not considered to be environmentally significant (RPS, 2019).</p> <p>With the mitigation measures proposed, is anticipated that the EPA objective for Inland Waters will be met.</p>
<b>Air Quality</b>	
<b>EPA objective</b>	To maintain air quality and minimise emissions so that environmental values are protected.
<b>Policy and guidance</b>	<ul style="list-style-type: none"> <li>• Environmental Factor Guideline: Air Quality (Environmental Protection Authority, 2016).</li> <li>• National Environment Protection (Ambient Air Quality) Measure (National Environment Protection Council, 2016).</li> </ul>
<b>Studies</b>	<ul style="list-style-type: none"> <li>• Atlas Iron Miralga Creek Air Quality Assessment (Environmental Technologies &amp; Analytics, 2019)</li> </ul>
<b>Receiving Environment</b>	<p>The development and operation of the Proposal will create dust emissions due to construction, blasting, haulage and general traffic activities, the impacts of which may not be confined to the Development Envelope.</p> <p>As reported by Environmental Technologies &amp; Analytics (2019), the Pilbara is a naturally dusty environment with wind-blown dust being a significant contributor to particulate loading.</p> <p>There are no sensitive receptors surrounding the Proposal therefore no triggers were exceeded in relation to human health.</p> <p>Dust has potential to cause impacts to the biological environment – flora, vegetation and fauna. These potential impacts have been considered in Chapters 5 and 6.</p>
<b>Potential impacts</b>	Reduced air quality due to dust emissions associated with construction, blasting, haulage and general traffic activities.



Item	Details
<b>Mitigation</b>	<p><b>Null impact:</b></p> <ul style="list-style-type: none"> <li>As reported in Environmental Technologies &amp; Analytics (2019) there are no sensitive (human) receptors in the area, therefore no mitigations beyond business as usual and safety mitigations are proposed.</li> </ul> <p><b>Minimisation and management:</b></p> <p>Compliance with the Proposal's Works Approval and Operating Licence (not yet applied for) and implementation of the Ground Disturbance Permit Procedure (950-HSE-EN-PRO-0001), Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004) and Dust Management Procedure (950-HSE-EN-PRO-0026) to ensure dust emissions and impacts are minimised. These procedures include the following management measures:</p> <ul style="list-style-type: none"> <li>Planning clearing so that only the areas of land required for immediate use (within 6 months) is cleared and exposed.</li> <li>Implementation and enforcement of speed limits on unsealed roads.</li> <li>Implementation of appropriate dust suppression mechanisms (e.g., sprinklers, water sprays and water carts) on roads, stockpiles and infrastructure areas, as required.</li> </ul>
<b>Predicted Outcome</b>	As the Proposal will not significantly affect air quality and will implement measures to minimise impacts on environmental values, this Proposal is expected to meet the EPA's objective for Air Quality.
<b>Social Surroundings</b>	
<b>EPA objective</b>	To protect social surroundings from significant harm.
<b>Policy and guidance</b>	<ul style="list-style-type: none"> <li>Environmental Factor Guideline: Social Surroundings (Environmental Protection Authority, 2016).</li> <li>Aboriginal Heritage Due Diligence Guidelines (Department of Planning, Lands and Heritage, 2013).</li> <li>Environmental Protection (Noise) Regulations 1997 (<i>Environmental Protection Act 1986</i>).</li> <li>Draft Guideline on Environmental Noise for Prescribed Premises (Department of Environment Regulation, 2016)</li> </ul>
<b>Studies</b>	<ul style="list-style-type: none"> <li>Archaeological and ethnographic site avoidance heritage survey of Atlas Iron's Miralga Creek Infrastructure and additional areas, with the Njamal Traditional Owners (Terra Rosa Consulting, 2019)</li> <li>Results of the archaeological and ethnographic survey of Atlas Iron's Miralga Creek Project Areas (AI160 and AI166), conducted with Njamal Traditional Owners (Terra Rosa Consulting, 2019)</li> <li>Report of an Aboriginal Archaeological and Ethnographic Site Avoidance Work Area Assessment of the AI156 Miralga Creek West (P1 and P2) Exploration Survey Area, in the Pilbara, Western Australia (Gavin Jackson Cultural Resource Management, 2017)</li> <li>Report of an Aboriginal archaeological and ethnographic survey of the Farrell Well: Miralga Creek Prospect, Pilbara, Western Australia (Gavin Jackson Cultural Resource Management, 2014)</li> <li>Report of an Aboriginal Heritage Survey with Representatives of the Njamul People of a Proposed Mineral Exploration Project at Miralga Creek and Miralga West, Near Port Hedland (Glendenning, 2011).</li> <li>Miralga Creek: Environmental Noise Impact Assessment (Talis, 2019)</li> </ul>



Item	Details
<b>Receiving Environment</b>	<p>The majority of the Development Envelope lies over pastoral tenure:</p> <ul style="list-style-type: none"> <li>• Stockyards – Coongan Station and Strelley Station</li> <li>• Sandtrax – Panorama Station and Unallocated Crown Land</li> <li>• Miralga East – Panorama Station</li> <li>• Miralga West – Panorama Station and Strelley Station</li> <li>• New haul road between Miralga East and West – Panorama Station and Strelley Station.</li> </ul> <p>The Development Envelope lies across two Native Title areas:</p> <ul style="list-style-type: none"> <li>• Nyamal People #1 (WCD2019/010) across Sandtrax, Miralga East and the southernmost portion of Miralga West including the eastern portion of the new haul road. This is now a determined claim as at 24 September 2019.</li> <li>• Nyamal People #10 (WCD2019/011) across the stockyards, the majority of Miralga West the western portion of the new haul road.</li> </ul> <p>Atlas Iron has a claim-wide agreement with Njamal and has conducted exploration activities on site in accordance with this agreement and in regular consultation with the Njamal people and their representatives.</p> <p>No registered Aboriginal heritage sites have been identified within the Development Envelope. The nearest registered site is Sulphur Spring, approximately 2 km south of Sandtrax. Archaeological and ethnographic surveys carried out by Atlas Iron in cooperation with the relevant Traditional Owners and their consultants have identified several sites of value that will require management during operations. The (confidential) details of these sites and Traditional Owners involved in the surveys are documented in Terra Rosa Consulting (2019), Terra Rosa Consulting (2019), Gavin Jackson Cultural Resource Management (2017), Gavin Jackson Cultural Resource Management (2014) and Glendenning (2011).</p> <p>The development and ongoing operation of the Proposal will generate noise and vibration due to blasting, general operation of heavy machinery and vehicles, diesel generators and the presence of personnel.</p> <p>Talis (2019) assessed operational and blasting noise and vibrations for these receptors. Noise received at Abydos Camp was modelled to be within acceptable limits under the Environmental Protection (Noise) Regulations 1997 for both normal operations and during a blast. Groundborne vibration was also predicted to comply with AS 2187.7 criteria for building damage and human comfort.</p>
<b>Potential impacts</b>	<ul style="list-style-type: none"> <li>• Impacts to significant heritage sites.</li> <li>• Impacts to workers accommodated at the Proposal's camp.</li> <li>• Impacts on pastoral activities (e.g., loss of grazing area, pressure on water resources, vehicle interacts with/ loss of cattle).</li> </ul>
<b>Mitigation</b>	<p><b>Null impact:</b></p> <ul style="list-style-type: none"> <li>• Talis (2019) modelled noise and vibration impacts at Abydos Camp and predicted that they would be within acceptable limits, no additional mitigation is proposed.</li> </ul> <p><b>Avoidance:</b></p> <ul style="list-style-type: none"> <li>• The Development Envelope was refined to exclude sites (and appropriate buffers) of interest to the Traditional Owners (e.g. within the mining area at Miralga East, and along the Miralga Haul Road as it approached Miralga West, among other locations).</li> </ul>



Item	Details
	<p><b>Minimisation and management:</b></p> <ul style="list-style-type: none"> <li>• Atlas Iron will continue to work in accordance with the Njamal Deed of Agreement, including: <ul style="list-style-type: none"> <li>– Ensuring all areas of proposed disturbance are surveyed for Aboriginal heritage (ethnographic and archaeological) prior to disturbance.</li> <li>– In the event that an Aboriginal heritage site cannot be avoided, Atlas Iron will submit a Section 18 application and obtain consent from the Minister for Aboriginal Affairs under the <i>Aboriginal Heritage Act 1972</i> prior to disturbance.</li> <li>– In the event that an item of indigenous heritage interest is identified during construction or operations, ground disturbance will cease and the item of interest will be left in-situ until such time that the area can be appropriately viewed. Approval for recommencement of ground disturbing activities will only occur after consultation with native title claimants or their representatives and the Department of Planning, Lands and Heritage as required.</li> </ul> </li> <li>• Atlas Iron will implement the following management plans and procedures to ensure impacts of clearing are minimised: <ul style="list-style-type: none"> <li>– Ground Disturbance Permit (GDP) Procedure (950-HSE-EN-PRO-0001).</li> <li>– Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).</li> </ul> </li> <li>• Atlas Iron will continue to consult with affected pastoralists to ensure impacts of the Proposal on their activities/land use are minimised.</li> </ul>
<b>Predicted Outcome</b>	<p>The Proposal will:</p> <ul style="list-style-type: none"> <li>• Compensate affected pastoralists for loss of resources (e.g., grazing land and water) and any loss of cattle, due to vehicle interactions/strike.</li> <li>• Not result in the removal of any Registered or otherwise important heritage site</li> <li>• Not result in an unacceptable impact through noise and vibration to any anthropogenic sensitive receptor</li> </ul> <p>This Proposal is expected to meet the EPA's objective for Social Surroundings.</p>





## 8. Offsets

Atlas Iron anticipates the need to make a contribution to the Pilbara Environmental Offset Fund at the appropriate rate at the time of approval. Rates are applied as follows, for clearing within the Chichester subregion:

- A base rate applies for impacts to native vegetation in good to excellent condition, which may include impacts to fauna habitat.
- A higher rate may apply for impacts to some types of specialised environmental values, including but not limited to impacts on:
  - Riparian vegetation
  - Threatened or Priority Ecological Communities
  - Important vegetation types
  - Specialised fauna habitat.

At the time of writing, the Roebourne subregion is not subject to offsetting based on hectares of clearing.



## 9. Matters of National Environmental Significance (MNES)

Atlas Iron referred the Proposal to the then DEE under the EPBC Act in December 2019 (EPBC 2019/8601). The referral was made primarily due to potentially significant impacts to the Ghost Bat, which Atlas Iron has mitigated through a variety of means. Significant impacts were also determined to be possible at the local scale for Northern Quolls. Other MNES (or potential habitat therefor) was identified during surveys for the Proposal, however impacts are not considered by Atlas Iron to be significant, even pre-mitigation. Mitigation has been built into the Proposal during the EIA stage, and additional mitigation in the form of a Significant Species Management Plan is proposed for the Ghost Bat and Northern Quoll due to the removal of habitat for these species (Appendix K).

The following MNES (currently listed, or pending) are considered in relation to State-level impacts in Chapter 5.6, and impacts will be assessed by DAWE:

- Northern Quoll (Endangered)
- Ghost Bats (Vulnerable)
- Pilbara Leaf-nosed Bats (Vulnerable)
- Northern Brushtail Possum (pending Vulnerable)
- Grey Falcon (pending Vulnerable)
- Pilbara Olive Python (Vulnerable) – not recorded during surveys for the Proposal, however potential habitat is present.



## 10. Holistic Impact Assessment

Various biological and physical studies have been completed in recent years to identify key environmental values and assess the risk of impact to these values from the Proposal. Where there has been information gaps or scientific uncertainty, Atlas Iron has sought to address these through additional investigations and specialist advice and has otherwise applied a conservative approach when assessing risk.

Careful evaluation has been made of options to avoid or minimise potential environmental impacts, followed by the identification and development of management measures and rehabilitation considerations for any residual risks to key environmental factors in consideration of the Environmental Objectives for each environmental factor, as well as the EPA's Environmental Principles (Chapter 4). Key environmental values avoided include:

- Caves
- Natural water features
- Heritage sites
- Priority flora
- *Polymeria* sp.

Detailed assessment of the Proposal's impact on each of the environmental factors, including relevant mitigation, management and rehabilitation commitments and the residual/predicted outcomes is provided in Chapters 5, 5.6 and 6.6. In accordance with Atlas Iron's HSEMS, an EMP will be developed and implemented to capture these commitments and ensure impacts to environmental values are mitigated to ALARP. The EMP will also capture any relevant conditions and requirements of other regulatory mechanisms, including but not limited to Part V of the EP Act and the EPBC Act.

When assessing the Proposal's impacts, it is important to be aware of and consider the various connections and interactions between environmental factors. For instance, Terrestrial Environmental Quality, specifically soil type and availability, is directly linked to and associated with the type of Landform. Landform and Terrestrial Environmental Quality (soils) are also linked to Flora and Vegetation and Terrestrial Fauna, as they control species composition and thus the vegetation types present, and provide differing habitat values. Specifically, this Proposal recognises that some those fauna habitats and features that are recognised as significant (e.g. caves) are often associated with vegetation types and landforms that are uncommon and/or restricted (e.g., Rocky Ridge and Gorge).

Table 10.1 provides a holistic overview of the potential risks of the Proposal on the various environmental factors, both directly and indirectly. It also demonstrates how key management measures often address multiple impacts across various environmental factors.

A summary of the findings for each key environmental factor, including potential impacts, proposed mitigation and predicted outcomes can be found in Table 5.10 and Table 6.12 .



**Table 10.1 – Holistic Impact Assessment Summary**

Contributing Activity/ Cause	Risk Summary by EPA Theme and Factor								Mitigations and Key Regulatory Mechanisms
	Land					Water	Air	People	
	Flora & Vegetation	Terrestrial Fauna	Subterranean Fauna	Landforms	Terrestrial Env. Quality	Inland Waters	Air Quality	Social Surroundings	
Clearing, earthworks and vehicle movements (including haulage)	Direct loss of vegetation and flora.  Decline in vegetation quality and poor revegetation/ rehabilitation success associated with introduction and/or spread of weeds, dust and loss of soil and changes to soil structure.	Direct loss and fragmentation of habitat. Vehicle interactions with fauna resulting in death/ injury. Decline in habitat quality and poor revegetation/ rehabilitation success associated with introduction and/or spread of weeds, dust, loss of soil and changes to soil structure.	Removal of troglofauna/ stygofauna habitat/ individuals.	Reduced landform diversity/ integrity.	Changes to soil availability, quality and structure.	Increased sediment/ turbidity.	Reduced air quality.	Direct loss of known/ unknown heritage sites. Dust/ noise impacts on sensitive receivers.	Compliance with EPBC requirements under EPBC 2019/8601 (regulated by DAWE). Annual Environmental Reporting to DWER and DMIRS. Implementation of the SSMP including the implementation of a monitoring strategy for Cave CMRC-15. Development of a Project EMP, which will include reference to the following procedures: <ul style="list-style-type: none"> <li>• GDP Procedure (950-HSE-EN-PRO-0001).</li> <li>• Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).</li> <li>• Flora Management Procedure (950-HSE-EN-PRO-0010).</li> <li>• Fauna Management Procedure (950-HSE-EN-PRO-0012)</li> <li>• Weed Hygiene Procedure (950-HSE-EN-PRO-0002).</li> <li>• Dust Management Procedure (950-HSE-EN-PRO-0026).</li> </ul> This will include the following key mitigations: <ul style="list-style-type: none"> <li>• No more than 284.9 ha of vegetation/habitat within the 621.1 ha Development Envelope will be cleared/disturbed.</li> <li>• Restricting clearing to the minimum necessary for safe construction and operation of the Proposal and to within approved areas through GDP Procedure.</li> <li>• Standard dust suppression techniques shall be used on roads, stockpiles and infrastructure areas (e.g., water carts, sprinklers).</li> </ul>
Water abstraction (from existing bores, currently licensed for abstraction)	Indirect loss of and/or change in health of GDV	Indirect loss of and/or change in health of GDV/ habitat.	Drying out of habitat through the lowering of the groundwater table.			Reduced groundwater availability. Loss of permanent surface water values.		Reduced groundwater availability/ quality for other	The key regulatory mechanism relevant to this factor is the 5C Licence to take water under the RIWI Act, regulated by DWER, and associated Water Management Plan and Site Water Operating Plan. The borefields are





Contributing Activity/ Cause	Risk Summary by EPA Theme and Factor								Mitigations and Key Regulatory Mechanisms
	Land					Water	Air	People	
	Flora & Vegetation	Terrestrial Fauna	Subterranean Fauna	Landforms	Terrestrial Env. Quality	Inland Waters	Air Quality	Social Surroundings	
		Alteration of fauna behaviour associated with loss of habitat and/or resources.						groundwater users (i.e., pastoralists).	previously licensed to abstract more water than is required for the implementation of the Proposal.  Development of a Project EMP in consideration of the above approvals, including: <ul style="list-style-type: none"> <li>Revision of the drawdown model during construction and operations.</li> </ul>
Mining of pits (including drilling and blasting)	Dust emissions resulting in a decline in vegetation quality.	Removal of landforms/ significant habitat. Structural damage to cave CMRC-15 and/or change in humidity preventing ongoing use by Ghost Bats on cessation of mining.  Dust/ noise/ light emissions resulting in decline in habitat quality and/or altered fauna behaviour, including abandonment caves near Miralga East.	Removal of troglofauna habitat/ individuals.	Reduced landform diversity/ integrity.		Dust resulting in increased turbidity in pools.	Reduced air quality.	Dust/noise impacts on sensitive receivers.  Reduced vegetation/ grazing quality.	Compliance with EPBC requirements under EPBC 2019/8601 (regulated by DAWE). Compliance with Works Approval and Licence requirements (regulated by DWER). Compliance with approved Mining Proposal and MCP (regulated by DMIRS).  Implementation of the SSMP including the implementation of a monitoring strategy for cave CMRC-15.  Management measures and monitoring were recommended by Blast It Global (2020) to validate predicted vibration and measure vibration received at caves. Atlas Iron will adopt the recommendations to ensure that blasting is carried out appropriately. Key measures include: <ul style="list-style-type: none"> <li>Design blasts to perform to the blast criteria (i.e. limit to 100 mm/s but design to achieve 85 mm/s) using the reference values set out in Blast It Global (2020).</li> <li>Establish vibration monitors in the nearest cave to all blasting at Miralga East pits 2 and 3.</li> <li>Avoid blasting within 100 m of a cave until the results of monitoring validate predictions with a reasonable degree of confidence.</li> <li>If vibration exceeds 100 mm/s, blasting should cease until the cause has been determined and steps to prevent a reoccurrence have been taken. A cave inspection is required to assess any impacts.</li> <li>Periodically inspect caves to confirm the vibration limits are fit for purpose.</li> </ul>



Contributing Activity/ Cause	Risk Summary by EPA Theme and Factor								Mitigations and Key Regulatory Mechanisms
	Land					Water	Air	People	
	Flora & Vegetation	Terrestrial Fauna	Subterranean Fauna	Landforms	Terrestrial Env. Quality	Inland Waters	Air Quality	Social Surroundings	
									<ul style="list-style-type: none"> <li>The measures outlined above apply to caves CMRC-13, -14 and -15 at Miralga East.</li> </ul> <p>As recommended by Bat Call WA (2020) to support the persistence of Ghost Bat in the Miralga Creek/ Lalla Rookh area, Atlas Iron will:</p> <ul style="list-style-type: none"> <li>Avoid direct disturbance of all caves except the category 4 cave CMRC 02 at Miralga West.</li> <li>Establish suitable exclusion zones around all remaining caves to prevent direct disturbance from the Proposed Action.</li> <li>Restrict personnel from entering any category 2 or 3 cave, except for survey personnel in accordance with the protocol outlined in Appendix B of Bat Call WA (2020).</li> <li>Monitor Ghost Bat usage of the category 2 caves CMRC-06 and -15 annually during operations and for one year following operations.</li> <li>Limit blasting vibrations at caves CMRC-13, -14 and -15 as per the recommendations of Blast It Global (2020).</li> </ul> <p>Development of a Project EMP, which will include reference to the following procedures:</p> <ul style="list-style-type: none"> <li>GDP Procedure (950-HSE-EN-PRO-0001).</li> <li>Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).</li> <li>Flora Management Procedure (950-HSE-EN-PRO-0010).</li> <li>Fauna Management Procedure (950-HSE-EN-PRO-0012)</li> <li>Weed Hygiene Procedure (950-HSE-EN-PRO-0002).</li> <li>Dust Management Procedure (950-HSE-EN-PRO-0026).</li> </ul> <p>This will include the following key mitigation:</p> <ul style="list-style-type: none"> <li>No more than 284.9 ha of vegetation/habitat within the 621.1 ha Development Envelope will be cleared/disturbed.</li> </ul>



Contributing Activity/ Cause	Risk Summary by EPA Theme and Factor								Mitigations and Key Regulatory Mechanisms
	Land					Water	Air	People	
	Flora & Vegetation	Terrestrial Fauna	Subterranean Fauna	Landforms	Terrestrial Env. Quality	Inland Waters	Air Quality	Social Surroundings	
									<ul style="list-style-type: none"> <li>Restricting clearing to the minimum necessary for safe construction and operation of the Proposal and to within approved areas through GDP Procedure.</li> </ul> Standard dust suppression techniques shall be used on roads, stockpiles and infrastructure areas (e.g., water carts, sprinklers).
Excavation, handling and disposal of problematic waste rock (Shales only, 2.1% of the total waste rock volume from Miralga West pit)	Poor revegetation/ rehabilitation success.	Poor revegetation/ rehabilitation success.			Erosion of waste dump surfaces.	Increased turbidity.			Compliance with approved Mining Proposal and MCP (regulated by DMIRS). Development of a Project EMP, which will include reference to the management erodible of waste rock). This will include the following key mitigation: <ul style="list-style-type: none"> <li>Shale from Miralga West will be buried within the waste dump and not left exposed on the final profile.</li> <li>Ensure appropriate surface water management is incorporated into the final mine design, in accordance with the objectives and design principles.</li> </ul>
Transport, handling, use and storage of hydrocarbons and chemicals	Reduced vegetation quality and revegetation/ rehabilitation success.	Reduced habitat quality and revegetation/ rehabilitation success.			Soil contamination.	Water contamination.			Compliance with Works Approval and Licence requirements (regulated by DWER). Compliance with approved Mining Proposal and MCP (regulated by DMIRS). Development of a Project EMP, which will include reference to the following procedures: <ul style="list-style-type: none"> <li>Hydrocarbon Management Procedure (950-HSE-EN-PRO-0005).</li> <li>Hydrocarbon (and Chemical) Spill Management Procedure (950-HSE-EN-PRO-0007).</li> </ul> This will include the following key mitigation: <ul style="list-style-type: none"> <li>Containment of hydrocarbons in accordance with AS 1940:2004 – <i>The Storage and Handling of Flammable and Combustible Liquids</i>, this includes siting and bunding/containment restrictions, provision and maintenance of relevant MSDS and regular inspections.</li> <li>Refuelling procedures, including the provision of a spill kit at all refuelling stations.</li> <li>Spill recovery and clean up materials maintained at all hazardous material</li> </ul>



Contributing Activity/ Cause	Risk Summary by EPA Theme and Factor								Mitigations and Key Regulatory Mechanisms
	Land					Water	Air	People	
	Flora & Vegetation	Terrestrial Fauna	Subterranean Fauna	Landforms	Terrestrial Env. Quality	Inland Waters	Air Quality	Social Surroundings	
									storage areas. Relevant employees and contractors will be trained in the use of this equipment. <ul style="list-style-type: none"> <li>The storage and regular disposal offsite by a licenced controlled waste contractor, of waste hydrocarbons (e.g., waste oil and used oil filters).</li> </ul>
Generation and disposal of waste materials, (excluding waste rock)	Reduced vegetation quality and rehabilitation success associated with soil and water contamination.	Introduction/ attraction of introduced species, which may predate on/compete for resources with native fauna. Reduced habitat quality and rehabilitation success associated with soil and water contamination.			Soil contamination.	Water contamination.		Wind-blown waste/ loss of visual amenity.	Compliance with approved Mining Proposal and MCP (regulated by DMIRS). Compliance with Works Approval and Licence requirements (regulated by DWER). Development of a Project EMP, which will include reference to the following procedures: <ul style="list-style-type: none"> <li>Introduced Fauna/Pest Control Procedure (950-HSE-EN-PRO-0022)</li> <li>Waste Management Procedure (950-HSE-EN-PRO-0023)</li> </ul> This will include the following key mitigation: <ul style="list-style-type: none"> <li>Record all introduced fauna sightings and the implement feral animal control program, as required (i.e., where sightings are regular and/or if nuisance or dangerous individuals are recorded).</li> <li>All waste shall be segregated appropriately to enable effective reuse, recycling, transport and disposal as appropriate.</li> </ul>
Crushing and screening of ore	Dust emissions resulting in a decline in vegetation quality.	Dust/noise emissions resulting in decline in habitat quality and/or altered fauna behaviour,				Increased turbidity.	Reduced air quality.	Dust/noise affects sensitive receivers. Reduced vegetation/ grazing quality.	Compliance with Works Approval and Licence requirements (regulated by DWER). Compliance with approved Mining Proposal and MCP (regulated by DMIRS). Development of a Project EMP, which will include reference to Dust Management Procedure (950-HSE-EN-PRO-0026). This will include the following key mitigation: <ul style="list-style-type: none"> <li>Implementation of appropriate dust suppression mechanisms (e.g., sprinklers, water sprays and water carts) on roads, stockpiles and infrastructure areas.</li> </ul>
Physical presence of Proposal (including human presence)	Changes to surface water flows, drainage shadowing/ ponding and/or erosion affecting	Changes to surface water flows, drainage shadowing/ponding and/or erosion affecting habitat quality and rehabilitation success.			Changes to surface water flows resulting in scour/ erosion.	Changes to surface water flows resulting in drainage shadowing/ponding and/or erosion affecting surface		Reduced availability of grazing resources (i.e., pastoralists).	Compliance with EPBC requirements under EPBC 2019/8601 (regulated by DAWE). Annual Environmental Reporting to DWER and DMIRS.





Contributing Activity/ Cause	Risk Summary by EPA Theme and Factor							Mitigations and Key Regulatory Mechanisms	
	Land				Water	Air	People		
	Flora & Vegetation	Terrestrial Fauna	Subterranean Fauna	Landforms	Terrestrial Env. Quality	Inland Waters	Air Quality		Social Surroundings
vegetation quality and rehabilitation success. Loss of vegetation associated with Proposal related fire.	Loss of habitat and/or individuals associated with fire.					water contribution to pools and increased turbidity.			Implementation of the SSMP including the implementation of a monitoring strategy for cave CMRC-15. Development of a Project EMP, to ensure appropriate surface water management is incorporated into the final mine design and maintained, in accordance with the following objectives and design principles: <ul style="list-style-type: none"> <li>• Diverting naturally occurring local surface water around mine infrastructure by means of drainage channels, earth bunds, and road culverts with adequate scour protection where necessary.</li> <li>• Isolating the waste rock dump areas from external runoff (i.e., clean stormwater) by bunding around the perimeter and encouraging the minimal internal flows to be retained and infiltrate and/or evaporate. Internal flows will otherwise be directed to a sedimentation pond, where the bulk of the suspended material will be settled out prior to any discharge to the downstream environment.</li> <li>• Waste rock dumps will be designed to resist erosion and sediment migration to the downstream environment.</li> </ul>



## 11. References

- Allen, G. R. (2006). *Field Guide to the Freshwater Fishes of Australia*. Perth, Western Australia: Western Australian Museum.
- Atlas Iron Pty Ltd. (2020). *Miralga Creek Project: Water Management Assessment*. Perth.
- Bat Call WA. (2020). *Miralga Creek Review*.
- Beard, J. (1990). *Plant Life of Western Australia*. Perth: Kangaroo Press.
- Beard, J. S. (1975). *Vegetation Survey of Western Australia, Pilbara 1:1 000 000. Map and Explanatory Notes to Sheet 7.* . University of Western Australia Press.
- BHP. (1997). *Newman satellite development mining of orebody 23 below the water table*.
- Biologic. (2017). *Pilbara Ghost Bat Genetic Project 2017*.
- Biologic. (2019). *Miralga Groundwater Dependent Vegetation Assessment*.
- Biologic. (2020a). *Miralga Creek Level 2 Terrestrial Fauna and SRE Survey*. Perth.
- Biologic. (2020b). *Miralga Creek Project: Conservation Significant Vertebrate Fauna Impact Assessment*.
- Biologic. (2020c). *Miralga Creek Project: Short-Range Endemic Invertebrate Fauna Impact Assessment*.
- Biologic. (2020d). *Miralga Creek: Subterranean Fauna Assessment*.
- Blast It Global. (2020). *Assessment of Blasting at Miralga Creek Project: Preservation of Ghost Bat Habitats Post Mining Activities*.
- Bullen, R., & McKenzie, N. (2002). *Scaling bat wingbeat frequency and amplitude.* . *Journal of Experimental Biology*, 2615-2626.
- Burbidge, A. A. (1989). *Patterns in modern decline of Western Australia's vertebrate fauna: causes and conservation implications.* *Biological Conservation*, 50, 143-198.
- Burbidge, A. H. (2010). *Birds in a vast arid upland: avian biogeographical patterns in the Pilbara region of Western Australian.* *Records of the Western Australian Museum Supplement*, 78, 247-270.
- Bureau of Meteorology. (2020). *Climate statistics for Australian locations: Marble Bar*. Retrieved January 28, 2020, from Bureau of Meteorology: [http://www.bom.gov.au/climate/averages/tables/cw\\_004020.shtml](http://www.bom.gov.au/climate/averages/tables/cw_004020.shtml)
- Burrows, N. D. (2006). *Evidence of altered fire regimes in the Western Desert region of Australia.* *Conservation Science Western Australia*, 5(3), 282-284.

- Calver, M. C. (1989). Assessment of an approximate lethal dose technique for determining the relative susceptibility of non-target species to 1080-toxin. *Australian Wildlife Research*, 16(1), 33-40.
- Car, C. A. (2019). The millipede genus *Antichiropus* (Diplopoda: Polydesmida: Paradoxosomatidae), Part 3: species of the Pilbara bioregion of Western Australia. *Zootaxa*, 4617, 1-71.
- Carwardine, J. N. (2014). Priority Threat Management for Pilbara Species of Conservation Significance. .
- Department of Biodiversity Conservation and Attractions. (2019). How does Parks and Wildlife manage weeds? . Retrieved from <https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds>
- Department of Biodiversity, Conservation and Attractions. (2014). Ecological Impact and Invasiveness Ratings from the Department of Parks and Wildlife Pilbara Region Species Prioritisation Process 2014. Retrieved from <https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds>
- Department of Biodiversity, Conservation and Attractions. (2017). Standard Operating Procedure – Transport and Temporary Holding of Wildlife. Perth: Government of Western Australia.
- Department of Biodiversity, Conservation and Attractions. (2019). NatureMap: Mapping Western Australia's Biodiversity (custom search). Retrieved 2019, from <http://naturemap.dec.wa.gov.au/default.aspx>
- Department of Biodiversity, Conservation and Attractions. (undated). Brushtail Possum *Trichosurus vulpecula* (Kerr 1792). Retrieved from <https://library.dbca.wa.gov.au>: <https://library.dbca.wa.gov.au/static/FullTextFiles/071547.pdf>
- Department of Environment. (2013). Matters of National Environmental Significance Significant impact guidelines 1.1. Retrieved from [https://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines\\_1.pdf](https://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf)
- Department of Environment Regulation. (2016). Draft Guideline on Environmental Noise for Prescribed Premises. Government of Western Australia.
- Department of Mines, Industry Regulation and Safety. (2020). Guidelines for Mine Closure Plans in Western Australia: Statutory Guidelines under the Mining Act 1978.
- Department of Parks and Wildlife. (2017a). Interim guideline for preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia.
- Department of Parks and Wildlife. (2017b). Pilbara Northern Quoll Research Program. Perth: Government of Western Australia.
- Department of Planning, Lands and Heritage. (2013). Aboriginal Heritage Due Diligence Guidelines. Government of Western Australia.



Department of Sustainability, Environment, Water, Population and Communities. (2012). Interim Biogeographic Regionalisation for Australia, Version 7. Commonwealth of Australia.

Department of the Environment. (2016). EPBC Act referral guideline for the endangered northern quoll *Dasyurus hallucatus*. Canberra: Commonwealth of Australia.

Department of the Environment and Energy. (2019a). Consultation Document on Listing Eligibility and Conservation Actions *Falco hypoleucos* (Grey Falcon). Retrieved from <https://www.environment.gov.au/biodiversity/threatened/nominations/comment/grey-falcon>

Department of the Environment and Energy. (2019b). *Rhinonicteris aurantia* (Pilbara form) — Pilbara Leaf-nosed Bat. Retrieved from Species Profile and Threats Database: [http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon\\_id=82790](http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=82790)

Department of the Environment and Energy. (2019c). Species Profile and Threats Database *Dasyurus hallucatus* Northern Quoll. Retrieved from [http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon\\_id=331](http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=331)

Department of the Environment, Water, Heritage and the Arts. (2008). Approved Conservation Advice for *Liasis olivaceus barroni* (Olive Python – Pilbara subspecies). Retrieved from <http://www.environment.gov.au/biodiversity/threatened/species/pubs/66699-conservation-advice.pdf>

Department of Water. (2010). Lower De Grey River: ecological values and issues. Environmental Water Report series(12).

Department of Water. (2013). Western Australian Water in Mining Guideline. Government of Western Australia.

Dickman, C. R. (1996). Overview of the impacts of feral cats on Australian native fauna. . National Parks and Wildlife Australian Nature Conservation Agency.

Doherty, T. S. (2016). Ecosystem responses to fire: Identifying cross-taxa contrasts and complementarities to inform management strategies. *Ecosystems*, 20, 872-884.

Doughty, P. R. (2011). Herpetological assemblages of the Pilbara biogeographic region, Western Australia: ecological associations, biogeographic patterns and conservation. *Records of the Western Australian Museum, Supplement*, 78, 315-341.

Ellis, R. J. (2013). Pilbara olive python (*Liasis olivaceus barroni*): a (sub)species overview. EPBC Act Threatened Species Workshop: Pilbara Olive Python. Kensington.

Environmental Protection Authority. (2004). Technical Guidance - Terrestrial fauna surveys. Government of Western Australia.

Environmental Protection Authority. (2007). Technical Guidance - Sampling methods for subterranean fauna. Government of Western Australia.

Environmental Protection Authority. (2009). Technical Guidance - Sampling of short range endemic invertebrate fauna. Government of Western Australia.





- Environmental Protection Authority. (2010). Technical Guidance - Sampling methods for terrestrial vertebrate fauna. Government of Western Australia.
- Environmental Protection Authority. (2013). Technical Guidance - Subterranean fauna survey. Government of Western Australia.
- Environmental Protection Authority. (2016a). Environmental Factor Guideline - Air Quality. Government of Western Australia.
- Environmental Protection Authority. (2016b). Environmental Factor Guideline - Social Surroundings. Government of Western Australia.
- Environmental Protection Authority. (2016c). Environmental Factor Guideline - Subterranean Fauna. Government of Western Australia.
- Environmental Protection Authority. (2016d). Environmental Factor Guideline - Terrestrial Environmental Quality. Government of Western Australia.
- Environmental Protection Authority. (2016e). Environmental Factor Guideline - Terrestrial Fauna. Government of Western Australia.
- Environmental Protection Authority. (2016f). Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment. Government of Western Australia.
- Environmental Protection Authority. (2016g). Environmental Factor Guideline - Human Health. Government of Western Australia.
- Environmental Protection Authority. (2018a). Environmental Factor Guideline - Inland Waters. Government of Western Australia.
- Environmental Protection Authority. (2018b). Environmental Factor Guideline - Landforms. Government of Western Australia.
- Environmental Protection Authority. (2018c). Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual. Government of Western Australia.
- Environmental Protection Authority. (2018d). Instructions for the referral of a Proposal to the Environmental Protection Authority under Section 38 of the Environmental Protection Act 1986. Government of Western Australia.
- Environmental Protection Authority. (2018e). Instructions on how to prepare an Environmental Review Document. Government of Western Australia.
- Environmental Protection Authority. (2018f). Statement of Environmental Principles, Factors and Objectives. Government of Western Australia.
- Environmental Protection Authority. (undated). Instructions on how to define the key characteristics of a proposal. Government of Western Australia.
- Environmental Technologies & Analytics. (2019). Atlas Iron Miralga Creek Air Quality Assessment.



- Executive Steering Committee for Australian Vegetation Information. (2003). Australian Vegetation Attribute Manual: National Vegetation Information System. Canberra: Department of the Environment and Heritage.
- Farmer, A. F. (1993). The effects of dust on vegetation - a review. *Environmental Pollution*, 79, 63-75.
- Gavin Jackson Cultural Resource Management. (2014). Report of an Aboriginal archaeological and ethnographic survey of the Farrell Well: Miralga Creek Prospect, Pilbara, Western Australia.
- Gavin Jackson Cultural Resource Management. (2017). Report of an Aboriginal Archaeological and Ethnographic Site Avoidance Work Area Assessment of the A1156 Miralga Creek West (p1 AND p2) Exploration Survey Area, in the Pilbara, Western Australia.
- Glendenning, W. (2011). Report of an Aboriginal Heritage Survey with Representatives of the Njamul People of a Proposed Mineral Exploration Project at Miralga Creek and Miralga West, Near Port Hedland.
- Graham, J. (2001). The root hydraulic architecture of *Melaleuca argentea*. The University of Western Australia.
- Grierson, P. F. (2015). Dust suppression and likelihood of adverse impact on *Acacia* sp. East Fortescue at Orebody 31.
- Harvey, M. S. (2002). Short range endemism in the Australian fauna: some examples from non-marine environments. *Invertebrate Systematics*, 16, 555-570.
- Hill, B., & Ward, S. (2010). National Recovery Plan for the Northern Quoll (*Dasyurus hallucatus*). Darwin: Department of Natural Resources, Environment, the Arts and Sport.
- J. Olsen, S. D. (2004). Breeding success, cliff characteristics and diet of Peregrine Falcons at high altitude in the Australian Capital Territory. *Corella*, 28(2), 33-37.
- Kendrick, P. &. (2001). A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002 - Pilbara 1 (PIL1 – Chichester Subregion). Department of Conservation and Land Management.
- Kendrick, P. &. (2002). Pilbara 4 (PIL4 - Roebourne synopsis).
- Kerle, J. F. (1992). The decline of the Brushtail Possum, *Trichosurus vulpecul* (Kerr 1798), in arid Australia. *The Rangeland Journal*, 14(2), 107-127. Retrieved from <https://doi.org/10.1071/RJ9920107>
- Leighton, K. (2004). Climate. . In A. P. A.M.E. van Vreeswyk (Ed.), *An Inventory and Condition Survey of the Pilbara Region, Western Australia*. (pp. 19-38). Department of Agriculture.
- Longcore, T. &. (2004). Ecological light pollution. *Frontiers in Ecology and the Environment*, 2(4), 191-198.



- Matsuki, M. e. (2016). Impacts of Dust on Plant Health, Survivorship and Plant Communities in Semi-Arid Environments. *Austral Ecology*, 41, 417–427.
- McKenzie, N. L. (2002). Bioregional Summary of the 2002 Biodiversity Audit for Western Australia. . Department of Conservation and Land Management.
- Medellin, R. A.-H. (2017). Conservation relevance of bat caves for biodiversity and ecosystem services. . *Biological Conservation*, 211(B), 45-50.
- Mine Earth. (2019). Miralga Creek Baseline Soil Assessment. Perth.
- Mine Earth. (2020). Miralga Creek Project Mine Waste Characterisation Assessment.
- Murray, B. R. (2003). Groundwater-dependent ecosystems in Australia: It's more than just water for rivers. *Ecological Management & Restoration*, 4(2), 110-113.
- MWH. (2012). Abydos East Haul Road - Mining Proposal: Hydrology and Hydrogeology Impact Assessment.
- MWH. (2015). Mt Dove DSO Project: Pilbara Leaf-nosed Bat Monitoring Survey 2015, Unpublished report prepared by MWH Australia Pty Ltd for Atlas Iron Limited, Perth, Western Australia.
- National Environment Protection Council. (2016). Variation to the National Environment protection (Ambient Air Quality) Measure - Impact statement.
- Olsen, P. D. (1989). Breeding og the Peregrine Falcon *Falco peregrinus*. III. Weather, nest quality and breeding success. *Emu*, 89(1), 6-14.
- Olsen, P. O. (1986). Distribution, status, movement and breeding of the Grey Falcon *Falco hypoleucos*. *Emu*, 86, 47-51.
- Parris, K. &. (2009). Impacts of traffic noise and traffic volume on birds of roadside habitats. *Ecology and Society*, 14(1), 29.
- Pearson, D. J. (2006). Giant Pythons of the Pilbara. *Landscape*, 19(1), 32-39.
- Ponder, W. F. (2002). What makes a narrow range taxon? Insights from Australian fresh-water snails. *Invertebrate Systematics*, 16(5), 571-582.
- Port Hedland Industries Council. (2018). Annual Report – FY 2017/18 Port Hedland Ambient Air Quality Monitoring Program .
- Prajapati, S. K. (2012). Ecological effect of airborne particulate matter on plants. *Environmental Skeptics and Critics*, 1(1), 12-22.
- Prugh, L. S. (2009). The rise of the mesopredator. *BioScience*, 59, 779-791.
- PSM Consult. (2020). Miralga Creek - Assessment of Potential Mining Activities Impact on the Structural Integrity of the Caves.
- Rowden, P. S. (2008). Road crashes involving animals in Australia. *Accident Analysis and Prevention*, 40(6), 1865–1871.



- RPS. (2019). Miralga Creek Project Surface Water Assessment.
- Ruprecht, J. &. (2000). Surface Hydrology of the Pilbara Region, Summary Report. Surface Water Hydrology Report Series, SWH32.
- Schoenjahn, J. (2018). Adaptations of the rare endemic Grey Falcon *Falco hypoleucos* that enable its permanent residence in the arid zone of Australia. The University of Queensland.
- Shannon, G. A. (2014). Road traffic noise modifies behaviour of a keystone species. *Animal Behaviour*, 94, 135-141.
- Shepherd, D. B. (2002). Native Vegetation in Western Australia. Extent, Type and Status. . Department of Agriculture.
- Spencer, P. B. (2013). Genetic Analysis of Northern Quolls from the Pilbara Region of Western Australia - Final Report. Murdoch University.
- Storr, R. J. (1998). Handbook of Western Australian Birds Volume 1 - Non-passerines (Emu to Dollarbird). Perth: Western Australian Museum.
- Talis. (2019). Miralga Creek: Environmental Noise Impact Assessment .
- Terra Rosa Consulting. (2019a). Archaeological and ethnographic site avoidance heritage survey of Atlas Iron's Miralga Creek Infrastructure and additional areas, with the Njama Traditional Owners.
- Terra Rosa Consulting. (2019b). Results of the archaeological and ethnographic survey of Atlas Iron's Miralga Creek Project Areas (AI160 and AI166), conducted with Njama Traditional Owners.
- Threatened Species Scientific Committee. (2008). Approved conservation advice for *Liasis olivaceus barroni* (Olive Python – Pilbara subspecies). Commonwealth of Australia.
- Threatened Species Scientific Committee. (2005). Listing Advice for the Northern Quoll (*Dasyurus hallucatus*). Department of the Environment.
- Threatened Species Scientific Committee. (2016a). Conservation Advice *Macroderma gigas* Ghost Bat. Department of the Environment. Department of the Environment.
- Threatened Species Scientific Committee. (2016b). Conservation Advice *Rhinonicteris aurantia* Pilbara Leaf-nosed Bat. Department of the Environment.
- Tutt, M. S. (2004). Unravelling the mysteries of Pilbara Olive Python ecology. Nickol Bay Naturalists' Club/WA CaLM.
- van Dyck, S. &. (2008). Mammals of Australia. (3rd, Ed.) Sydney, New South Wales: Australian Museum.
- van Vreeswyk, A. P. (2004). An Inventory and Condition Survey of the Pilbara Region of Western Australia. Government of Western Australia.
- Woinarski, J. C. (2014). The Action Plan for Australian Mammals 2012. CSIRO Publishing.





Woodman Environmental. (2019a). Miralga Creek Iron Ore Project: Detailed Flora and Vegetation Survey 2019.

Woodman Environmental. (2019b). Desktop Review of Potential Groundwater Dependent Vegetation.

Woolley, P. A. (2015). Phylogenetic relationships within *Dasyurus* (Dasyuromorphia: Dasyuridae): quoll systematics based on molecular evidence and male characteristics. *Journal of Mammalogy*, 96, 37-46.



# Appendix A Detailed Flora and Vegetation Assessment

Report prepared by Woodman Environmental (2019a) – refer to separate document.



# Appendix B Groundwater Dependent Vegetation Desktop Review

Report prepared by Woodman Environmental (2019b) – refer to separate document.



# Appendix C Groundwater Dependent Vegetation Field Assessment

Report prepared by Biologic (2019) – refer to separate document.

---





## Appendix D Summary of Local Waterholes



Water Feature Name	Observations	Permanency
WMRC-01	<p>Phreatophytic species:</p> <ul style="list-style-type: none"> <li>• <i>Melaleuca argentea</i></li> <li>• <i>Eucalyptus camaldulensis</i></li> <li>• <i>Melaleuca bracteata</i><sup>1</sup></li> </ul> <p>Dry.<sup>3</sup></p>	<p>Concluded permanent water<sup>1</sup></p> <p>Not considered to be permanent<sup>3</sup> (Figure 6.4)</p>
WMRC-02	<p>Phreatophytic species:</p> <ul style="list-style-type: none"> <li>• <i>Melaleuca glomerata</i></li> <li>• <i>Eucalyptus camaldulensis</i><sup>1</sup></li> </ul> <p>Some pooling within 100 m<sup>3</sup></p> <p>Phreatophytic species:</p> <ul style="list-style-type: none"> <li>• <i>Melaleuca argentea</i></li> <li>• <i>Melaleuca linophylla</i><sup>4</sup></li> </ul>	<p>Concluded permanent water<sup>1</sup></p> <p>Considered likely to be surface expressions of sub-surface flow within the creek alluvials<sup>3</sup> (Figure 6.4)</p> <p>Concluded non-permanent<sup>4</sup></p>
WMRC-03	<p>No typical phreatophytic species recorded<sup>1</sup></p> <p>Small puddle of water remaining, similar puddles in a number of locations in the valley<sup>3</sup> (Figure 6.4)</p>	<p>Appears to be fed by a seep<sup>1</sup></p> <p>Considered highly unlikely to be permanent<sup>3</sup></p>
WMRC-04	No typical phreatophytic species recorded <sup>1</sup>	-
WMRC-05	No typical phreatophytic species recorded <sup>1</sup>	-
WMRC-06	No typical phreatophytic species recorded <sup>1</sup>	-
WMRC-07	No typical phreatophytic species recorded <sup>2</sup>	-
WMRC-08	No typical phreatophytic species recorded <sup>2</sup>	-
WMRC-09	No typical phreatophytic species recorded <sup>2</sup>	-
WMRC-10	No typical phreatophytic species recorded. <sup>2</sup>	-
WMRC-11	No typical phreatophytic species recorded <sup>2</sup>	-
WRMC-12	No typical phreatophytic species recorded. <sup>2</sup>	-



Water Feature Name	Observations	Permanency
WMRC-13	No typical phreatophytic species recorded <sup>2</sup>	-
WMRC-14	Phreatophytic species were present <sup>2</sup>	Concluded permanent water <sup>2</sup>
WMRC-15	Phreatophytic species were present <sup>2</sup>	Concluded permanent water <sup>2</sup>
WMIR-01	Phreatophytic species: <ul style="list-style-type: none"> <li>• <i>Eucalyptus camaldulensis</i><sup>4</sup></li> </ul>	Concluded semi-permanent <sup>4</sup>
WMIR-02	Phreatophytic species: <ul style="list-style-type: none"> <li>• <i>Melaleuca glomerata</i><sup>4</sup></li> </ul>	Concluded semi-permanent <sup>4</sup>
WMIR-03	Phreatophytic species: <ul style="list-style-type: none"> <li>• <i>Melaleuca glomerata</i><sup>4</sup></li> </ul>	Concluded semi-permanent <sup>4</sup>
WMIR-04	Phreatophytic species: <ul style="list-style-type: none"> <li>• <i>Eucalyptus camaldulensis</i><sup>4</sup></li> </ul>	Concluded semi-permanent <sup>4</sup>
WMIR-06	Phreatophytic species: <ul style="list-style-type: none"> <li>• <i>Melaleuca argentea</i><sup>4</sup></li> </ul>	Concluded semi-permanent <sup>4</sup>
WMIR-07	Phreatophytic species: <ul style="list-style-type: none"> <li>• <i>Melaleuca argentea</i><sup>4</sup></li> </ul>	Concluded semi-permanent <sup>4</sup>
WMIR-08	Phreatophytic species: <ul style="list-style-type: none"> <li>• <i>Melaleuca argentea</i><sup>4</sup></li> </ul>	Concluded semi-permanent <sup>4</sup>
WMIR-09	Phreatophytic species: <ul style="list-style-type: none"> <li>• <i>Melaleuca argentea</i><sup>4</sup></li> </ul>	Concluded non-permanent <sup>4</sup>
WMIR-10	Phreatophytic species: <ul style="list-style-type: none"> <li>• <i>Eucalyptus camaldulensis</i></li> <li>• <i>Melaleuca argentea</i><sup>4</sup></li> </ul>	Concluded semi-permanent <sup>4</sup>
WMIR-11	Phreatophytic species: <ul style="list-style-type: none"> <li>• <i>Melaleuca argentea</i><sup>4</sup></li> </ul>	Concluded non-permanent <sup>4</sup>
WMIR-12	-	Concluded non-permanent <sup>4</sup>
WMIR-13	Phreatophytic species: <ul style="list-style-type: none"> <li>• <i>Eucalyptus camaldulensis</i></li> <li>• <i>Cyperus vaginatus</i></li> <li>• <i>Melaleuca argentea</i><sup>4</sup></li> </ul>	Concluded semi-permanent <sup>4</sup>



Water Feature Name	Observations	Permanency
WMIR-14	-	Concluded non-permanent <sup>4</sup>
WMIR-15	Phreatophytic species: <ul style="list-style-type: none"><li>• <i>Eucalyptus camaldulensis</i></li><li>• <i>Melaleuca argentea</i><sup>4</sup></li></ul>	Concluded semi-permanent <sup>4</sup>
WMIR-16	Phreatophytic species: <ul style="list-style-type: none"><li>• <i>Eucalyptus camaldulensis</i></li><li>• <i>Melaleuca argentea</i><sup>4</sup></li></ul>	Concluded semi-permanent <sup>4</sup>
WMIR-17	Phreatophytic species: <ul style="list-style-type: none"><li>• <i>Melaleuca argentea</i><sup>4</sup></li></ul>	Concluded semi-permanent <sup>4</sup>
WMIR-18	Phreatophytic species: <ul style="list-style-type: none"><li>• <i>Melaleuca argentea</i><sup>4</sup></li></ul>	Concluded semi-permanent <sup>4</sup>

(1) Observations from May 2019 Survey (Biologic, 2020a)

(2) Observation from July 2019 Survey (Biologic, 2020a)

(3) Observations from November 2019 (Atlas Iron, 2020)

(4) Observation from December 2019 (Biologic, 2019)





# Appendix E Level 2 Vertebrate and SRE Invertebrate Fauna Assessment

Report prepared by Biologic (2020a) – refer to separate document.

---



## Appendix F Ghost Bat Review

Report prepared by Bat Call WA (2020) – refer to separate document.

---



## Appendix G Geotechnical Investigation

Report prepared by PSM Consult (2020) – refer to separate document.

---



## Appendix H Blast Impact Assessment

Report prepared by Blast It Global (2020) – refer to separate document.

---





# Appendix I Vertebrate Fauna Impact Assessment

Report prepared by Biologic (2020b) – refer to separate document.



# Appendix J Invertebrate Fauna Impact Assessment

Report prepared by Biologic (2020c) – refer to separate document.



## Appendix K Significant Species Management Plan

Refer to separate document.

---



## Appendix L Subterranean Fauna Assessment

Report prepared by Biologic (2020d) – refer to separate document.

---





# Appendix M Baseline Soil and Landform Assessment

Report prepared by Mine Earth (2019) – refer to separate document.

---



## Appendix N Mine Waste Characterisation

Report prepared by Mine Earth (2020) – refer to separate document.

---



## Appendix O Water Management Assessment

Report prepared by Atlas Iron Pty Ltd (2020) – refer to separate document.

---



## Appendix P Noise and Vibration Assessment

Report prepared by Talis (2019) – refer to separate document.

---