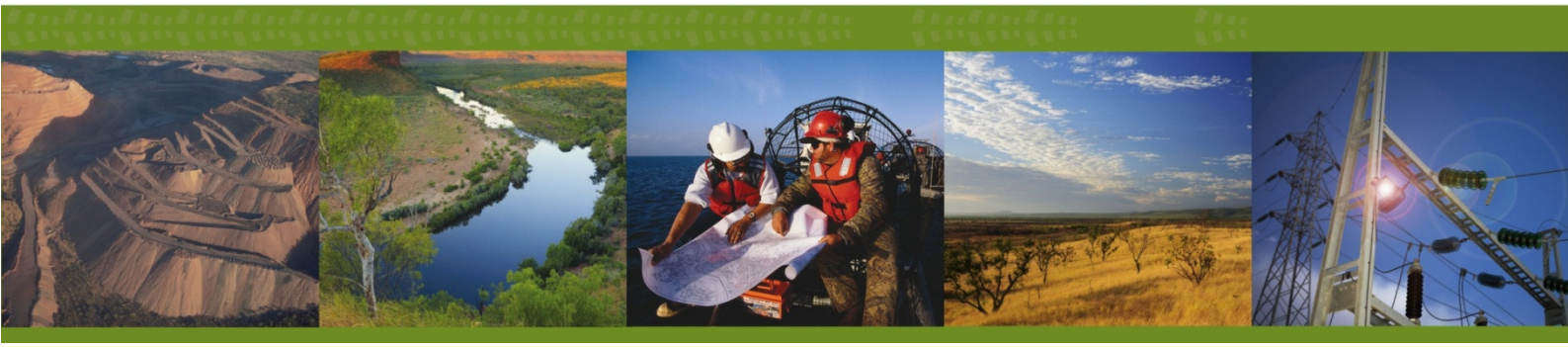

# Nullagine Iron Ore Extension Project

Section 38 Referral Supporting Document

Prepared for
BC Iron Limited
by Strategen

July 2013

STRATEGEN
environmental consultants

# Nullagine Iron Ore Extension Project

Section 38 Referral Supporting Document

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July 2013

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### Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

**Client:** BC Iron Limited

| Report Version | Revision No. | Purpose | Strategen author/reviewer | Submitted to Client | |
|---|---|---|---|---|---|
| | | | | Form | Date |
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# 1. Introduction

## 1.1 Proposal overview

BC Iron Limited (BC Iron) proposes to extend their existing Nullagine Iron Ore Project (NIOP), to include new mining areas at Bonnie East and Warrigal North. The Nullagine Iron Ore Extension Project (the proposal) will comprise an expected iron ore resource of approximately 22 million tonnes (Mt) which will extend the mine life by up to 5 years.

The proposal is located 20 km southwest of Nullagine and 150 km north of Newman in the Pilbara region of Western Australia (Figure 1).

### 1.1.1 Location

The proposal is located in the eastern Pilbara region, occurring within Mining Leases M46/522 and M46/523, both pending approval (Figure 2). Miscellaneous Licences under the Western Australian *Mining Act 1978* (Mining Act) will be sought for access to land for construction of any road infrastructure outside these tenements.

The proposal is located within the Bonney Downs and adjacent to the Hillside (pastoral) Stations. The proposal locality and surrounds has historically been used for stock grazing and more recently exploration and mining.

### 1.1.2 Purpose of document

This document has been prepared to provide supporting information to Environmental Protection Authority (EPA) for the referral of the proposal under section 38 (Part IV) of the *Environmental Protection Act 1986* (EP Act). The document utilises project and study information currently available.

The completed s 38 referral form is presented in Appendix 1.

## 1.2 Proponent details

The proponent is BC Iron Nullagine Pty Ltd (BC Iron), a subsidiary of BC Iron Limited.

BC Iron Limited is an iron ore exploration, development and mining company with key assets in the Pilbara. The NIOP is the company's main focus, comprising an unincorporated 75/25 joint venture with Fortescue Metals Group Limited.

The proponent contact details for the proposal:

Gerry Bradley
BC Iron Limited
Sustainability Manager
GPO Box 2811
Perth WA 6001

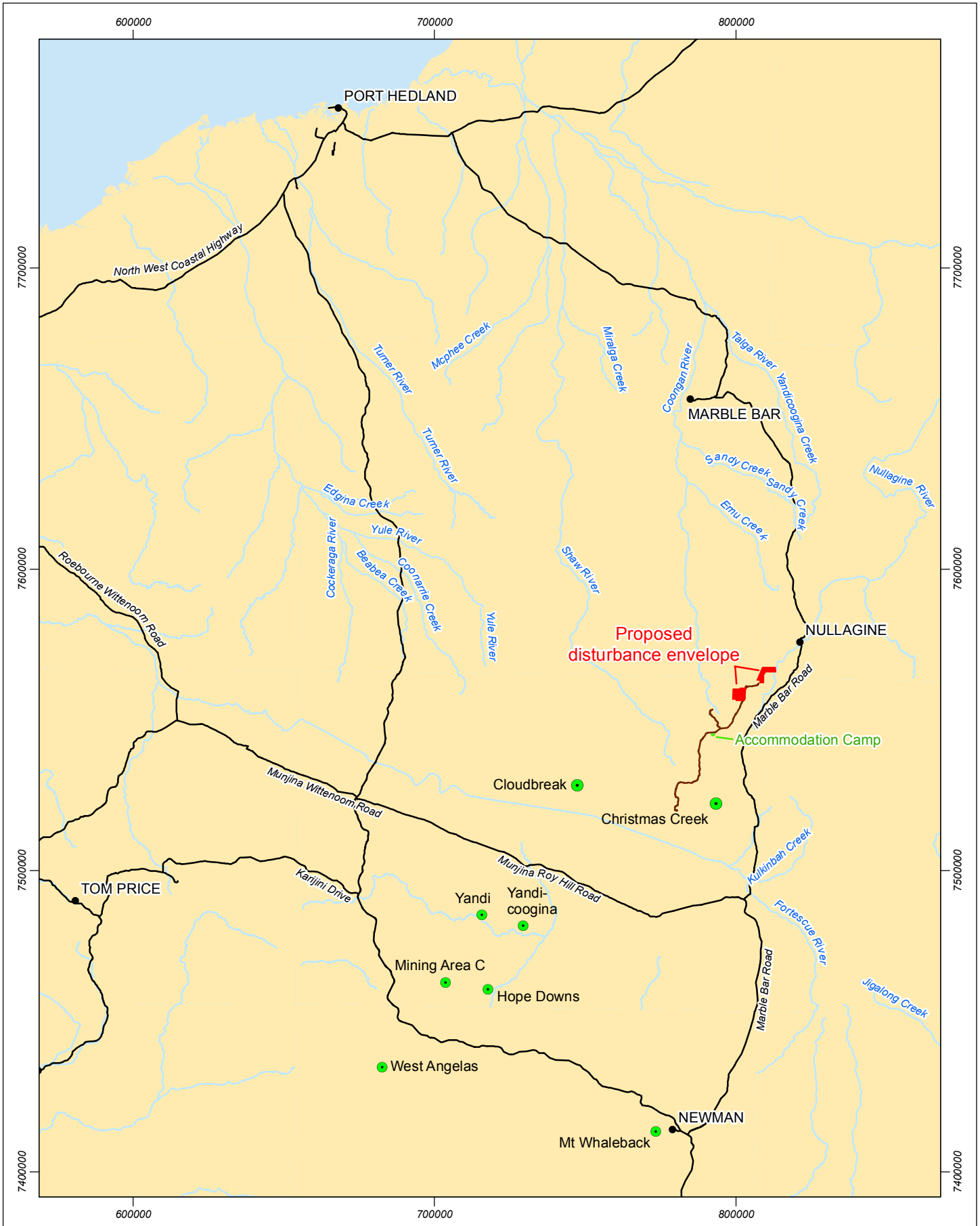


**Figure 1 Regional location of the proposal**

Scale 1:1,700,000 at A4

0 10 20 30 40 50 km

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 22/06/2013

Author: JCrute

Source: Topography: Geoscience Australia 2011.

All other data: BCI 2010-2012.


**Legend**

- Town
- Operating mines
- Existing haul road
- Major road
- Major river
- Proposed disturbance envelope
- Accommodation camp

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Path: Q:\GIS\Consult\2012\BCI\BCI12047\Projects\R005\BCI12047_R005_RevA_F001.mxd

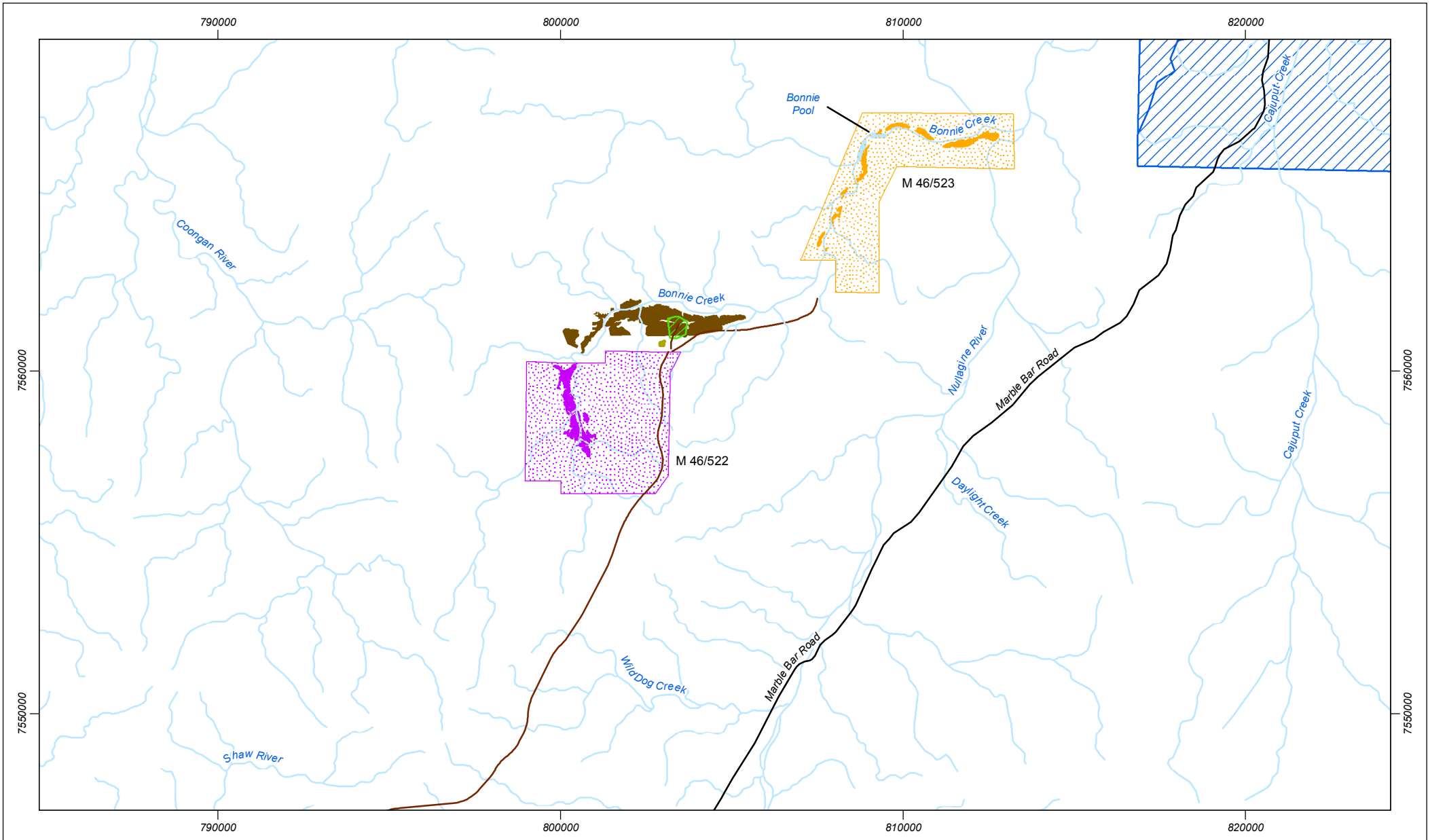


**Figure 2 Land tenure & conceptual layout of the proposal & Nullagine Iron Ore Project**

Scale 1:150,000 at A4

0 0.5 1 1.5 2 2.5 km

Coordinate System: GDA94 / MGA zone 50
Note that positional errors may occur in some areas
Date: 22/06/2013
Author: JCrute
Source: Topography & Pools: Geoscience Australia, 2011.
Catchments & PDWA: DoW, 2012. All other data: BCI 2010-2012.
Path: Q:\GIS\Consult\2012\BCI\BCI12047\Projects\R005\BCI12047_R005_RevA_F002.mxd

**Legend**

- Existing landfill outline
- Infrastructure
- Major road

**Proposed disturbance envelope**

- Bonnie East
- Warrigal North

- Existing MOC Area
- Nullagine Water Reserve
- Existing Approval EPBC 2009/4930

- Proposed Bonnie East mesas
- Proposed Warrigal North mesas

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# 2. Proposal description

## 2.1 Proposal history

The original NIOP was assessed and approved by the Department of Mines and Petroleum (DMP) and the former Commonwealth Department of Environment Water Heritage and Arts (DEWHA), now Department of Sustainability Environment Water Population and Communities (DSEWPaC) in October 2010, with operations commencing in late 2010.

The operating NIOP involves mining of Channel Iron Deposit (CID) ore from the Outcamp and Warrigal deposits from within the Bonnie Creek catchment area. Mining operations comprise progressive development and surface mining of a number of mesas as open pits/panels above the water table. Ore is transported to a central Mining Operations Centre (MOC) for on-site processing (crushing), before being transported to the Christmas Creek rail head operated by FMG, via a 58 km private haul road. Direct shipping ore (DSO) product is then transported via rail from Chichester to FMG's iron ore berths at Herb Elliot Port in Port Hedland before export to market.

The NIOP is operated on Mining Lease M46/515 and various Miscellaneous Licence and General Purpose Lease areas which are held by BC Iron.

## 2.2 Proposal overview

The Nullagine Iron Ore Extension Project (the proposal) involves the mining of CID from several greenfield deposits from within the Bonnie Creek catchment area. The two mine areas that form part of the proposal include Bonnie East and Warrigal North mesas (Figure 2). The proposal involves the clearing of up to approximately 740 ha of native vegetation for the extraction of iron ore at a crushing and screening rate of up to 6 Mt per annum (Mtpa). The maximum area of direct ground disturbance within the proposed disturbance envelope is distributed as follows:

- mine pits (189.4 ha)
- mineral waste dumps and stockpiles (337.1 ha)
- infrastructure areas including haul roads, access roads and other supporting infrastructure such as processing areas (213.5 ha).

### 2.2.1 Key proposal characteristics

Key characteristics and areas of disturbance are presented in Table 1 and Table 2.

Table 1 Key characteristics

| | |
|---|---|
| Proposal title | Nullagine Iron Ore Extension Project |
| Proponent name | BC Iron Nullagine Pty Ltd |
| Short description | The proposal is for extension of the existing NIOP, incorporating mining of Channel Iron Deposit ore from two greenfield deposits.<br>Mining of the two deposits will be undertaken over a period of up to 5 years. |

Table 2 Physical and operational elements

| Element | Location | Extent |
|---|---|---|
| Proposed disturbance envelope | Figure 2, Figure 3; Figure 4 | 2995 ha in size and comprises two pending mining lease tenements at Bonnie East (M46/522) and Warrigal North (M46/523). |
| Disturbance footprint | Figure 3; Figure 4 | 740 ha of native vegetation proposed within the proposed disturbance envelope is distributed as follows:<br>• mine pits (189.4 ha)<br>• mineral waste dumps and stockpiles (337.1 ha)<br>• infrastructure areas including haul roads, access roads and other supporting infrastructure such as processing areas (213.5 ha). |
| Average strip ratio of waste to ore | N/A | 1:9:1 |
| Overburden/low grade resource (waste rock) | N/A | 40 Mt |

### 2.2.2 Mining operations

An approximate DSO iron ore resource of 10.8 Mt at Bonnie East and 11.0 Mt at Warrigal North will be mined as part of the proposal, extending the mine life by up to 5 years. The mining method for the proposal will be consistent with the NIOP, including surface mining techniques, eliminating the need for blasting, drilling, loading and primary crushing. Cutting and crushing along linear transects will be undertaken by surface miners utilising a robust cutting drum which can potentially prevent damaging vibrations within the immediate area. Crushed material will be deposited into wind rows behind the surface mining machinery.

During the early stages of the proposal crushed material will be transported from the mesas and, if required, deposited at the existing secondary crusher and screening facility at the MOC for minimal dry processing before being transported to FMG's Christmas Creek railhead via the existing 58 km private haul road (Figure 1). DSO product is then transported via rail from Chichester to FMG berths in Port Hedland. During the implementation of the proposal there is potential for the crushing and screening plant to be re-located from the existing MOC to the Bonnie East and/or Warrigal North Mining Leases (pending) as well as the potential to operate an additional small mobile crushing and screening plant near the proposed Bonnie East mine area to meet production targets.

Stable overburden and low grade mineral dumps will be located near the respective deposits on raised ground away from creeks and areas potentially subject to flooding where practicable. Topsoil and subsoil from disturbance areas will be stripped and stored in stockpiles for later placement onto areas undergoing rehabilitation on accordance with the Mine Closure Plan to be approved under the *Mining Act 1978*. Overburden from stripping topsoil and subsoil will be removed and transferred to stable above ground dumps following removal of soil.

### 2.2.3 Infrastructure

The proposal will utilise existing supporting infrastructure where practicable, including the following:

- 58 km haul road to and railhead at Christmas Creek
- accommodation camp
- workshops
- crushing and screening plant
- Mining Operations Centre including administration offices
- groundwater supply bores
- communication towers
- access tracks.

Additional infrastructure for the proposal will include:

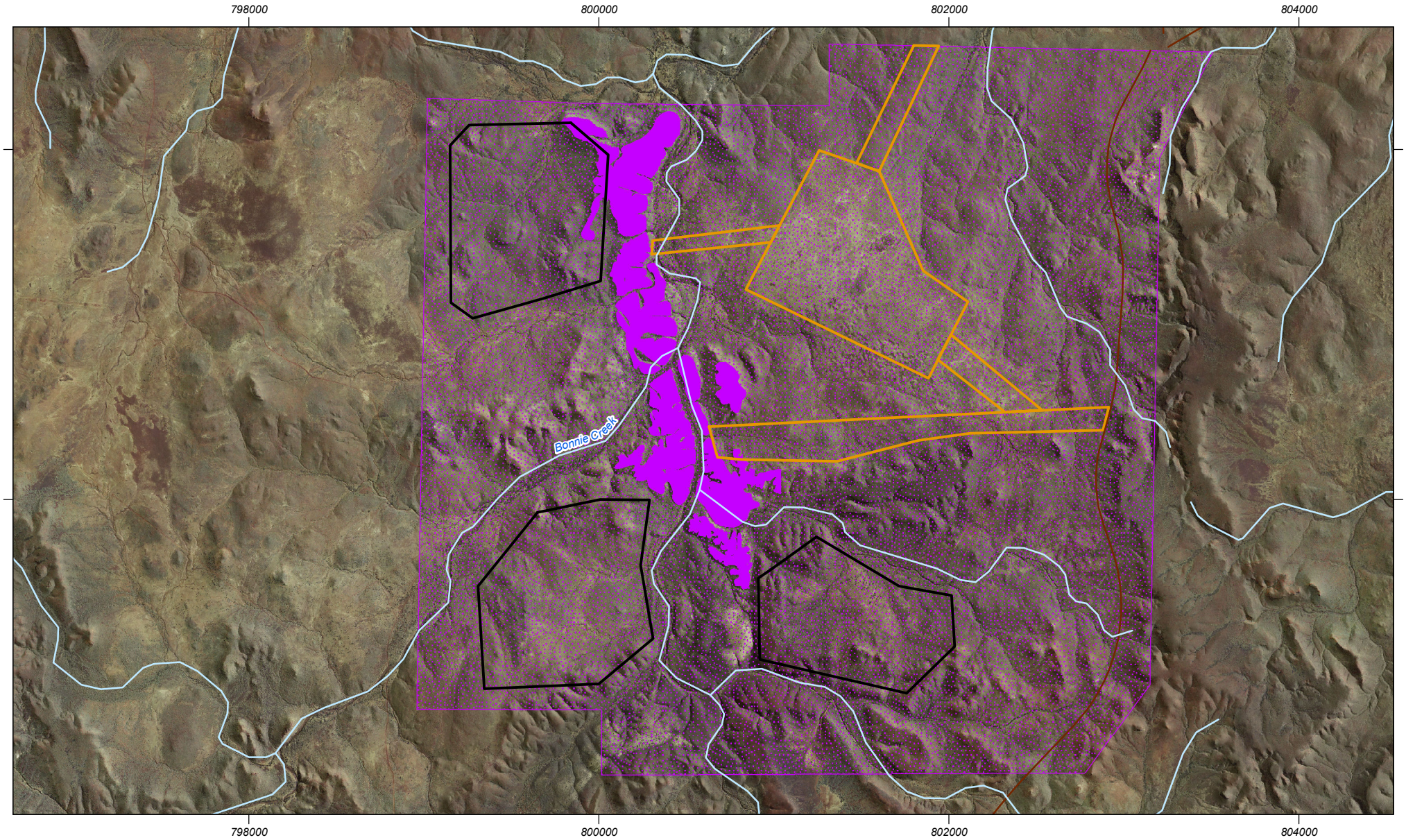
1. Stable overburden and mineral waste dumps and low grade stockpiles; refer to Section 2.2.2.
2. Crushing and screening plant(s); refer to Section 2.2.2.
3. Access and haul roads to the proposal deposits; where practicable haul roads will replace existing exploration or pastoral access roads to minimise clearing.

Additional infrastructure for the proposal may include:

1. Conveyors; these may be used to transfer ore across surface water features where practicable to limit the environmental impact to surface water features and gorge/breakaway habitat.
2. Communication towers.

### 2.2.4 Project schedule and life

Subject to regulatory approvals, it is anticipated that construction will commence for the Nullagine Iron Ore Extension Project in Q1 2014, with operations commencing in Q2 2014.




## Figure 3 Conceptual layout of Bonnie East

Scale 1:30,000 at A4

0 200 400 600 800 1,000 m

Coordinate System: GDA94 / MGA zone 50
Note that positional errors may occur in some areas
Date: 22/06/2013
Author: JCrute
Source: Topography & Pools: Geoscience Australia, 2011.
Catchments & PDWA: DoW, 2012. All other data: BCI 2010-2012.
Path: Q:\GIS\Consult\2012\BCI\BCI12047\Projects\R005\BCI12047_R005_RevA_F003.mxd

**Legend**

- Rivers
- Haul road
- Proposed areas for potential waste dumps
- Proposed areas for potential infrastructure including haul roads, lay-down areas, crushing plant etc.
- Proposed Bonnie East mesas
- Proposed disturbance envelope: Bonnie East

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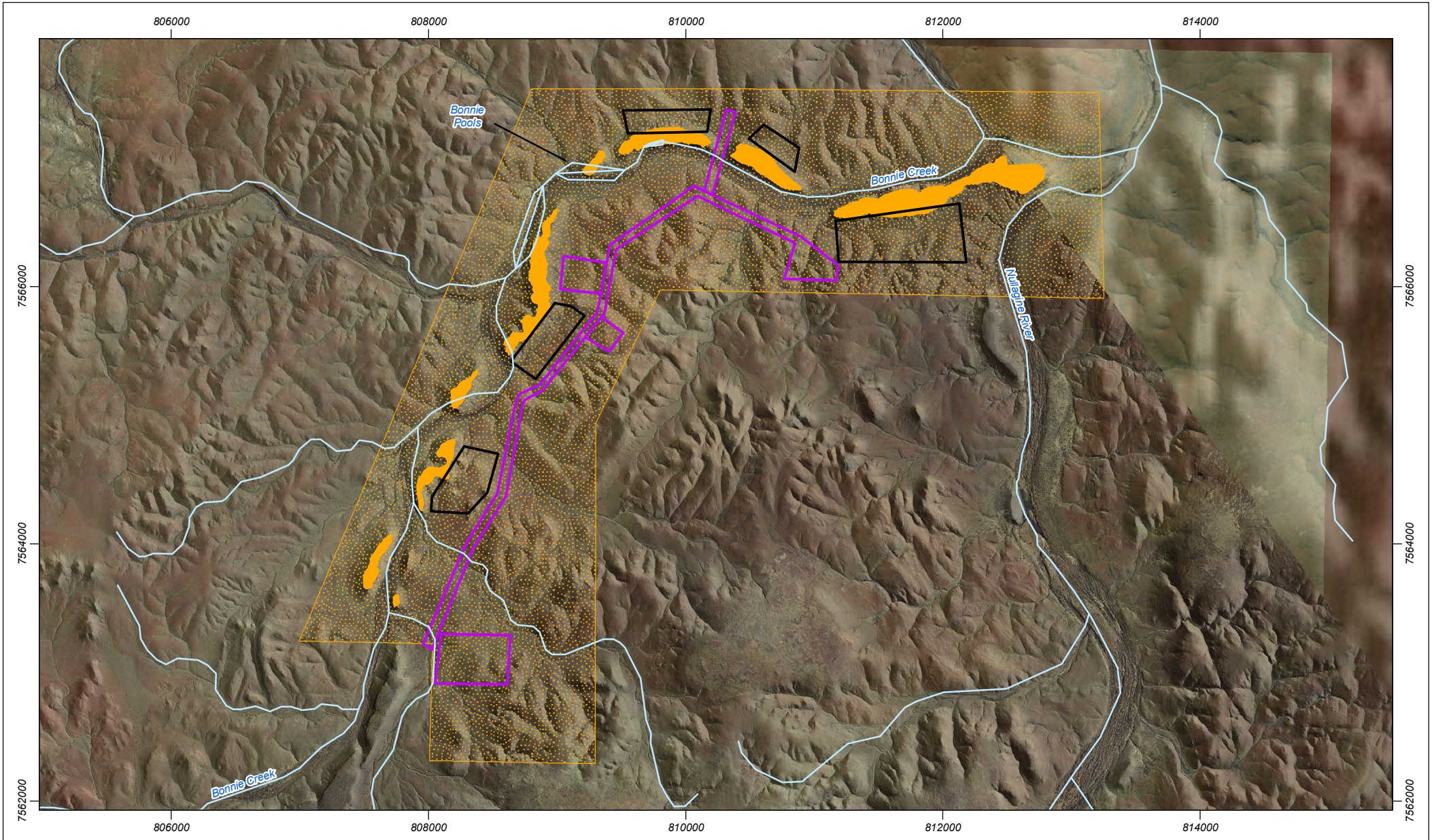


## Figure 4 Conceptual layout for Warrigal North

Scale 1:40,000 at A4

0 200 400 600 800 1,000 m

N

Coordinate System: GDA94 / MGA zone 50
Note that positional errors may occur in some areas
Date: 22/06/2013
Author: JCrute
Source: Topography & Pools: Geoscience Australia, 2011.
Catchments & PDWA: DoW, 2012. All other data: BCI 2010-2012.

**Legend**

- Rivers
- Proposed areas for potential infrastructure including haul roads, lay-down areas, crushing plant etc.
- Proposed areas for potential waste dumps
- Proposed Warrigal North mesas
- Proposed disturbance envelope: Warrigal North

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# 3. Regulatory framework and environmental approvals

### 3.1.1 Applicable legislation

The key environmental legislation applying to the proposal includes, but is not limited to:

- *Environmental Protection Act 1986* (WA)
- *Conservation and Land Management Act 1984* (WA)
- *Wildlife Conservation Act 1950* (WA)
- *Mining Act 1978* (WA)
- *Aboriginal Heritage Act 1972* (WA)
- *Rights in Water and Irrigation Act 1914 (WA)*
- *Dangerous Goods Safety Act 2004* (WA)
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
- *Native Title Act 1993* (Commonwealth).

### 3.1.2 Western Australian environmental impact assessment process

The EP Act is the primary legislation that governs environmental impact assessment and protection in Western Australia. This proposal is being referred to the EPA under s 38(1) of the EP Act.

### 3.1.3 Other state environmental approvals

A clearing permit under Part V of the EP Act will be required if the proposal is not assessed. DMP has delegated responsibility for the administration, assessment and approval of clearing permit applications relating to mineral and petroleum activities in Western Australia.

The proposal will require a works approval under Part V of the EP Act for the construction of a crushing and screening plant in the proposed disturbance envelope as this is a prescribed activity defined by Schedule 1 of the Environmental Protection Regulations 1987, i.e. Category 12 'crushing and screening'. An operating licence will also be required for operation of the crushing and screening plant. It is expected BC Iron will prepare and submit works approval and licence application(s) to Department of Environment and Conservation (DEC) for assessment under Part V of the EP Act in approximately mid–late 2014.

The Mining Act regulates mineral exploration and mining in Western Australia. A Mining Proposal and Mine Closure Plan will be submitted to DMP.

The *Rights in Water and Irrigation Act 1914* (RIWI Act) provides the legislation for Department of Water (DoW) to manage and allocate water resources in Western Australia. BC Iron will submit applications to maintain/renew existing 5C licences under the provisions of the RIWI Act for groundwater abstraction from water supply bores for the potable and process water requirements for the proposal. If there is a requirement for additional or new groundwater supply bores, BC Iron will submit 26D licence applications for their construction and amend 5C licences appropriately (if required) under the provisions of the RIWI Act.

The *Aboriginal Heritage Act 1972* (AH Act) makes provision for the preservation of places and objects customarily used by or traditional to the original inhabitants of Australia or their descendants. BC Iron will submit applications under section 18 of the AH Act for disturbance to Aboriginal heritage sites if required.

### 3.1.4 Australian Government environmental impact assessment process

While the states and territories have responsibility for environmental matters at a state and local level, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) aims to focus the Australian Government interests on protecting Matters of National Environmental Significance (MNES).

The EPBC Act requires an assessment as to whether a proposed action is likely to have a significant effect on a MNES.

The most relevant matter of MNES is that which aims to protect threatened species and ecological communities. The EPBC Act lists flora and fauna species that are either extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent. Ecological communities are listed that are critically endangered, endangered or vulnerable. An assessment requires determining the presence (either confirmed or likely) of listed threatened species and communities in the proposed disturbance envelope and surrounds and the likelihood of significant impacts that may be posed by the proposal.

The proposal has been assessed against the DSEWPaC 'Test of Significance' criteria and the Northern Quoll Impact Assessment Guidelines. The proposal was referred to DSEWPaC on 30 May 2013 for assessment under the EPBC Act; based on discussions with DSEWPaC and the outcomes of the assessment (including survey results and management actions already implemented for the NIOP), it is anticipated that the proposal will not require formal assessment under the EPBC Act.

# 4. Stakeholder consultation

Consultation in relation to the proposal has been undertaken and/or is proposed with various stakeholders as outlined in Table 3. Consultation has been undertaken or is proposed with the following stakeholders:

- State and Commonwealth Government Members of Parliament
- Government agencies
- Native Title Claimant Groups
- Local landowners.

Table 3 Summary of stakeholder consultation undertaken and proposed as part of the proposal

| Stakeholder | Date of Consultation | Items Discussed/proposed to be discussed | Outcomes |
|---|---|---|---|
| **Commonwealth, State and Local Government** | | | |
| DSEWPaC<br>(meeting in Canberra) | 19 February 2013 | NIOP environmental management framework and management record.<br>Introduction to proposal as an extension of the current mining operations and summary of completed/ongoing environmental studies.<br>Impacts on Matters of National Environmental Significance (MNES) and broader environment from the existing and proposal. | The proposal will have limited impacts on MNES. BC Iron to clearly demonstrate their positive environmental management record for the existing action.<br>The proposal will have net conservation gain through mitigation strategies.<br>The proposal has benefits for employment and economic exports including employment for indigenous people provided under the agreement between BC Iron and Palyku Native Title Claimant Group. |
| The Office of the Commonwealth Minister for the Environment (Hon. Tony Burke MP)<br>(letter with briefing note) | 15 February 2013 | Introduction to project and potential environmental approval requirements under the EPBC Act. | Response from the Office of the Minister for the Environment to seek update from DSEWPaC and contact BC Iron if any concerns. |
| Office of the Environmental Protection Authority (OEPA) | 27 March 2013<br><br>May 2013 | Introduction to proposal as an extension of the current operation including summary of completed/ongoing environmental studies and proposed impacts on the environment.<br>Discussion with the Director (Assessment and Compliance) of OEPA regarding the requirement to refer the proposal under Part IV of the EP Act. | OEPA recommended the proposal be referred under Part IV of the EP Act. Advice from OEPA staff indicated that the proposal is likely to be 'not assessed – advice given'.<br>The proposal will have limited impacts on environmental issues of State significance.<br>The EIA of the proposal under the Mining Act will include thorough examination of environmental impacts and existing approved environmental management plans will be updated appropriately; therefore it is anticipated that assessment under Part IV of the EP Act is unnecessary. |

| Stakeholder | Date of Consultation | Items Discussed/proposed to be discussed | Outcomes |
|---|---|---|---|
| DEC Environmental Management Branch (EMB)<br>(Briefing note) | 13 February 2013 | Introduction to proposal as an extension of the current operation including summary of completed/ongoing environmental studies and proposed impacts on the environment. | DEC is satisfied that the proposal appears straight forward with limited impacts on environmental issues of State significance and they require no further consultation; however DEC recommended discussion of the proposal with OEPA and DSEWPaC in regards to relevant environmental approvals. |
| | Additional consultation proposed for June 2013 and ongoing until year 3 of the closure plan (proposed) | Present and seek feedback on proposed post-closure land use, closure objectives and completion criteria | N/A |
| DMP Minerals Branch, Environment Division | Multiple meetings, including 20 February, 12 March and 27 March 2013 | Introduction to proposal as an extension of the current operation including summary of completed/ongoing environmental studies and proposed impacts on the environment.<br>NIOP environmental management framework and management record.<br>Surface water study and Mine Closure Plan requirements. | BC Iron is gaining DMP input into the approvals process including investigation scoping and Mine Closure Plan development.<br>Additional stakeholders to be consulted have been identified by DMP and a consultation program will be implemented during the first half of 2013.<br>Development of Mine Closure Plan for the existing and proposal to be retro-fitted and prepared in accordance with 'Guidelines for Preparing Mine Closure Plans' (DMP & EPA 2011) and submitted to DMP for assessment under the Mining Act with the Mining Proposal.<br>BC Iron is committed to avoiding and/or minimising potential environmental impacts including the construction of stable landforms such as waste dumps; creek levies (potential) and re-instated creek(s) following diversion work (potential). |
| | 27 May 2013 | Mine Closure Plan including draft completion criteria in addition to structure and proposed content.<br>Stakeholder communications planned for to discuss closure commitments and objectives; meeting with Palyku Native Title Claimant Group planned for June 2013.<br>Short Range Endemic (SRE) invertebrate surveys conducted to date. | DMP assessment officer (Phil Boglio) to review draft completion criteria.<br>DMP to accept advice from technical experts regarding suitability of SRE surveys conducted to date.<br>DMP advised that the structure and proposed content of Mine Closure Plan looks suitable. |

| Stakeholder | Date of Consultation | Items Discussed/proposed to be discussed | Outcomes |
|---|---|---|---|
| | Additional consultation events are proposed for June–August 2013 and ongoing until year 3 of the closure plan (proposed) | Ongoing discussion of mine closure and surface water studies.<br>Updated design of the proposal. | N/A |
| The Office of the State Minister for Mines and Petroleum (Hon. Bill Marmion MLA) | Q2 2013 (proposed) | Brief introduction to proposal as an extension of the current operation and potential environmental approval requirements under the EP Act and Mining Act.<br>State employment and economic benefits resulting from the proposal. | N/A |
| Department of Water (DoW) | November 2012 | Impacts on water resources (groundwater and surface water) and design/scope of surface water studies. | BC Iron has implemented a surface water study to assess potential surface water impacts at a level and standard satisfactory to DoW. This includes collection of data upstream and downstream of the potential diversion sites, at Bonnie Pool and at two control sites over a 18 month period (including the 2012/13 & 2013/14 wet seasons) to gain a good understanding of baseline surface water conditions for future monitoring.<br>BC Iron is committed to avoiding and/or minimising potential environmental impacts to water resources and has considered DoW advice where practicable. |
| | 23 May 2013 | Meeting to present the results of BC Iron's baseline monitoring programme that commenced in the Bonnie Creek catchment in November 2012. | BC Iron to keep DoW informed of further monitoring and results. |
| Shire of East Pilbara and Member for Pilbara (State) | Q2 2013 and ongoing until year 3 of the closure plan (proposed) | Brief introduction to proposal as an extension of the current operation including potential environmental impacts and approval requirements under Local, State and Federal legislation.<br>Local employment and economic benefits resulting from the proposal.<br>Present and seek feedback on proposed post-closure land use, closure objectives and completion criteria | N/A |
| Department of Aboriginal Affairs (DAA) | Q2 2013 (proposed) | Consultation undertaken with indigenous stakeholders and demonstration of feedback. | N/A |

| Stakeholder | Date of Consultation | Items Discussed/proposed to be discussed | Outcomes |
|---|---|---|---|
| Consultation will be held with the following stakeholders to introduce the proposal and/or to discuss mine closure planning:<br>• Main Roads Department (WA)<br>• Pilbara Development Commission<br>• Pastoral Lands Board (WA) | Q2 2013 (proposed) | Present and seek feedback on proposed post-closure land use, closure objectives and completion criteria | N/A |
| Regional Development and Lands (WA). | Q2 2013 and ongoing until year 3 of the closure plan (proposed) | Present and seek feedback on proposed post-closure land use, closure objectives and completion criteria. | N/A |
| **Native Title Claimant group** | | | |
| Palyku Native Title Claimant Group (Palyku) | 10 June 2013 and ongoing until year 3 of the closure plan | BC Iron introduced the proposal to Palyku regarding the potential land access and heritage and/or environmental (water) impacts.<br>Employment opportunities for Palyku during operations and rehabilitation work. | Ongoing consultation outcomes continue to be a key driver for design of the proposal.<br>BC Iron to ensure the proposal does not affect formal agreements with Palyku. |
| Nyiyaparli Native Title Claimant Group (Nyiyaparli) | Ongoing until year 3 of the closure plan | BC Iron to introduce relevant aspects of proposal to Nyiyaparli regarding any land access and heritage impacts that may arise. | BC Iron to ensure the proposal does not affect formal agreements with Nyiyaparli. |
| **Local Landowners and Other Stakeholders** | | | |
| Fortescue Metals Group (FMG) | Ongoing | Explanation of proposal and discussion of Joint Venture agreement. | Anticipated amendment of Joint Venture agreement to extend the arrangement |
| Pastoral operators (Bonney Downs and Hillside) | February 2013 | Introduction to proposal including development intentions and timeframes.<br>Land access agreements.<br>Input/comment for mine closure planning including post land use agreements. | Consultation outcomes to help inform final design of proposal.<br>Proposal to have minimum impact on pastoral activities.<br>BC Iron still in process of seeking comments on mine closure planning. |
| | Additional consultation events are proposed for April–July 2013 and ongoing until year 3 of the closure plan | Updated design of the proposal.<br>Ongoing mine closure planning. | N/A |

BC Iron will continue to consult with specific agencies and stakeholders as required throughout the assessment process for the proposal and throughout the life of the proposal. Consultation with the Palyku people will also be ongoing throughout the proposal.

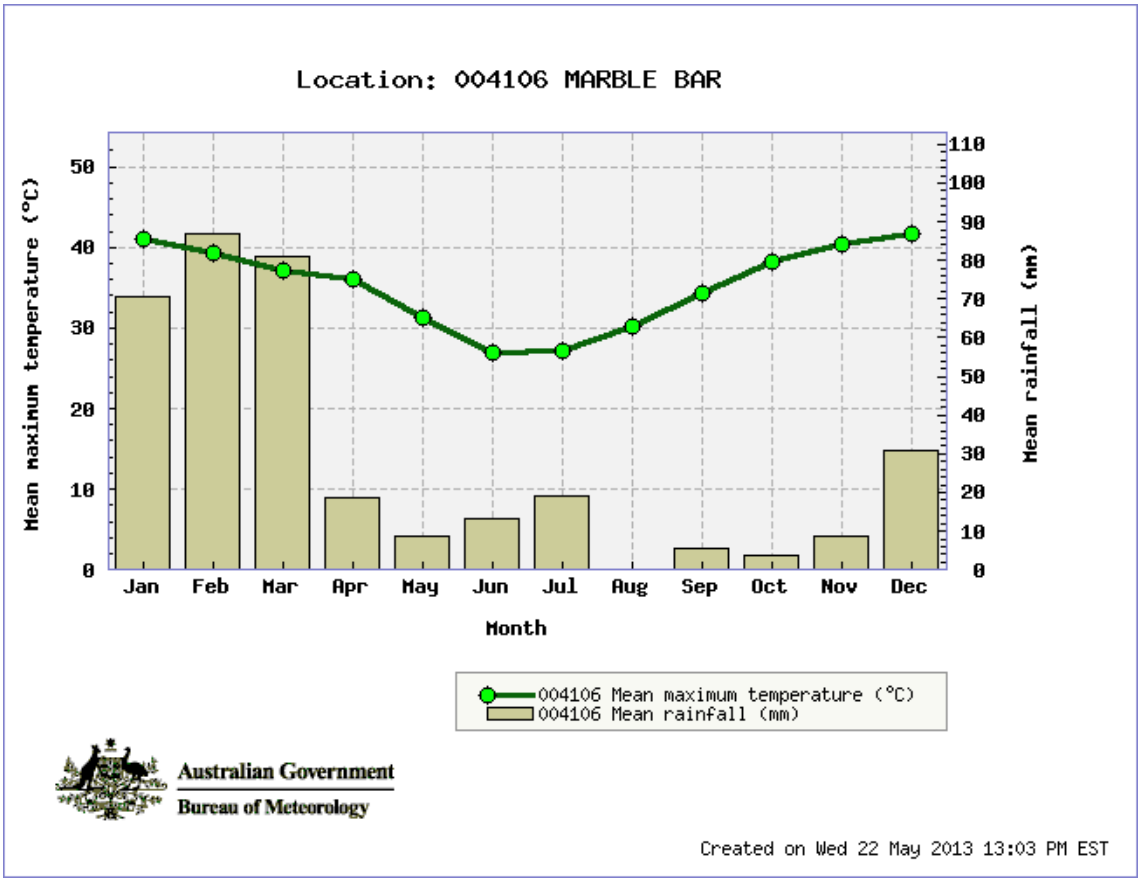
# 5. Existing environment

## 5.1 Physical environment

### 5.1.1 Climate

The proposal is located within the Pilbara region of Western Australia, characterised by a semi-arid to arid climate, with hot wet summers and warm, dry winters. The closest Bureau of Meteorology (BoM) weather station to the proposal is located at Marble Bar, approximately 90 km away (BoM 2013).

Average daily maximum temperatures range from 41.7°C in December to 26.9°C in June (BoM 2013). Average minimum temperatures range from 26°C in January to 12.1°C in July (BoM 2013). The weather station receives average annual rainfall of 348.5 mm, with maximum average rainfall occurring in February (86.9 mm) and minimum average rainfall in August (0.3 mm). The majority of rainfall occurs from December to March (BoM 2013). Relevant climatic data for this station is presented in Figure 5.




Source: Marble Bar weather station BOM (2013)

Figure 5 Climatic data for Marble Bar

### 5.1.2 Regional setting

The proposal is located within the Pilbara bioregion, characterised as part of the Interim Biogeographic Regionalisation for Australia (IBRA) (Van Vreeswyk *et al.* 2004*).* The proposal is located within the Chichester subregion of the Pilbara bioregion, characterised by undulating Archaen granite and basalt plains including significant areas of basaltic ranges (Van Vreeswyk *et al.* 2004). The proposed disturbance envelope is characterised by low hills, ridges and slopes and minor stony plains associated with the Rocklea, Robe and Wona land systems.

### 5.1.3 Geology

The Pilbara region comprises of the Pilbara Craton, subdivided into the Archean granite-greenstone terrain in the north and the Archaen and Proterozoic Hamersley Basin in the south. The proposal occurs within the Hamersley Basin, consisting of mafic and felsic volcanic, shale, siltstone, sandstone and conglomerate, as well as dolomite and banded iron formation.

The geology of the proposed disturbance envelope is complex, incorporating metamorphosed basic and ultra-basic volcanic and intrusive rocks, including; basalt, dacite and sandstone and shale of Proterozoic origin and iron formation and shale of Archaen-Proterozoic origin.

The proposed disturbance envelope is characterised by Channel Iron Deposits (CID) formed approximately 40 million years ago as major river valleys were eroded and iron-rich sediments were deposited along the floor of paleochannels.

CID ores differ from the classic bedded ores derived from the Brockman and Marra Mamba Iron formations as they have a pisolitic texture, made up of rounded haematite ‘pea-stones’, usually less than 5 mm in diameter, and rimmed with hydrated iron oxides (goethite and/or limonite) cementing the ore together.

#### *Waste characterisation*

As part of the assessment of the operating NIOP, characterisation of waste materials was undertaken to determine the potential risk of acid mine drainage (AMD) occurring. The assessment was undertaken from a number of locally collected samples from the Outcamp, Coongan and Warrigal deposits. Waste characterisation results identified a very low to negligible potential for AMD (Campbell 2010). Acid forming materials (sulphides) are generally found in insignificant amounts within CID, with no historical records of AMD within CIDs of the Pilbara (Campbell 2010).

Total sulphur levels were measured from samples taken from ore and waste rock across the NIOP site. Sulphur measurements indicated total sulphur values for the majority of waste rock is below 0.1%, with an average total sulphur of 0.0177%; the geological material that was to be disturbed by the NIOP was therefore considered to have a negligible content for acid-generating material (Campbell 2010).

Waste characterisation investigations are complete at Bonnie East and will be undertaken at Warrigal North to inform waste management strategies to support the Mining Proposal and Mine Closure Plan. Results of the investigation to date confirm that the waste rock at Bonnie East has low acid generating potential consistent with previous investigations undertaken for the NIOP (Campbell G [Graeme Campbell & Associates Pty Ltd] 2013, pers. comm. 30 May).

### 5.1.4 Landform and soils

Characterisation of soils at Bonnie East and Warrigal North is being undertaken to inform operational and closure aspects of the proposal. These soil investigations are expected to be complete in July 2013 to support the Mining Proposal and Mine Closure Plan.

Soils of the region are generally shallow red alkaline loams, with substantial areas devoid of soil (Strategen 2010a). The proposed disturbance envelope is characterised by undulating plains dominated by stony soils, with a pebbly mantle of shale, chert, ironstone, sandstone or dolomite over red shallow

loams or calcareous loamy soils. The flanks of the mesas contain iron-rich gravelly soils that form extensive sheets of scree, abutting lower levels of topography (Strategen 2010a).

Floodplains exhibit extensive sheets of silty and sandy soils with areas of higher clay content in the cracking clay sites. River channels generally have a base of alluvial sand or unconsolidated rock (Strategen 2010a).

Soils of the proposed disturbance envelope are expected to be predominately Tertiary-aged colluviums, characterised by angular fragments of banded iron formation, chert and shale (Strategen 2010a).

Ground elevations across the site generally range between 530 and 445 m Australian Height Datum (Worley Parsons 2013). Well-developed drainage lines incise into mesas, forming gullies of approximately 20 to 30 m depth (Worley Parsons 2013).

### 5.1.5 Groundwater and surface water

#### *Groundwater*

Groundwater of the region comprises Tertiary CID that occupies palaeochannels incised through the Fortescue Group Basalts (Worley Parsons 2013). The basalts are typically characterised by low primary porosity, low storage and limited aquifer potential (Worley Parsons 2013). Fracturing can produce local zones of higher permeability, these fracture zones are often localised and have limited storage (Worley Parsons 2013). Regional groundwater flow is likely to be controlled by secondary permeability developed through fractures within bedrock and by localised aquifers of higher permeability.

In the vast majority of the proposed disturbance envelope the CIDs reportedly occur above the groundwater table; therefore their importance as aquifers in the proposed disturbance envelope is limited. The CIDs, however, are likely to be important throughflow zones following major rainfall and runoff events and may act as recharge zones at locations where creeks intersect CID (Worley Parsons 2013).

Groundwater is present in some alluvial sediments in creek systems within the proposed disturbance envelope, however groundwater storage in the majority of the proposed disturbance envelope is limited (Worley Parsons 2013). The presence of alluvial sediments allows for lateral groundwater flow which can recharge pools located in topographic depressions, however recharge is limited by the available storage upstream (Worley Parsons 2013).

#### *Surface water*

Rainfall patterns in the region are spatially and temporally variable with the majority of streamflow occurring between February and March, and the remainder distributed over December, January and April, coinciding with cyclonic activity (BOM 2009). Bonnie Creek is the major ephemeral watercourse that traverses the proposed disturbance envelope with a 254 $km^2$catchment area. Two other major ephemeral watercourses exist adjacent to the proposed disturbance envelope including Coongan River (catchment area 7010 $km^2$) and Nullagine River (catchment area 6949 $km^2$) which Bonnie Creek is a tributary. These three watercourses all flow in a general northward direction.

Several small ephemeral pools and one confirmed permanent pool, Bonnie Pool, occur within the proposed disturbance envelope (Figure 2). While Bonnie Pool is not listed as a Priority Ecological Community, permanent wetlands in the Pilbara are included in a 'provisional list' of threatened ecosystems in Australia and have a recommended status of "vulnerable" (ANRA 2007, McKenzie *et al.* 2003). Threatening processes that are affecting fringing vegetation of the Bonnie Pool riparian zones include domestic animal grazing and weed invasion (Astron 2009). Bonnie Pool has been subjected to grazing pressure; however it is likely to support a range of ecological values (Worley Parsons 2013, Bamford 2013a). Bonnie Pool appears likely to support both surface and groundwater flows and would be flushed/scoured during wet season flows (Worley Parsons 2013).

The proposal is located in the upper reaches of the Bonnie Creek and Coongan River systems; therefore the catchment areas contributing runoff are generally smaller with steep grades (Worley Parsons 2013).

## 5.2 Biological environment

The proposal is located within the Chichester subregion of the Pilbara Interim Biogeographic Region of Australia (Plantecology 2013). The Chichester subregion comprises three land systems that occur within the proposed disturbance envelope, including the following:

1. Rocklea: Basalt hills, plateaux, lower slopes and minor stony plains supporting hard Spinifex (and occasionally soft Spinifex) grasslands.
2. Robe: Low limonite mesas and buttes supporting soft Spinifex (and occasionally hard Spinifex) grasslands.
3. Wona: Basalt upland gilgai plains supporting tussock grassland and minor hard Spinifex grassland.

The Rocklea and Robe Land Systems support mainly hard Spinifex hummock grasslands, which are preferentially grazed by livestock and are therefore not usually subject to land degradation. The Wona Land System, however, supports tussock grasses and herbs that are highly preferred by stock and is susceptible to degrading processes (Plantecology 2013).

### 5.2.1 Vegetation and flora

A Level 2 flora and vegetation survey of the proposed disturbance envelope was undertaken by Plantecology in 2012 and 2013 (Appendix 2). The investigation incorporated a dry season survey (2012) and two post wet-season surveys (2012 and 2013). In addition a targeted Priority Flora search was undertaken in April 2013.

The vegetation of the NIOP area and surrounds was originally surveyed and mapped by Astron between May and October 2008 (Astron 2009) and in March 2011, Cardno conducted a Priority Flora search of proposed infrastructure areas of the cracking clay communities, focussing on ephemeral species (Cardno 2011).

#### *Vegetation*

##### Vegetation associations

Two vegetation associations mapped by Shepherd *et al.* 2002 occur within the proposed disturbance envelope: Chichester Plateau 173 and Abydos Plain – Chichester 173 (Plantecology 2013). Chichester Plateau 173 is extensive throughout the Pilbara with an estimated 1 124 000 ha remaining uncleared since European settlement equating to 99.99% of the original extent. 618 000 ha of the Abydos Plain-Chichester 173 association is estimated to remain uncleared since European settlement which equates to 99.99% of the original extent (Plantecology 2013).

##### Assigned vegetation communities

A cluster analysis was undertaken for the most recent survey (Plantecology 2013), assigning plant communities to the existing classifications developed by Astron (2009). Ten communities were defined from the analysis and an additional two communities were mapped, extending from previous surveyed areas at Warrigal, but were not sampled due to their limited extent. Vegetation communities in the proposed disturbance envelope are described in Table 4, and presented in Figure 6 and Figure 7, based on the 2009 and 2013 survey results.

##### Threatened or Priority Ecological Communities

No Threatened Ecological Communities (TECs) were recorded from the proposed disturbance envelope during the survey (Plantecology 2013).

A search of the DEC database of Threatened and Priority Ecological Communities (PECs) found two PECs that have been recorded within 10 km of the flora and vegetation survey area, including:

- the Priority 1 Fortescue Marsh (Marsh Land System)
- the Priority 3 Stony saline clays of the Mosquito Land System.

Neither of these PECs are likely to occur within the proposed disturbance envelope as the area does not include any part of either the Fortescue Marshes or Mosquito Land System (Plantecology 2013).

Areas of cracking clays identified in the survey area are part of the Wona Land System, which can support four Priority Ecological Communities (PECs) in the Pilbara including:

1. The Priority 1 cracking clays of the Chichester and Mungarroona Range; this grassless plain of stony gibber community occurs on the tablelands with very little vegetative cover during the dry season, however during the wet season a suite of ephemerals/annuals and short-lived perennials emerge, many of which are poorly known and range-end taxa.
2. The Priority 1 annual sorghum grasslands on self-mulching clays; this community appears very rare and restricted to the Pannawonica-Robe valley end of Chichester Range.
3. The Priority 3 Mitchell grass plains (*Astrebla* spp.) on gilgai.
4. The Priority 3 Mitchell grass and Roebourne Plan grass (*Eragrostis xerophila)* plain on gilgai (typical type, heavily grazed).

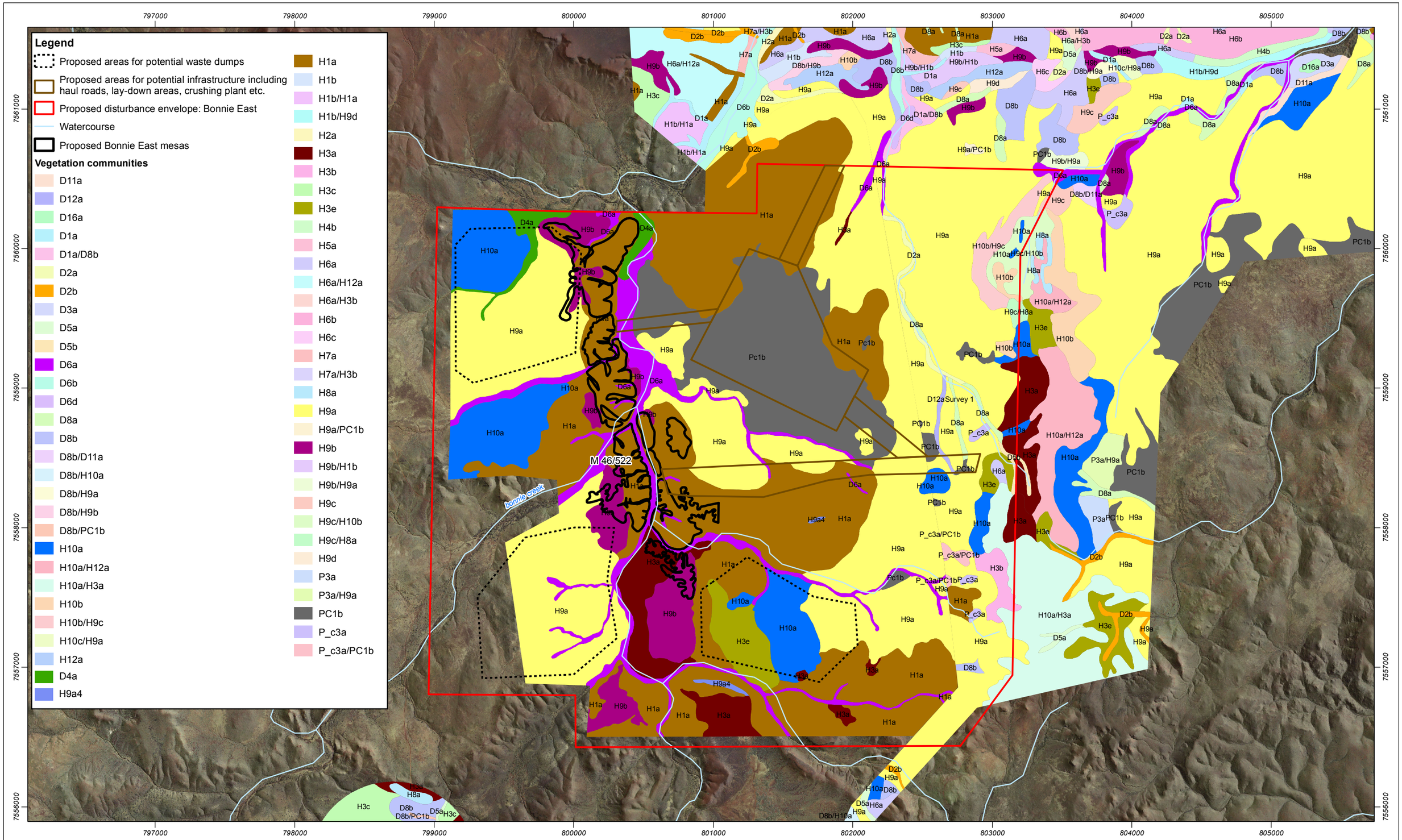
The only extensive areas of cracking clays in the current survey area were identified in the Bonnie East sub-area, which supports community of mixed low shrubs over *Ptilotus gomphrenoides* herbland and mixed *Panicum laevinode* open tussock grassland (vegetation community PC1b) which is generally considered a PEC (Plantecology 2013). The proposed disturbance envelope is not in the Pannawonica-Robe valley end of the Chichester Range and therefore PC1b is unlikely to be the 'annual sorghum grasslands on self-mulching clays' PEC. In addition, this community is not a grassless plain and it contains a significant shrub layer, and therefore does not correspond to the Priority 1 "Cracking clays of the Chichester and Mungaroona Range". Of these four PECs the two Priority 3 PECs are the most likely to be represented on the cracking clays within the proposed disturbance envelope; however, neither *Eragrostis xerophila* nor any *Astrebla* species (the main dominant species of these two communities) were recorded within the PC1b community (Plantecology 2013).

Table 4 Current extent of vegetation communities identified in the proposed disturbance envelope[1]

| Community Code | Community Description | Mapped local extent of vegetation communities (ha) |
|---|---|---|
| D2a | *Corymbia hamersleyana* scattered low trees to low woodland over mixed *Acacia* spp. Scattered shrubs to shrubland over mixed *Triodia epactia* hummock / **Cenchrus* spp. Tussock grassland. | 103.55 |
| D2b | *Corymbia hamersleyana* scattered low trees over mixed *Acacia* spp. shrubland over mixed *Triodia epactia* hummock / *Paraneurachne muelleri* tussock grassland. | 34.30 |
| D4a | *Eucalyptus camaldulensis* woodland over mixed shrubland or mixed **Cynodon dactylon* grassland / *Typha domingensis* sedgeland. | 97.82 |
| D6a | *Eucalyptus victrix* woodland over *Melaleuca* spp. high shrubland over mixed *Triodia epactia* hummock grassland / **Cenchrus* spp. tussock grassland / *Cyperus vaginatus* sedgeland. | 128.04 |
| D6d | *Eucalyptus victrix / Acacia ampliceps* woodland over mixed shrubland over *Triodia longiceps* hummock / **Cenchrus* spp. tussock grassland. | 2.26 |
| D8a | Mixed A*cacia* spp. shrubland over *Triodia epactia* hummock grassland. | 61.61 |
| D8a4 | *Acacia tumida* and *Grevillea wickamii* closed scrub over *Corchorus lasiocarpus* subsp. *lasiocarpus* and *Indigofera monophylla* scattered low shrubs over *Triodia epactia* hummock grassland. | 1.39 |
| D9a | Mixed *Acacia* spp. shrubland over mixed *Triodia epactia* hummock / **Cenchrus ciliaris* tussock grassland / herbland. | 7.18 |
| D12a | **Vachellia farnesiana* shrubland over **Cenchrus ciliaris* tussock grassland. | 7.53 |
| H1a | *Corymbia hamersleyana* scattered low trees over mixed *Acacia* spp. scattered shrubs to shrubland over *Triodia epactia* hummock grassland. | 1017.92 |
| H3a | *Eucalyptus leucophloia* scattered low trees over mixed *Acacia* spp. scattered shrubs to shrubland over *Triodia epactia* hummock grassland. | 249.36 |
| H3e | *Eucalyptus leucophloia* scattered low trees over mixed *Senna* spp. scattered shrubs over *Triodia brizoides* hummock grassland. | 275.56 |
| H6a | *Acacia pruinocarpa* scattered low trees over mixed *Acacia* spp. scattered shrubs over *Triodia epactia* hummock grassland. | 52.07 |
| H8a | *Acacia aneura* and *A. pruinocarpa* low woodland over mixed *Eremophil*a shrubland over *Triodia pungens* hummock grassland. | 112.03 |
| H9a | Mixed *Acacia* spp. scattered shrubs to shrubland over *Triodia epactia* hummock grassland. | 2204.66 |
| H9a4 | *Acacia monticola, A. ancistrocarpa* and *Grevillea wickhamii* scattered tall shrubs over *Triodia epactia* hummock grassland | 1.6 |
| H9b | Mixed *Acacia* spp. scattered shrubs to shrubland over *Triodia wiseana* hummock grassland. | 259.90 |
| H10a | Mixed *Senna* spp. scattered shrubs over *Triodia epactia* open hummock grassland. | 192.82 |
| H12a | Mixed *Triodia epactia* hummock / *Eriachne.* spp tussock grassland. | 24.47 |
| PC1b | Mixed low shrubs over *Ptilotus gomphrenoides* herbland and mixed *Panicum laevinode* open tussock grassland. | 278.26 |
| Total | N/A | 5112.33 |

Source: Plantecology (2013), Astron (2009)

[1] Vegetation community codes and descriptions are taken from Astron 2009.




## Figure 6 Vegetation communities: Bonnie East

Scale 1:25,000 at A3

0 200 400 600 800 1,000 m

Coordinate System: MGA50
Note that positional errors may occur in some areas
Date: 22/06/2013
Author: JCrute
Source: Client 2011- 2012.
Path: Q:\GIS\Consult\2012\BCI\BCI12047\Projects\R005\BCI12047_R005_RevA_F006_A3.mxd

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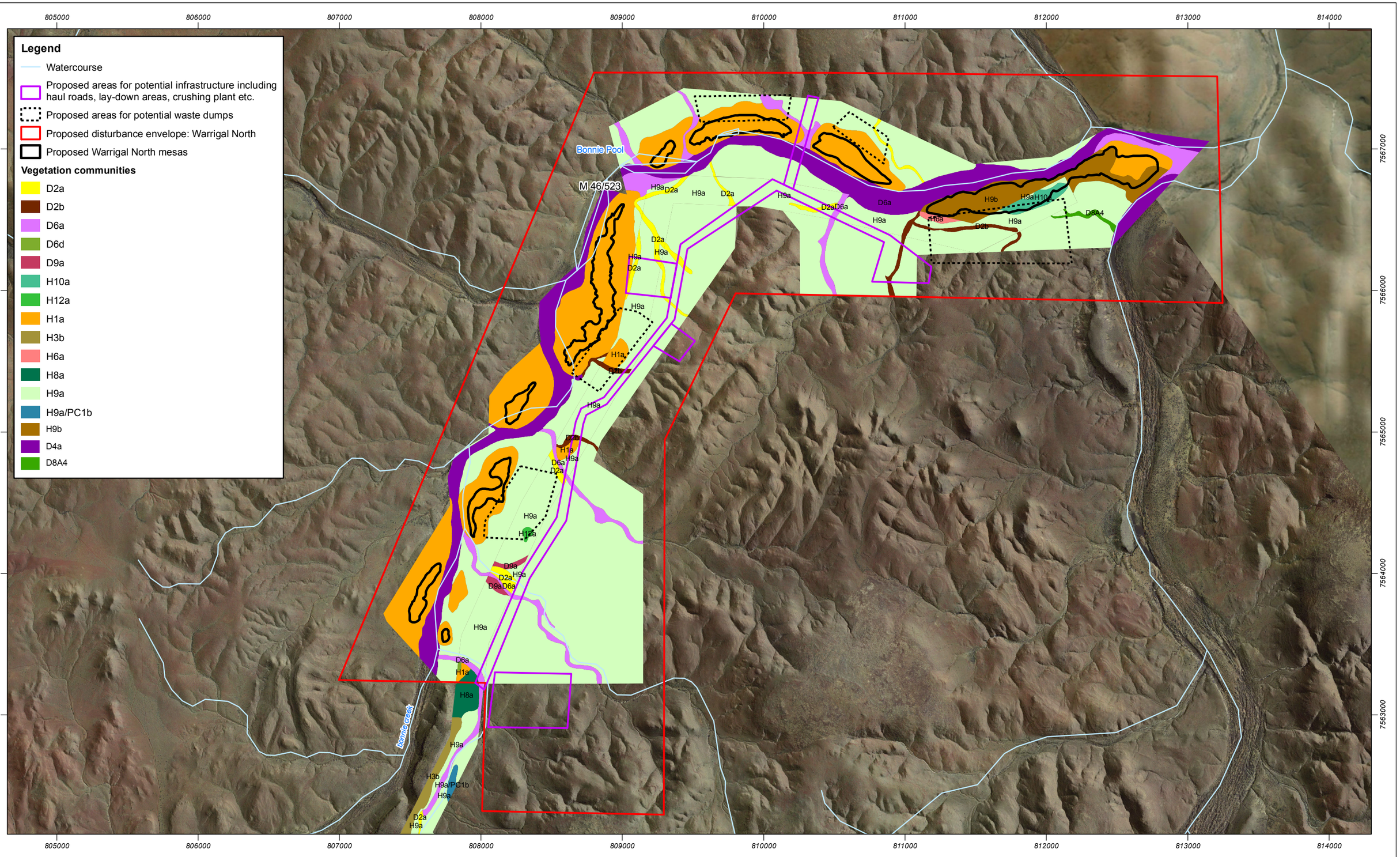


## Figure 7 Vegetation communities: Warrigal North

Scale 1:25,000 at A3

0 200 400 600 800 1,000 m

N

Coordinate System: MGA50
Note that positional errors may occur in some areas
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Author: JCrute
Source: Client 2011- 2012.
Path: Q:\GIS\Consult\2012\BCI\BCI12047\Projects\R005\BCI12047_R005_RevA_F007_A3.mxd

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## Vegetation condition

Vegetation condition in the proposed disturbance envelope ranges from Very Poor to Very Good (Plantecology 2013). All vegetation within the proposed disturbance envelope has been subject to some form of degradation since European settlement, primarily due to grazing (Plantecology 2013). Weed infestation and cattle grazing is most evident along drainage lines and vegetation associated with cracking clays (Plantecology 2013).

The most degraded areas at Bonnie East are located along drainage lines, especially vegetation associated with cracking clays (Plantecology 2013). Warrigal North was mostly rated as Very Good with weed infestations again restricted to riparian vegetation, which was rated as either Good or Poor (Plantecology 2013).

A summary of vegetation condition within the area surveyed by Plantecology (2013) is presented in Table 5.

Table 5 Vegetation condition

| Condition Rating | Survey Sub-area | | | | | |
|---|---|---|---|---|---|---|
| | **Bonnie East** | | **Warrigal** | | **Total** | |
| | Area (ha) | % area | Area (ha) | % area | Area (ha) | % area |
| Very Poor | 23.06 | 1.85 | 0.00 | 0.00 | 23.06 | 1.23 |
| Poor | 210.79 | 16.96 | 45.32 | 7.23 | 256.11 | 13.69 |
| Good | 47.34 | 3.81 | 40.53 | 6.46 | 87.87 | 4.70 |
| Very Good | 962.03 | 77.38 | 541.15 | 86.31 | 1503.18 | 80.37 |
| Excellent | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total | 1243.21 | 100.00 | 627.00 | 100.00 | 1870.22 | 100.00 |

Source: Plantecology (2013)

### *Flora*

A total of 280 native and 14 introduced taxa (including subspecies and varieties) were recorded during the survey, representing 138 genera from 52 families. The dominant families containing mostly native taxa were Fabaceae (57 native taxa, one weed taxon), Poaceae (44 native taxa, four weed taxa) and Malvaceae (32 native taxa, one weed taxon) (Plantecology 2013). The most common genera were Acacia spp. (20 taxa). Senna spp. (12 taxa) and Ptilotus sp. (10 taxa) (Plantecology 2013).

## Conservation significant flora

A desktop search of the DEC's database of Threatened and Priority Flora identified ten taxa with the potential to occur within the proposed disturbance envelope (Plantecology 2013). Of these, only one, *Ptilotus mollis*, has been previously recorded in the NIOP area. Table 6 outlines the likelihood of Priority Flora species potentially occurring in the proposed disturbance envelope based on the results of the desktop assessment only. No Threatened flora species with the potential to occur in the proposed disturbance envelope were identified by the desktop assessment (Plantecology 2013).

Table 6 Priority flora potentially occurring within the survey area

| Taxa | DEC Rating | Likelihood of occurrence within proposed disturbance envelope based on desktop findings |
|---|---|---|
| Acacia aphanoclada | P1 | Possible |
| *Acacia cyperophylla* var. *omearana* | P1 | Possible |
| *Acacia fecunda* | P3 | Possible |
| *Acacia levata* | P3 | Unlikely |
| *Acacia* sp. Nullagine (B.R. Maslin 4955) | P1 | Unlikely |
| *Atriplex spinulosa* | P1 | Unlikely |
| *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) | P3 | Possible |
| *Ptilotus mollis* | P4 | Likely |
| *Indigofera ixocarpa* | P2 | Possible |
| *Tribulus minutes* | P1 | Unlikely |

No Threatened or Priority Flora were recorded during the Level 2 flora and vegetation survey which included a targeted survey for Priority Flora within the cracking clays of the Bonnie East survey area (Plantecology 2013).

## Weed species

Fourteen introduced or weed species were recorded in the proposed disturbance envelope or surrounds during the Level 2 flora and vegetation (Plantecology 2013), including:

- **Calotropis procera*
- **Argemone ochroleuca* subsp. *ochroleuca*
- **Cenchrus ciliaris*
- *Cenchrus setiger*
- *Cynodon dactylon*
- *Setaria verticillata*
- **Vachellia farnesiana*
- **Malvastrum americanum*
- *Aerva javanica*
- *Portulaca oleracea*
- *Citrullus colocynthis*
- *Cucumis melo* subsp. *agrestis*
- *Flaveria trinervia*
- *Bidens bipinnata.*

**Calotropis procera* was recorded in a small area within the cracking clays at Bonnie East; a total of 125 plants were recorded. This species is a declared weed under the *Biosecurity and Agriculture Management Act 2007* because it can reduce grazing and be poisonous to stock and humans (Plantecology 2013).

**Cenchrus ciliaris* (Buffel Grass) was identified as an Invasive Species in the search of the DSEWPaC database and is the main weed species in the survey area (Plantecology 2013) as the species was introduced extensively throughout the Pilbara region by the WA Agriculture Department for its grazing potential. *Cenchrus ciliaris* was often the dominant grass species in riparian vegetation.

**Vachellia farnesiana* was common in disturbed areas, especially on cracking clays.

**Malvastrum americanum* was common in low numbers at many sites along drainage lines.

**Argemone ochroleuca* subsp. *ochroleuca* (Mexican Poppy) was recorded at Warrigal North within vegetation community D4a.

### 5.2.2 Terrestrial Fauna

A Level 1 fauna investigation of the proposed disturbance envelope was undertaken by Bamford Consulting Ecologists (Bamford) in May 2012 (Appendix 3). As part of the assessment, a desktop investigation was undertaken incorporating a review of relevant database and literature relevant to the proposal including (Bamford 2013a):

- Everard and Bamford (2009): *Fauna Assessment of the Nullagine Project area*
- Strategen (2010b & 2010c), Harris *et al*. (2010) and Harris & Bamford (2011): *Northern Quoll monitoring and management plans, and monitoring survey results.*
- Bamford Consulting Ecologists and Strategen 2010: *Targeted Fauna Survey: BC Iron Nullagine Project – Proposed Haul Road Route*.

In addition to the 2012 Level 1 survey of the proposed disturbance envelope (Bamford 2013a), a targeted survey for the Pilbara Leaf-nosed Bat (Bamford 2013b) and a desktop assessment of potential Northern Quoll 'core' habitat availability in the local area was undertaken including the proposed disturbance envelope (Bamford 2013c) (Appendix 4 and Appendix 5). Additional targeted survey work was undertaken for the Pilbara Leaf-nosed Bat in May 2013 (Bamford 2013b).

#### *Habitat*

Five Vegetation Substrate Associations (VSAs) were identified by the Level 1 survey as key habitat types within the proposed disturbance envelope (Bamford 2013a). The key characteristics and conservation significance of each VSA is outlined in Table 7, and the extent of each VSA in the proposed disturbance envelope is presented in Figure 8 and Figure 9.

Table 7 Vegetation Substrate Associations in the proposed disturbance envelope

| No. | Name | Key characteristics | Conservation significance |
|---|---|---|---|
| VSA 1 | Acacia shrubs over hummock grasslands on stony hills and plains | Mixed Acacia shrub species over hummock grasses, such as *Triodia epactia* on stony soils, with some gravel and loam. Extensive and well-represented in the region, including across parts of all Warrigal North Mining Lease M46/523 (pending) and Bonnie East Mining Lease M46/522 (pending). | Low; can support the Western Pebble-mound Mouse where the stony hills are well-developed. |
| VSA 2 | Eucalypt woodland over hummock grasslands on stony hills and plain | Eucalyptus trees (e.g. *E. leucophloia*) trees over hummock grasses such as *Triodia epactia* on stony soils. Moderately extensive and well-represented in the region; often well-developed on mesa-tops such as in the Warrigal North Mining Lease M46/523 (pending). | Low |
| VSA 3 | Bloodwood woodland over hummock grasslands on undulating stony hills | *Corymbia hamersleyana* trees over hummock grasses such as *Triodia epactia*. Some calcareous stony soils. These woodlands appear to have limited representation within the broader region but are extensive in the Bonnie East Mining Lease M46/522 (pending). | Low to moderate; may be of higher value seasonally, when bloodwoods are in flower; providing foraging resource for honeyeaters, as well as invertebrates and associated predators (e.g. insectivorous birds and bats). |

| No. | Name | Key characteristics | Conservation significance |
|---|---|---|---|
| VSA 4 | Well-developed cliff lines along mesa edges or gorges | Variable vegetation (although usually shrubs, hummock grasses and occasional eucalypts) on very steep, rocky slopes. May have considerable bare areas of large exposed rocks, rock piles or scree slopes. Caves and crags are present to varying degrees. Linear and narrow in the context of the broader landscape. Although widespread regionally, this VSA comprises a very small proportion of the total landscape. It is extensive in the Warrigal North Mining Lease M46/523 (pending) with small areas in the Bonnie East Mining Lease M46/522 (pending). This VSA is widespread outside the proposed disturbance envelope. | High; provides the potential for significant refugia for some fauna, in the form of caves or interstitial spaces between rocks. These areas are preferred by species such as Northern Quoll, Rothschild's Rock-wallaby, Pilbara Monitor, Pilbara Leaf-nosed Bat and Ghost Bat that may occur in the proposed disturbance envelope. In the Warrigal North survey area in particular, this VSA is linear and this may allow for movement of dependent fauna through the landscape. |
| VSA 5 | Riparian zones | Ephemeral drainage lines and permanent pools, and surrounding vegetation (often dominated by large eucalypts that form riparian woodland). Substrate variable, including sands, loams, gravel, cobbles and exposed rock; the loam soils extend away from watercourses in some broad valleys. Shrub and tree density considerably greater than non-riparian VSAs. Linear and narrow in the context of the broader landscape. Although well represented, regionally, this VSA comprises a relatively small proportion of the overall landscape. | Very high; typically has a high to very high (relative abundance) and richness of fauna species. A number of significant fauna are dependent on riparian zones.<br>The loam-dominated substrate in this VSA is locally uncommon and may support a range of burrowing fauna (e.g. burrowing frogs, semi-fossorial reptiles, and burrowing mammals potentially including Mulgara) not regularly encountered in other, rock-dominated VSAs. |

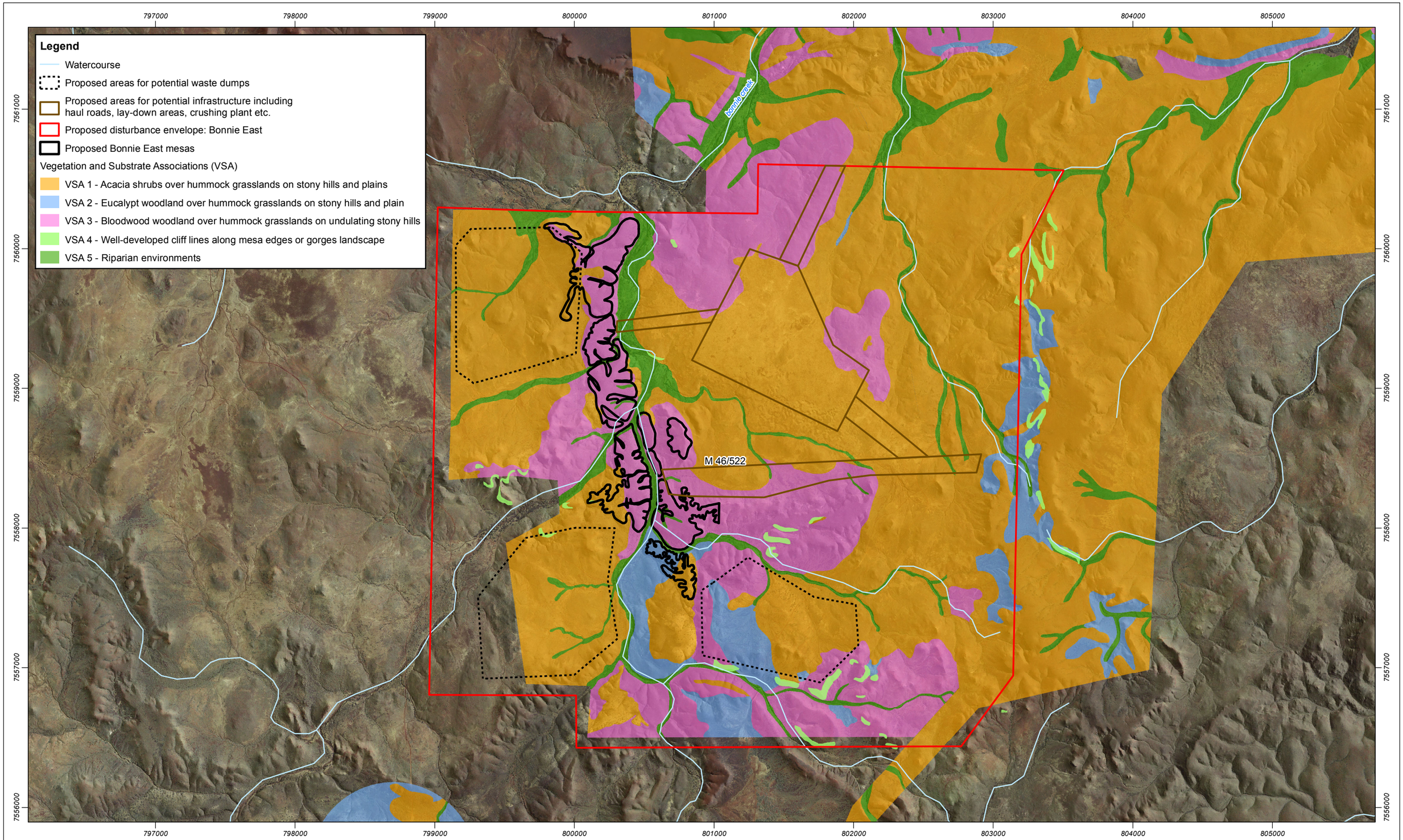


**Figure 8 Vegetation and substrate associations: Bonnie East**

Scale 1:25,000 at A3

0 200 400 600 800 1,000 m

N

Coordinate System: MGA50
Note that positional errors may occur in some areas
Date: 22/06/2013
Author: JCrute
Source: Client 2011- 2012.
Path: Q:\GIS\Consult\2012\BCI\BCI12047\Projects\R005\BCI12047_R005_RevA_F008_A3.mxd

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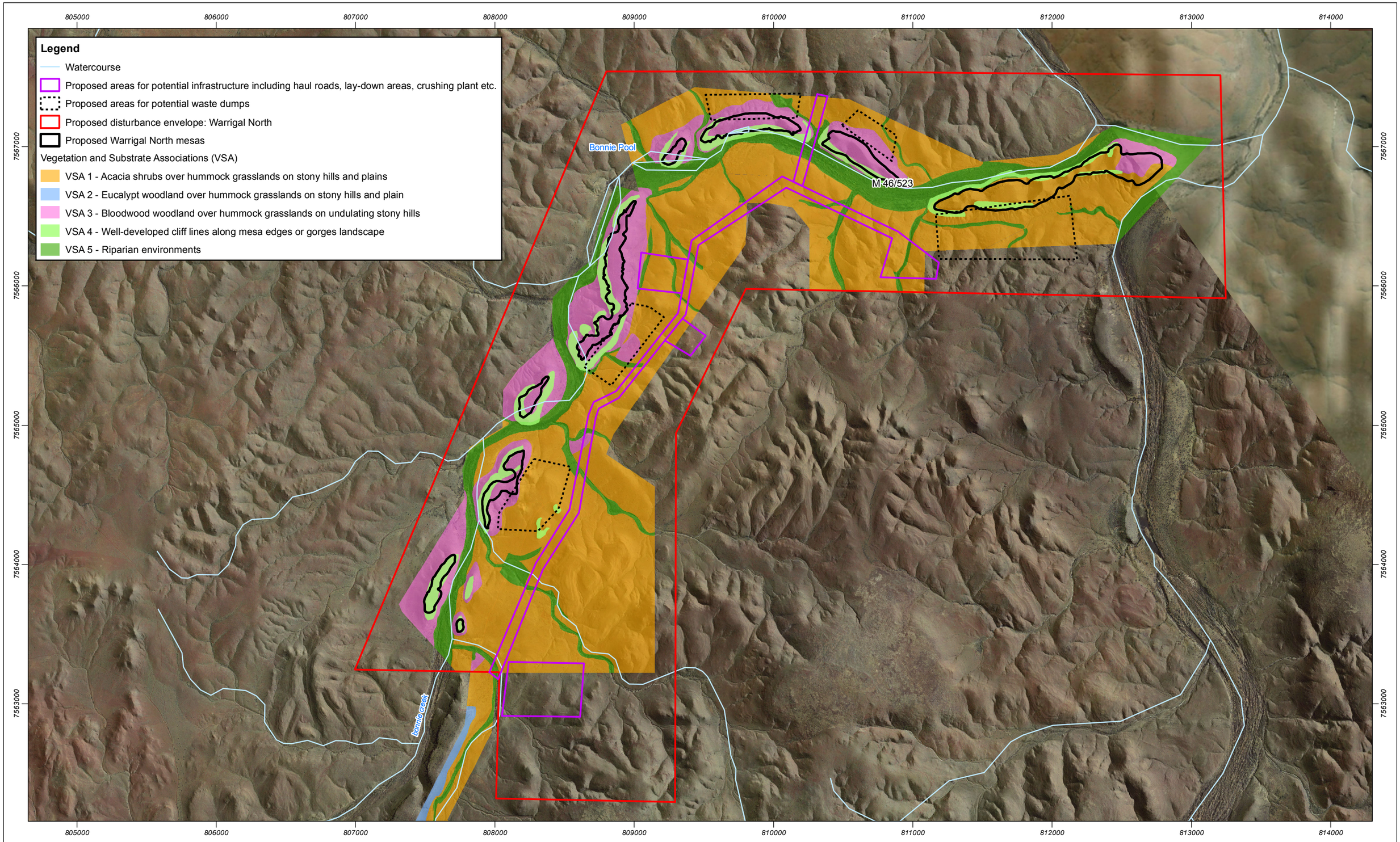


## Figure 9 Vegetation and substrate associations: Warrigal North

Scale 1:25,000 at A3

0 200 400 600 800 1,000 m

Coordinate System: MGA50
Note that positional errors may occur in some areas
Date: 22/06/2013
Author: JCrute
Source: Client 2011- 2012.

Path: Q:\GIS\Consult\2012\BCI\BCI12047\Projects\R005\BCI12047_R005_RevA_F009_A3.mxd

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*Fauna*

A total of 325 vertebrate fauna species may occur in the proposed disturbance envelope. However some species are considered unlikely to be present or likely to be infrequent visitors to the area as migratory species (Bamford 2013a).

A total of 168 species were confirmed present during the field surveys, including 4 fish, 4 frog, 39 reptile, 96 bird and 25 mammal species. In general, the faunal assemblage is typical of the northern Pilbara, with many species being widespread (Bamford 2013a).

The likelihood of the presence of short range endemic (SRE) invertebrates in the proposed disturbance envelope is considered to be low as watercourses and mesas that may provide the type of environmental conditions that can support the evolution of SRE invertebrate species are well connected and not isolated to the proposed disturbance envelope; therefore such species are likely to have a long but narrow distribution that extends well outside the proposed disturbance envelope (Bamford 2013a).

Despite the conclusion that the likelihood of the presence of SRE invertebrates in the proposed disturbance envelope is low, field investigations were undertaken at a number of potential habitats and specimens collected focussing on taxonomic groups that are known to include SRE invertebrate species (Bamford 2013a). .

Conservation significant fauna

Conservation significant fauna include species protected under the Australian Government EPBC Act, the Western Australian *Wildlife Conservation Act 1950* (WC Act), DEC Priority fauna lists and species of local conservation significance. 41 species of conservation significance have been recorded or may occur in the proposed disturbance envelope (Bamford 2013a).

Species of conservation significance protected under the WC Act and the EPBC Act recorded or considered to have a moderate to high likelihood of occurrence within the proposed disturbance envelope are listed in Table 8.

Species of conservation significance confirmed or likely to occur within the proposed disturbance envelope and the significant of the potential impact is discussed in Section 6.1.2.

Table 8 Conservation status of significant fauna species that may occur in the proposed disturbance envelope

| Species | Common Name | Conservation Status | Likelihood of occurrence |
|---|---|---|---|
| *Dasyurus hallucatus* | Northern Quoll | Schedule 1 endangered (WC Act)<br>Endangered (EPBC Act) | Recorded<br>The Northern Quoll has been recorded in the local area in rocky gorge or gully type habitats within the NIOP area in 2008 (Bamford 2009). No activity has been identified in the proposed disturbance envelope and little activity of the species (i.e. scats) has been observed locally since 2008 despite extensive survey effort. It is considered likely that the region currently represents marginal habitat for the species (Bamford 2013a). There is potential foraging and core habitat present throughout the proposed disturbance envelope; however, given the lack of evidence of the species occurring in the proposed disturbance envelope and local area during the past five years, the likelihood of occurrence of this species is considered moderate (Bamford 2013a). |

| Species | Common Name | Conservation Status | Likelihood of occurrence |
|---|---|---|---|
| *Liasis olivaceus barroni* | Pilbara Olive Python | Schedule 1 vulnerable (WC Act)<br>Vulnerable (EPBC Act) | Recorded<br>The Pilbara Olive Python inhabits areas where prey species congregate including pools, gorges and rocky ranges. Potential habitat for the species was identified in the 2012 survey around Bonnie Pool and along surrounding ephemeral water courses. The species was not recorded by either the 2008 or 2012 fauna surveys; however a sloughed skin of a juvenile was recorded along Bonnie Creek in the existing approval area just to the north of the Bonnie East Mining Lease M46/522 (pending) in 2011 (Bamford 2011). Based on the presence of potential habitat and recorded evidence of the species (sloughed skin) just outside of the proposed disturbance envelope the likely occurrence of the species is high (Bamford 2013a). |
| *Dasycercus cristicauda* | Crest-tailed Mulgara | Schedule 1 vulnerable (WC Act)<br>Vulnerable (EPBC Act) | The Crest-tailed Mulgara and Bilby are considered to have a low–moderate likelihood of occurrence in the proposed disturbance envelope as the availability of the preferred soft soil substrate habitat is limited; however the species is known from the greater region and may pass through the proposed disturbance envelope as vagrants (Bamford 2013a). |
| *Macrotis lagotis* | Greater Bilby | Schedule 1 vulnerable (WC Act)<br>Vulnerable (EPBC Act) | |
| *Rhinonicteris aurantia* | Pilbara Leaf-nosed Bat | Schedule 1 vulnerable (WC Act)<br>Vulnerable (EPBC Act) | Recorded<br>The Pilbara Leaf-nosed Bat requires caves with hot and humid conditions for roosting; it was assessed that potential suitable roosting habitat could occur at one or two Warrigal North mesas and no suitable roosting habitat is likely to occur in the Bonnie East mining area (Bamford 2013a).<br>The species was not recorded during the 2008 surveys of the area; however its presence was recently confirmed in the Warrigal North mining area with several individuals recorded along Bonnie Creek (Bamford 2013b). Additional survey work has confirmed that there are no roosts present at Warrigal North (Bamford 2013b).<br>The species has been recorded in the development envelope, predominantly in the riparian environments, therefore its likelihood of occurrence is considered high. |
| *Rostratula australis* | Australian Painted Snipe | Schedule 1 vulnerable (WC Act)<br>Vulnerable (EPBC Act) | Recorded<br>The Australian Painted Snipe generally inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans. One specimen was observed at Bonnie Pool within the Warrigal North Mining Lease (pending) in November 2012, therefore the likelihood of this species to occur is considered high (Bamford 2013a). |
| *Chlidonias leucopterus* | White-winged Black Tern | Schedule 3 (WC Act)<br>Migratory (EPBC Act) | Recorded<br>The White-winged Black Tern was recorded during the 2008 survey for the existing Nullagine operations and as such the likelihood of occurrence as a vagrant to water bodies within the proposed disturbance envelope and surrounds is high. |

| Species | Common Name | Conservation Status | Likelihood of occurrence |
|---|---|---|---|
| *Merops ornatus* | Rainbow Bee-eater | Schedule 3 (WC Act)<br>Migratory (EPBC Act) | Recorded<br>The Rainbow Bee-eater is a summer migrant to southern Australia but may be resident in the north. They prefer lightly wooded country, near water and preferably with sandy soils suitable for their breeding burrows. The species is common in cleared and semi-cleared habitats and as such there is potential for increased utilisation of habitats as a result of the proposal. One bird was recorded during the 2008 survey for the existing Nullagine operations and as such the likelihood of occurrence as a regular visitor is high. |
| *Apus pacificus* | Fork-tailed Swift | Schedule 3 (WC Act)<br>Migratory (EPBC Act) | Fork-tailed Swift spends most of the summer and autumn in Australia. This species does not require terrestrial habitat and although it may occur in the area it rarely lands. The species was not recorded during the 2008 or 2012 fauna surveys, however it is likely to fly over the area, therefore the likelihood of occurrence is considered high. |
| *Ardea modesta* | Eastern Great Egret | Schedule 3 (WC Act)<br>Migratory (EPBC Act) | Likely to be an irregular visitor to water bodies, especially after significant rainfall that may attract greater numbers of this species to the region. |
| *Ardea ibis* | Cattle Egret | Schedule 3 (WC Act)<br>Migratory (EPBC Act) | Vagrants to water bodies within the proposed disturbance envelope and surrounds. |
| *Charadrius veredus* | Oriental Plover | Schedule 3 (WC Act)<br>Migratory (EPBC Act) | |
| *Calidris ruficollis* | Red-necked Stint | Schedule 3 (WC Act)<br>Migratory (EPBC Act) | |
| *Haliaeetus leucogaster* | White-bellied Sea-Eagle | Schedule 3 (WC Act)<br>Migratory (EPBC Act) | |
| *Falco peregrinus* | Peregrine Falcon | Schedule 4 (WC Act) | Likely to be a resident or regular visitor. The species was not recorded by Bamford during fauna investigations; however the species may potentially nest along cliffs or in tall trees along creeklines. |
| *Ctenotus nigrilineatus* | - | DEC Priority 1 | May occur in the area; however not recorded during any fauna investigations. |
| *Ctenotus uber johnstonei* | - | DEC Priority 1 | |
| *Lerista macropisthopus remota* | - | DEC Priority 1 | |
| *Ramphotyphlops ganei* | - | DEC Priority 1 | |
| *Lagorchestes conspicillatus leichardti* | Spectacled Hare-Wallaby | DEC Priority 3 | Not considered likely to occur however potential habitat does exist within the proposed disturbance envelope. |
| *Dasycercus blythi* | Brush-tailed Mulgara | DEC Priority 4 | Not considered likely to occur due to a lack of suitable habitat, however may pass through the proposed disturbance envelope. |
| *Falco hypoleucos* | Grey Falcon | DEC Priority 4 | Likely to occur (recorded). The species was recorded in wooded creekline near the camp. The species is likely to be a resident or regular foraging visitor. |
| *Ardeotis australis* | Australian Bustard | DEC Priority 4 | Likely to occur as a resident or regular visitor. The species is probably president regularly in small numbers in grassland around the proposed disturbance envelope. |

| Species | Common Name | Conservation Status | Likelihood of occurrence |
|---|---|---|---|
| *Burhinus grallarius* | Bush Stone-curlew | DEC Priority 4 | Likely to occur as a resident or regular visitor. The species has been recorded associated with drainage systems in the region. |
| *Neochmia ruficauda subclarescens* | Star Finch | DEC Priority 4 | Likely to occur as a resident. The species was recorded in the Warrigal North area in 2008. |
| *Sminthopsis longicaudata* | Long-tailed Dunnart | DEC Priority 4 | May occur in the area as a vagrant, however has not been recorded in any fauna surveys. |
| *Macroderma gigas* | Ghost Bat | DEC Priority 4 | Not recorded during targeted bat surveys but likely to be an irregular visitor. The absence of roost sites has been confirmed. |
| *Leggadina lakedowensis* | Short-tailed Mouse | DEC Priority 4 | May occur in the area as a vagrant, however has not been recorded in any fauna surveys. |
| *Pseudomys chapmani* | Western Pebble-mound mouse | DEC Priority 4 | Likely to occur as a resident. |
| *Polytelis alexandrae* | Princess Parrot | DEC Priority 4 | Likely to occur as a vagrant to the area |

Source: Bamford 2013a

Introduced species

Four introduced terrestrial fauna species were recorded during surveys of the proposed disturbance envelope including *Mus musculus* (house mouse), *Felis catus* (feral cat), *Bos taurus* (European cattle) and *Canis lupus* (dog) (Bamford 2013a). Other introduced mammal species may occur in the area including the Red Fox, European Rabbit, donkey and dingo (Bamford 2009).

### 5.2.3 Subterranean fauna

Subterranean fauna surveys were undertaken in a survey area in 2008 by Bennelongia Environmental Consultants and in 2013 by Dalcon Environmental which included the NIOP area and proposed disturbance envelope. The combined survey effort is equivalent to and the methodology in accordance with EPA Guidance Statement No. 54 'Consideration of Subterranean Fauna in Groundwater and Caves during EIA in WA' and EPA Guidance Statement No. 54a 'Sampling methods and survey considerations for subterranean fauna in Western Australia' (Campagna V [Dalcon environmental] 2013, pers. comm. 14 June). The survey report and taxonomic vouchering is currently incomplete and will be made available as soon as possible in accordance with the guidance statements.

In summary 256 troglofauna samples were collected in total from the survey area which included Coongan, Outcamp, Bonnie East, Woggies and Warrigal North deposits. A moderately rich troglofauna community was recorded from the combined survey area with 21 troglofauna species identified. There were a high proportion of epigean (surface) taxa present in the litter samples and many traps yielded no troglofauna specimens. Generally the troglofauna were typical of the subregion and well distributed throughout the CIDs of the survey area. One result that is being investigated further includes a spider collected from Warrigal North (Warrigal 1 mesa) in 2013, *Tetrablemma* sp. indet. The specimen has been submitted for DNA barcoding to confirm the species level and is likely to demonstrate that its range distribution extends outside the impact areas.

Additionally, in 2013 troglofauna traps were deployed in three holes located within the post-mining mesa shell of the Outcamp deposit (i.e. of the NIOP) to assess the presence of troglofauna in an impacted area. A pseudoscorpion, *Indohya* sp. indent, was collected suggesting that troglofauna have continued to inhabit the available mesa habitat during disturbance and that the remaining mesa habitat post mining is actively being utilised by troglofauna. *Indohya* sp. indent is a potentially new species with other *Indohya* sp. recorded in nearby Solomon Mine. BC Iron has submitted the specimen for DNA barcoding to assist in assessing the species range distribution.

In 2008 fourteen bore holes were sampled for stygofauna as part of a reconnaissance survey for the NIOP. The NIOP area was found to have a moderately rich stygofauna community, again typical of the Pilbara subregion, dominated by copepods which are typically planktonic and well distributed throughout groundwater aquifers in Western Australia (Dalcon 2013). An additional 15 stygofauna sites were sampled in 2013, targeting the Hamersley Fractured Rock aquifer. From the two combined surveys, 29 stygofauna taxa were identified in the survey area. Typical of the sub-region the stygal community included amphipods, isopods, synacrids, oligochaetes, copepods and ostracods (Campagna V [Dalcon environmental] 2013, pers. comm. 14 June). A number of potentially new taxa were identified by the 2013 survey and their taxonomic vouchering is underway.

## 5.3 Social environment

### 5.3.1 Aboriginal heritage

The Palyku Native Title Group's claim covers all of proposed disturbance envelope. BC Iron has engaged directly with the Palyku in relation to heritage surveys and Mining Agreement negotiations. The positive relations established with this key stakeholder group has led to the Palyku agreeing to the terms of a Mining Agreement with BC Iron to allow mining and associated activities within their boundaries. This Agreement between BC Iron and the Palyku was signed in April 2010.

Ethnographic and archaeological surveys of Bonnie East have now been completed, while surveys of Warrigal North are currently being undertaken. All Aboriginal heritage surveys undertaken thus far have been undertaken with the Palyku people. Ongoing consultation and survey outcomes continue to be a key driver for design of the proposal, and this may result in some mesas with key indigenous heritage values being removed from the mine plan. The Palyku people have also identified that Bonnie Pool and Bonnie Creek in general have high indigenous heritage values and BC Iron are committed to avoiding and/or minimising impacts to these values by ensuring the protection of both surface water features.

No sites registered under the Western Australian *Aboriginal Heritage Act 1972* (AH Act) are known to occur within the vicinity of the proposed disturbance envelope. In the event that disturbance of an Aboriginal heritage site will be required, BC Iron will comply with the requirements of the AH Act. This will involve the undertaking of targeted surveys of any sites that will likely be impacted by the proposal in order to characterise the site and assess the disturbance impact. Should a site need to be disturbed consultation will be undertaken with the relevant Aboriginal traditional owners and applications will be submitted to Department of Aboriginal Affairs for assessment under section 18 of the AH Act.

### 5.3.2 European heritage

No sites of European heritage significance occur within the proposed disturbance envelope.

# 6. Potential environmental impacts and management

A preliminary risk analysis of the proposal has identified the key and other environmental factors affecting the proposal. A significance test was undertaken for each environmental factor in accordance with the EPA *Administrative Procedures 2012*. Key environmental and other factors are discussed in the following sections.

## 6.1 Key environmental factors

Based on an analysis of the aspects and potential impacts of the proposal, the following environmental factors were assessed as being of significance and therefore considered key factors:

- vegetation and flora
- terrestrial fauna
- subterranean fauna
- surface water
- groundwater
- closure
- cumulative impacts.

The impacts and associated management of key factors are presented in the following sections.

### 6.1.1 Vegetation and flora

The following aspects and associated environmental impacts are relevant to vegetation and flora:

1. **Clearing of vegetation:** will directly reduce the extent of vegetation communities, including vegetation communities of local conservation significance and conservation significant flora species.
2. **Abstraction of groundwater:** will impact groundwater levels potentially impacting on vegetation health.
3. **Vehicle movements and earthworks:** may spread weeds and increase bushfire risk.
4. **Dust generation:** due to earthworks, mining and vehicle movements has the potential to smother vegetation.

The EPA environmental objective for vegetation and flora is:

*To maintain the abundance, species diversity, geographic distribution and productivity of flora at species and ecosystems levels through the avoidance or management of adverse impacts and improvements in knowledge.*

#### *Key findings*

No TECs or PECs were recorded from the proposed disturbance envelope during the survey (Plantecology 2013). The only extensive areas of cracking clays in the current survey were identified in the Bonnie East sub-area which is part of the Wona Land System, associated with vegetation community PC1b. However, the proposed disturbance envelope is not in the Pannawonica-Robe valley end of the Chichester Range, the community is not a grassless plain and it contains a significant shrub layer, and neither *Eragrostis xerophila* nor any *Astrebla* species were recorded in this community (Plantecology 2013). Therefore community PC1b is unlikely to be any of the four PECs of the Wona Land Systems. No vegetation condition was regarded as Excellent, as all vegetation types have been affected to some degree since European settlement.

The vegetation communities recorded in the 2012/2013 surveys were all recorded in the 2009 survey undertaken by Astron (2009), suggesting that the vegetation communities in the proposed disturbance envelope are likely to be well distributed in the local region. EPA's Position Statement No. 2 identifies a 30% threshold level for vegetation types, beyond which species extinction is believed to occur at an exponential rate (EPA 2000). All vegetation communities proposed to be disturbed by the proposal will have more than 30% of the pre-clearing extent of the vegetation community remaining in the local region based on the current known local extent for these communities (Table 9), i.e. what has been mapped by the Proponent. The proposed areas to be cleared are based on an indicative mine layout which may not account for all proposed clearing; however, the final mine plan is unlikely to significantly change the impact to vegetation communities.

Table 9 Proportion of vegetation proposed to be disturbed

| Community code* | Original extent (ha) | Current extent(ha) | Current % remaining | Indicative areas proposed to be cleared (ha) | Indicative areas proposed remaining (ha) | Indicative proposed % remaining |
|---|---|---|---|---|---|---|
| D2a | 109.59 | 103.55 | **94** | 2.35 | 101.21 | **92** |
| D2b | 34.94 | 34.30 | **98** | 3.88 | 30.42 | **87** |
| D4a | 97.87 | 97.82 | **100** | 5.02 | 92.80 | **95** |
| D6a | 129.13 | 128.04 | **99** | 10.99 | 117.05 | **91** |
| D8a | 69.82 | 61.61 | **88** | 0.13 | 61.48 | **88** |
| D8A4 | 1.39 | 1.39 | **100** | 0.17 | 1.21 | **88** |
| D12a | 7.53 | 7.53 | **100** | 0.34 | 7.18 | **95** |
| H1a | 1048.23 | 1017.92 | **97** | 161.51 | 856.41 | **82** |
| H3a | 254.94 | 249.36 | **98** | 2.60 | 246.76 | **97** |
| H3e | 282.47 | 275.56 | **98** | 16.40 | 259.16 | **92** |
| H6a | 74.48 | 52.07 | **70** | 0.69 | 51.38 | **69** |
| H8a | 118.34 | 112.03 | **95** | 0.07 | 111.96 | **95** |
| H9a | 2313.51 | 2204.66 | **95** | 258.37 | 1946.29 | **84** |
| H9b | 264.91 | 259.90 | **98** | 32.12 | 227.77 | **86** |
| H10a | 199.81 | 192.82 | **97** | 48.43 | 144.39 | **72** |
| H12a | 29.15 | 24.47 | **84** | 0.39 | 24.08 | **83** |
| PC1b | 280.96 | 278.26 | **99** | 90.05 | 188.20 | **67** |

* Vegetation calculations are based on both Astron and Plantecology survey results.

** Vegetation communities D9a, D6d and H9a4 were recorded in the proposed disturbance envelope but are unlikely to be disturbed based on the current mine plan therefore have not been included in the table above.

No Threatened or Priority Flora were recorded during the 2012/13 Level 2 flora and vegetation surveys of the proposed disturbance envelope. Priority Flora species previously recorded in the adjacent NIOP area include *Ptilotus mollis*, *Stemodia* sp. Battle Hill (A.L. Payne 1006), *Vigna* sp. Central (M.E. Trudgen 1626), *Atriplex flabelliformis*, *Swainsona* sp. Hamersley Station (A.A. Mitchell 196) and *Iotasperma sessilifolium*; however these species could not be located in the proposed disturbance envelope and therefore are unlikely to occur within the proposed disturbance envelope (Plantecology 2013).

### *Management measures*

Management measures for vegetation and flora include:

- provide information on flora and vegetation management requirements to all employees and contractors through the site induction process, including:
  - clearing procedures, i.e. requirement for a ground disturbance permit
  - consequences of clearing outside of designated areas.
- clearing activities will be undertaken in accordance with Environmental Protection (Native Vegetation) Regulations 2004
- demarcating clearing boundaries with flagging tape to ensure minimal area is impacted

- clearing of native vegetation will be kept to the minimum required for mine construction, cleared incrementally, and not too far in advance of mine activities
- use of existing station infrastructure (i.e. tracks) where possible to minimise clearing for construction of road infrastructure
- restrict light vehicles to roads, tracks and cleared mine-site areas
- clean all machinery and equipment entering known areas of weed infestation of weed propagules by manual brushdown or water.

BC Iron successfully implements these management measures already for the management of flora and vegetation for the existing NIOP in accordance with the vegetation and flora subsection of the Environmental Management Plan (EMP) approved under the Mining Act. It is proposed that vegetation and flora in the proposed disturbance envelope will be managed in accordance with the EMP during the implementation of the proposal.

### *Outcome*

The proposal is not anticipated to result in a significant to impact vegetation and flora given the expected post clearing extent of vegetation communities remaining in the local and regional area and the proposed implementation of avoidance and management measures.

### 6.1.2 Terrestrial fauna

The following aspects and associated environmental impacts are relevant to terrestrial fauna:

1. **Clearing of vegetation:** will directly disturb fauna habitat and may result in the loss of individual terrestrial fauna.
2. **Vehicle movements**: may result in the injury or fatality of individual terrestrial fauna, especially less mobile species.
3. **Human activities:** may cause an increase in introduced predator species populations (i.e. foxes and cats).

The EPA environmental objectives for terrestrial fauna are:

*To maintain the abundance, diversity geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement of knowledge.*

*To maintain biological diversity that represents the different plants, animals and microorganisms, the genes they contain and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.*

### *Key findings*

Five Vegetation and Substrate Associations (VSAs) were identified as key habitat types within the proposed disturbance envelope (Bamford 2013a and Bamford 2013b); a summary of the proposed maximum disturbance to each habitat is outlined in Table 10.

Table 10 Proposed disturbance to fauna habitat

| VSA type | Conservation significance | Proportion of total clearing proposed (%) | Maximum area (approximate) proposed for clearing (ha) | Maximum proposed habitat loss relative to the total area of each VSA type mapped locally (%) |
|---|---|---|---|---|
| VSA 1 | Low | 65.8 | 486.9 | 11.7 |
| VSA 2 | Low | 3.0 | 22.2 | 2.4 |
| VSA 3 | Moderate | 22.9 | 169.7 | 16.5 |
| VSA 4 | High | 4.7 | 34.8 | 3.8 |
| VSA 5 | Very high | 3.6 | 26.4 | 3.2 |

Two VSAs are considered to have high to very high conservation significance including the 'Well-developed cliff lines along mesa edges or gorges' (VSA 4) and the 'Riparian zones' (VSA 5) (Table 7). VSA 4 provides potential habitat for conservation significant fauna species such as the Northern Quoll and Pilbara Olive Python while VSA 5 provides potential habitat for conservation significant fauna species such as the Pilbara Olive Python, Pilbara leaf-nosed Bat, Australian Painted-snipe and other migratory birds and burrowing mammals (refer to Table 11 below). Bonnie Creek (VSA 5) is also considered to provide an important dispersal corridor. Potential impacts to these two VSAs are considered to be the most significant of the five VSA types.

Forty one species of conservation significance may occur in the proposed disturbance envelope. Of these, 21 species of conservation significance have been recorded in or have a moderate to high likelihood of occurrence in the proposed disturbance envelope; of these 15 species are protected under the WC Act and 14 species protected under the EPBC Act (Bamford 2013a) and are discussed in Section 5.2.2 and Table 8. The significance of the proposed impact to these species is discussed in Table 11 below. No SRE species have been confirmed in the proposed disturbance envelope (Bamford 2013a).

Table 11 Significance of impact to conservation species that are known or likely to occur within the proposed disturbance envelope

| Species | Conservation status | Significance of impact |
|---|---|---|
| *Dasyurus hallucatus*<br>Northern Quoll | Schedule 1 endangered (WC Act)<br>Endangered (EPBC Act) | The total amount of potential core habitat for the Northern Quoll expected to be potentially disturbed by the proposal is up to 34.8 ha; this represents approximately one quarter of the potential habitat available (130 ha) in the proposed disturbance envelope and less than 3.8% of the amount of potential core habitat mapped locally (914 ha). Regionally, the loss of Northern Quoll habitat is expected to be minimal. Therefore, the scale of habitat loss is not considered significant given the large extent of potential core habitat for the Northern Quoll available within the Pilbara region, and the disturbance of potential core habitat is confined to the mine footprint only. |
| *Liasis olivaceus barroni*<br>Pilbara Olive Python | Schedule 1 vulnerable (WC Act)<br>Vulnerable (EPBC Act) | The most likely habitat for the Pilbara Olive Python in and around the proposed disturbance envelope is located at Bonnie Pool which is within the Warrigal North mining lease boundary (pending). Indirect and direct impacts to Bonnie Pool will be avoided. Ephemeral creeklines that may provide seasonal habitat for this species may be disturbed during the proposal, however this is not expected to have an impact on the species as this habitat is widespread throughout the region. As there has been only one occurrence of the Pilbara Olive Python near the proposed disturbance envelope and the most suitable habitat of this species is located at Bonnie Pool (which will be protected from being impacted), it is considered that the proposal will not have a significant impact on the size of a population of this species. |
| *Dasycercus cristicauda*<br>The Crest-tailed Mulgara | Schedule 1 vulnerable (WC Act)<br>Vulnerable (EPBC Act) | Potential (foraging) habitat is likely to be present in the proposed disturbance envelope; however, no evidence of either species was recorded during the 2012 survey of the proposed disturbance envelope or during the 2008 surveys undertaken for existing Nullagine operations. The 2012 Level 1 fauna survey indicated that the proposed disturbance envelope generally lacks the softer substrates preferred by these mammals and, as a consequence, both species are unlikely to inhabit the proposed disturbance envelope. Instead, they may be vagrant species that utilise the possibly suitable soils present along the larger watercourses (i.e. Bonnie Creek) in the proposed disturbance envelope (Bamford 2013a).<br>Potential direct and indirect impacts to watercourses have been considered during the design and planning phase of the proposal to ensure there are no significant impact to these species, i.e. where practicable, stable overburden and low grade mineral dumps will be located near the respective deposits on raised ground away from creeks and areas potentially subject to flooding where the softer substrates are likely to be present. |
| *Macrotis lagotis*<br>Greater Bilby | Schedule 1 vulnerable (WC Act)<br>Vulnerable (EPBC Act) | |

| Species | Conservation status | Significance of impact |
|---|---|---|
| *Rhinonicteris aurantia* Pilbara leaf-nosed Bat | Schedule 1 vulnerable (WC Act) Vulnerable (EPBC Act) | Potential foraging habitat for this species has been identified at Warrigal North around Bonnie Pool and along the ephemeral watercourses that occur within and in proximity to the proposed disturbance envelope, especially riparian environments (VSA 5) along Bonnie Creek that are adjacent to areas of well-developed cliff lines or gorges landscape (VSA 4) (Bamford 2013a). Impacts to riparian environments in the proposed disturbance envelope that are adjacent to areas of well-developed cliff lines or gorges landscape at Bonnie Pool and along Bonnie Creek will be avoided as the Pilbara Leaf-nosed Bat is likely to continue to forage in these areas (Bamford 2012b). However, proposed disturbance to some riparian environments cannot be avoided at the proposed Bonnie Creek and drainage line crossings but disturbance will be minimised through strategic design and management during construction and operations. Up to 26.4 ha of riparian environments may potentially be directly impacted by the proposal; this represents approximately 10% of all of the riparian environments identified in the proposed disturbance envelope and only 3.2% of VSA 5 mapped locally. |
| *Rostratula australis* Australian Painted-snipe | Schedule 1 vulnerable (WC Act) Vulnerable (EPBC Act) | These species may be occasional vagrants to the proposed disturbance envelope to visit seasonal or permanent water bodies, including Bonnie Pool. These water bodies will not be directly impacted by the proposal and potential indirect impacts will be managed, as discussed below, to ensure there is no significant impact to these habitats. |
| *Chlidonias leucopterus* White-winged Black Tern | Schedule 3 (WC Act) Migratory (EPBC Act) | |
| *Merops ornatus* Rainbow Bee-eater | Schedule 3 (WC Act) Migratory (EPBC Act) | Given the widespread occurrence of the species and the range of habitat available in the region it is unlikely the proposal will have a significant impact on important habitat for the species. |
| *Apus pacificus* Fork-tailed swift | Schedule 3 (WC Act) Migratory (EPBC Act) | Fork-tailed Swift is unlikely to be affected by the proposal as this species rarely lands and any occurrence within the proposed disturbance envelope is anticipated to be sporadic. |
| *Ardea ibis* Cattle Egret | Schedule 3 (WC Act) Migratory (EPBC Act) | Vagrants to water bodies within the proposed disturbance envelope and surrounds; the significance of the impact is anticipated to be minor as impacts to riparian vegetation and water bodies will be minimal. |
| *Charadrius veredus* Oriental Plover | Schedule 3 (WC Act) Migratory (EPBC Act) | |
| *Calidris ruficollis* Red-necked Stint | Schedule 3 (WC Act) Migratory (EPBC Act) | |
| *Haliaeetus leucogaster* White-bellied Sea-Eagle | Schedule 3 (WC Act) Migratory (EPBC Act) | |
| *Ardea modesta* Eastern Great Egret | Schedule 3 (WC Act) Migratory (EPBC Act) | Likely to be an irregular visitor to water bodies, especially after significant rainfall that may attract greater numbers of this species to the region. Being an irregular visitor the vegetation is not considered a significant habitat for this species. |
| *Falco peregrinus* Peregrine Falcon | S4 | Likely to be a resident or regular visitor within the proposed disturbance envelope, dependent upon the riparian environments. Impact to this habitat will be avoided where practicable and minimised where disturbance cannot be avoided (i.e. at creekline crossings). Therefore the species is unlikely to be significantly impacted by mining activities. |
| *Falco hypoleucos* Grey Falcon | P4 | Species dependent upon riparian vegetation within the proposed disturbance envelope. However the significance of the impact is anticipated to be minor as impacts to riparian vegetation will be minimal. |
| *Ardeotis australis* Australian Bustard | P4 | This species is probably present regularly in small numbers in grasslands around the proposed disturbance envelope. It is a widespread and wide-moving species that is unlikely to be significantly impacted by mining activities. |

| Species | Conservation status | Significance of impact |
|---|---|---|
| *Burhinus grallarius* Bush Stone-curlew | P4 | Species dependent upon riparian vegetation within the proposed disturbance envelope. However the significance of the impact is anticipated to be minor as impacts to riparian vegetation and water bodies will be minimal. |
| *Neochmia ruficauda subclarescens* Star Finch | P4 | |
| *Pseudomys chapmani* Western Pebble-mound mouse | P4 | While some loss of habitat will occur, much of the species' habitat is outside potential impact areas and outside the proposed disturbance envelope. Habitat is also extensive in the immediate region (Bamford 2013a); therefore impacts are not expected to be significant. |
| *Polytelis alexandrae* Princess Parrot | P4 | Likely to occur as a vagrant to the area and therefore the vegetation is not considered a significant habitat for this species. |

Proposed disturbance to VSA 4 and VSA 5 has been avoided and/or minimised where practicable by proposing the location of waste dumps and other supporting infrastructure away from both VSAs and by minimising the number of drainage line and Bonnie Creek crossings. However, disturbance to VSA 4 is unavoidable due to the locality of the resource (i.e. located in the mesas). BC Iron propose to limit disturbance to VSA 4 to only what is essential for the proposal with the use of surface mining methods rather than using conventional drill and blast techniques. Additionally, the resource material at Warrigal North is generally located in the upper half of the mesa bodies, similar to the mesas mined for the existing NIOP, thereby ensuring a significant proportion of VSA 4 along the lower mesa slopes (i.e. below the resource level) is retained on completion of mining, so the impact (i.e. area of disturbance) is likely to be lower than the value presented in Table 10.

Bonnie Creek is the other main ecological feature of the landscape in the proposed disturbance envelope; impacts have been minimised by minimising the number of proposed crossings of Bonnie Creek and the locating of infrastructure as far away from Bonnie Creek (but near the respective deposits) where practicable.

### *Management measures*

Management measures for terrestrial fauna include:

- provide information to all personnel (employees and contractors) on fauna management requirements, i.e., ground disturbance permits for clearing of habitat, driving in designated areas, following speed limits etc
- infrastructure will be constructed to enable fauna egress
- restrict fauna access to operational areas where possible
- prohibit the use of firearms and the hunting of native animals within the proposed disturbance envelope
- limit vehicle speed to 60 km/h on private unsealed roads
- prohibit off-road driving outside the approved proposed disturbance envelope
- demarcate areas to be cleared with flagging/pegging or some other form of highly visible marking
- place food wastes in secure bins to minimise the potential for feral animals
- external containers, used for food wastes across the site, will be kept closed.
- protect surface water and permanent pools (i.e. Bonnie Pool) through careful design and implementation of engineering controls for drainage management
- locate infrastructure such as waste dumps, stockpiles (topsoil, resource) and roads near the respective deposits on raised ground away from creeks and areas potentially subject to flooding where practicable.
- implement the revised Northern Quoll Monitoring and Management Plan approved by SEWPAC to ensure potential Northern Quoll populations are adequately protected
- if Pilbara Olive Python and/or other conservation significant fauna are encountered during construction and operation within the proposed disturbance areas and are in danger of mortality

they will be relocated to non-impact sites with appropriate habitat. Such relocation activities will be undertaken by a trained snake/animal handler

- monitor the effectiveness of the relocation of species such as the Pilbara Olive Python as per the revised EMP
- monitor the proposed disturbance envelope for introduced fauna species to ensure no new pest animals or increased presence of feral animals during construction and operation. Implement a feral animal trapping and eradication program if required.

BC Iron successfully implements these management measures already for the management of terrestrial fauna for the existing NIOP in accordance with the terrestrial fauna subsection of the EMP approved under the Mining Act. It is proposed that terrestrial fauna in the proposed disturbance envelope will be managed in accordance with the EMP during the implementation of the proposal.

*Outcome*

The proposal is not anticipated to result in a significant impact to terrestrial fauna given the habitat preferences, the expected post disturbance (direct) of conservation significant habitat (VSAs) remaining in the local and regional area and the proposed implementation of avoidance and management measures.

### 6.1.3 Subterranean fauna

The following aspects and associated environmental impacts are relevant to subterranean fauna:

1. **Mining excavations:** may remove potential subterranean fauna (troglofauna) habitat and has the potential to result in the associated loss of individual subterranean fauna (troglofauna).
2. **Excavation and abstraction of water:** will alter groundwater levels which may reduce the extent of stygofauna habitat and has the potential to result in individual losses of fauna as well as population fragmentation.
3. **Hydrocarbon spills:** have the potential to degrade the habitat for subterranean fauna through surface and/or groundwater contamination.
4. **Surface water management**: changes to surface hydrology, particularly in regards to sealing areas within groundwater recharge zones and increased surface water runoff, leading to a reduction in habitat suitability.

The EPA environmental objectives for subterranean fauna are:

*To maintain the abundance, diversity geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement of knowledge.*

*To maintain biological diversity that represents the different plants, animals and microorganisms, the genes they contain and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.*

*Key findings*

Subterranean fauna surveys undertaken in 2008 and 2013 recorded the presence of at least 21 troglofauna taxa and 29 stygofauna taxa within the combined NIOP area and proposed disturbance area (Dalcon 2013). The surveys identified a moderately rich troglofauna community with taxa typical of the subregion that was well distributed throughout the CIDs of the survey area. It is therefore considered that it is unlikely that there are specific troglofauna species that are only found within the proposed disturbance envelope and the troglofauna community is likely to extend outside the proposed disturbance envelope following the well connected CID network. Additionally, the 2013 survey demonstrated that troglofauna are expected to continue inhabiting the available mesa habitat during and post-disturbance.

The stygofauna groups recorded from the 2008 and 2013 survey were also typical of the Pilbara region. Impact to the fractured rock aquifer in the existing groundwater supply borefield is also considered to be minimal due to the nature of the aquifer (disjointed fractured rock systems that are unlikely to be connected

to any major creek systems) (Campagna V [Dalcon environmental] 2013, pers comm. 14 June). Additionally, proposed mining is above the groundwater table and therefore the potential impact on the stygofauna community from the proposal is considered to be low.

*Management measures*

Management measures for subterranean fauna include:

- provide information to all personnel (employees and contractors) on fauna management requirements, i.e., ground disturbance permits for clearing of habitat
- provide information on fauna and flora and vegetation management requirements to all employees and contractors through the site induction process, including:
  - clearing procedures, i.e. requirement for a ground disturbance permit
  - consequences of clearing outside of designated areas.
- demarcating clearing boundaries with flagging tape to ensure minimal vegetation is removed and surface water runoff and impacts to groundwater recharge zones following major rainfall and runoff events is minimised
- implement spill response procedures to address accidental spillage of hydrocarbons to reduce impacts on groundwater
- abstract groundwater for mining operations and monitor groundwater levels in accordance with Groundwater Licence conditions.

BC Iron successfully implements these management measures already for the management of subterranean fauna for the existing NIOP in accordance with the subterranean fauna subsection of the EMP approved under the Mining Act. It is proposed that subterranean fauna in the proposed disturbance envelope will be managed in accordance with the EMP during the implementation of the proposal.

*Outcome*

Overall the subterranean habitat within the proposed disturbance envelope was found to be similar to other areas in the Pilbara region and as yet, no subterranean fauna communities of regional significance have been identified within the proposed disturbance envelope. Therefore it is unlikely that there will be any significant impacts to subterranean fauna within the proposed disturbance envelope.

### 6.1.4 Surface water

The following aspects and associated environmental impacts are relevant to watercourses and pools:

1. **Reduction of catchment areas**: resulting from development of mesa panels.
2. **Runoff from disturbed areas and overburden dumps:** may result in increased sediment transport to pools and/or watercourses.
3. **Hydrocarbon spills:** have the potential to impact surface water quality through potential contamination resulting from transport, handling and storage of hydrocarbons.
4. **Waste generation:** has the potential to result in surface water contamination from the transport, handling, storage and disposal of solid and liquid wastes.

The EPA environmental objectives for surface water are:

*To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.*

*To ensure that emissions do not adversely affect environmental values or the health, welfare or amenity of people and land uses by meeting statutory requirements and acceptable standards.*

### *Key findings*

Worley Parsons was engaged by BC Iron to undertake baseline surface water monitoring at various locations within the proposed disturbance envelope (Worley Parsons 2013). Seven monitoring locations were selected after consultation with the DoW. Baseline surface water monitoring results are anticipated to be available mid 2013, however it is anticipated that the proposal will have no impact on creeks (i.e. Bonnie Creek) or permanent pools (i.e. Bonnie Pool).

Worley Parsons (2012) have undertaken flood modelling of the proposed disturbance envelope to assess impacts post-development. The Bonnie East resource lies within the extents of the RORB hydrological model that was developed by Worley Parsons in 2008 for the Outcamp Flood Study. The model was adopted for the Bonnie East and Warrigal North areas, with a number of modifications. Major outcomes of the modelling include the following:

- small drainage lines may require installation of diversion drains
- Warrigal North pits are located in close proximity to Bonnie Creek and appear to encroach on the 100 year ARI flood zone, therefore flood levees may be required to prevent flood spills into the pits (if the mine plan determines that mining of the Warrigal North mesas will be at low lying areas near creek level) and protect supporting infrastructure such as the haul roads that lead to the mesa tops.

### *Management measures*

Management measures for surface water include:

- provide environmental awareness training specific to surface water to all employees as part of the site induction process
- locate waste dumps and supporting infrastructure near the respective deposits on raised ground away from creeks, drainage lines and areas potentially subject to flooding where practicable
- construct surface water management structures in accordance with detailed design requirements to minimise interruption of surface flows and adverse changes to flow regimes
- clearing will be avoided and/or minimised where possible to minimise impacts on surface water flows
- prevent erosion, minimise infiltration and maximise surface runoff from waste dumps by stabilising waste dumps during construction and completing finished waste dumps in accordance with the Mine Closure Plan
- install adequate surface water infrastructure (i.e. settling ponds or sediment traps/basins) at the base of waste dumps to minimise potential sediment transport
- progressively rehabilitate areas no longer required for operations
- surface water management structures will be designed to accommodate stormwater runoff from a 1:100 ARI storm event
- place oil-water separators where surface water may be contaminated with hydrocarbons
- bunding of fuel and chemical storage areas with impervious material
- implement spill response procedures to address accidental spillage of liquid or solid waste materials to reduce impacts on surface water.

BC Iron successfully implements these management measures already for the management of surface water for the existing NIOP in accordance with the surface water subsection of the EMP approved under the Mining Act and the approved existing NIOP Erosion and Surface Flow management plans. It is proposed that surface water in the proposed disturbance envelope will be managed in accordance with the EMP during the implementation of the proposal.

### *Outcome*

The proposal is not anticipated to result in a significant impact to surface water within the proposed disturbance envelope and surrounds given preliminary results of investigations and current and proposed management measures.

### 6.1.5 Groundwater

The following aspects and associated environmental impacts are relevant to groundwater:

1. **Abstraction of groundwater:** water supply for on-site usage has the potential to impact on groundwater levels and flows.
2. **Hydrocarbon spills:** have the potential to impact groundwater quality through potential contamination resulting from transport, handling and storage of hydrocarbons.

The EPA environmental objectives for groundwater are:

*To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.*

*To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.*

### *Key findings*

In the vast majority of the proposed disturbance envelope the CIDs reportedly occur above the groundwater table; therefore their importance as aquifers in the proposed disturbance envelope is limited. The CIDs, however, are likely to be important throughflow zones following major rainfall and runoff events and may act as recharge zones at locations where creeks intersect CID (Worley Parsons 2013).

Groundwater abstraction volumes for construction and operation of the proposal is anticipated to be less than the allocated volume of the existing abstraction licence *GWL 171278(1)* and similar to the abstraction regime implemented for the NIOP; the total groundwater abstraction volume for operation of the NIOP from 1 July 2011 to 30 June 2012 was 470 094 kL. Based on the likely water demand by the proposal, anticipated abstraction rates required to meet the water demand are unlikely to result in significant drawdown. Groundwater is present in some alluvial sediments, however in the majority of the proposed disturbance envelope and surrounding area, groundwater storage is limited (Worley Parsons 2013). The presence of alluvial sediments allows for lateral groundwater flow which can recharge pools located in topographic depressions (Worley Parsons 2013).

The proposal will incorporate groundwater abstraction activities consistent with activities as part of the NIOP. Groundwater is abstracted in accordance with abstraction licence *GWL 171278(1)*, which supersedes two previous licences (*GWL 168582(1)* and *GWL 171334(1)*). BC Iron reports annually to the Department of Water on groundwater monitoring undertaken for the NIOP. Groundwater monitoring undertaken as part of the proposal will be reported annually in accordance with Annual Groundwater Monitoring requirements. Outcomes of groundwater monitoring indicate that BC Iron's groundwater use to date is compliant with licence conditions and use of groundwater has not impacted negatively on local or regional groundwater (Emerge Associates 2013).

### *Management measures*

Management measures for groundwater include the following:

- provide environmental awareness training specific to groundwater to all employees as part of the site induction process
- store all hazardous materials in containment areas to reduce potential for runoff to reach the environment
- construct chemical and hydrocarbon storage to protect areas from stormwater ingress

- store all chemicals and hydrocarbons in accordance with AS 1940
- store minor storage (<500 litres) in secondarily contained bunded areas or chemical storage cabinets
- contain and clean up any spillages in accordance with site procedures
- dispose all wastes, solvents and chemicals in accordance with legislation and recommendations obtained from MSDS
- handle and transport controlled waste in accordance with the Environmental Protection (Controlled Waste) Regulations 2005
- ensure site hygiene and management through provision of general waste and recycling bins on the site and visual inspections for litter and general waste
- implement a waste management hierarchy (avoidance/reduction, re-use and recycling) and waste minimisation through resource recovery, re-use and recycling programs
- operate abstraction bores in accordance with Groundwater Well Licences issued under *Rights in Water and Irrigation Act 1914*.

BC Iron successfully implements these management measures already for the management of groundwater for the existing NIOP in accordance with the hydrocarbon and waste subsections of the EMP approved under the Mining Act, the existing NIOP Groundwater Operating Strategy approved under the RIWI Act and groundwater abstraction (5C) licence conditions. It is proposed that groundwater in the proposed disturbance envelope will be managed in accordance with the EMP, Operating Strategy and licence conditions during the implementation of the proposal.

*Outcome*

Groundwater abstraction and hydrocarbon spills are not anticipated to result in a significant impact to groundwater sources within the proposed disturbance envelope and surrounds.

### 6.1.6 Closure

The EPA environmental objective for decommissioning is:

*To ensure, as far as practicable that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.*

Mine closure and rehabilitation has the potential to result in serious long-term environmental impacts if not planned and managed appropriately. Closure risks are associated with a lack of suitable baseline data and lack of planning. Unsuitable reconstruction of landforms post-closure could result in ongoing erosion and an inappropriate soil profile. This may prevent the establishment of biological ecosystems, pose contamination hazards and affect end land uses.

The key risks to closure associated with the proposal include:

- final landform development
- waste characterisation and placement
- ecosystem development.

BC Iron will develop a Mine Closure Plan in accordance with the DMP/EPA *Mine Closure Guidelines* (DMP/EPA 2011) to support the Mining Proposal and manage closure risks. The Mine Closure Plan will be subject to review and updated every three years and will be updated accordingly as additional information becomes available and gaps in closure data are addressed.

The Mine Closure Plan will address the following:

- BC Iron obligations and commitments
- post-mining land use
- objectives and completion criteria for closure

- identification and management of closure issues
- financial provisioning
- closure tasks and implementation
- closure monitoring and maintenance
- unexpected closure.

### 6.1.7 Cumulative impacts

Cumulative impacts from the proposal and the existing NIOP have been assessed for key environmental factors; these impacts have been considered in the design of the proposal and are outlined in Table 12.

Table 12 Cumulative impact assessment

| Factor | Cumulative impacts |
|---|---|
| Flora and vegetation | The main potential cumulative effect on vegetation and flora is the combined effect of clearing vegetation communities from the proposal and the existing NIOP. Of the 17 communities proposed for clearing (refer to Table 9) it is expected that greater than 80% of the mapped local extent will remain undisturbed for 14 communities. Approximately 70% will remain uncleared for communities H6a, H10a and PC1b. These clearing proportions are expected to be even lower in the wider local and regional extent; therefore the cumulative effect on vegetation as a result of the proposal is consequently expected to be insignificant.<br>No cumulative impacts to conservation significant flora are expected as a result of the proposal as no such species have been identified in the proposed disturbance envelope. |
| Fauna | The proposal and the existing NIOP will disturb less than 20% of each VSA type mapped locally by BC Iron; specifically the cumulative loss/disturbance of VSA 4 and VSA 5 is estimated to be up to 5% and 8% respectively. Given that the landscape is typical of the Pilbara region as the Robe and Rocklea land systems are widespread, each VSA type is expected to be widespread outside the proposed disturbance envelope. The cumulative effect on the fauna present or potentially present as a result of the proposal is consequently expected to be insignificant. |
| Subterranean fauna | The proposed disturbance envelope does not appear to support significant troglofauna habitat and the stygofauna complexes identified in the proposed disturbance envelope appear to be typical of the subregion preferring the upper calcrete or alluvial aquifer habitats along the creek lines rather than the fractured rock aquifers. Additionally there is no dewatering proposed; therefore potential cumulative impacts to subterranean fauna are not anticipated. |
| Surface water | The proposal is expected to have negligible cumulative impacts on surface water features such as Bonnie Creek or Nullagine River due to the implementation of the proposed surface water management measures. No cumulative impacts to the Nullagine Water Reserve are anticipated as the proposal footprint (i.e. up to 740 ha) and the existing approved footprint (up to 550 ha) accounts for less than 1% of the total area contributing runoff and recharge to the Nullagine Water Reserve. |
| Groundwater | It is expected that the size of existing groundwater licences will remain unchanged during implementation of the proposal. As groundwater monitoring indicates that BC Iron's groundwater use has not impacted negatively on local or regional groundwater (levels or quality), it is anticipated that the existing groundwater supply bores will continue to be operated in a responsible manner and in compliance with licence conditions resulting in no negative impacts on local or regional groundwater (levels or quality).<br>No potential cumulative impacts on groundwater quantity and quality are anticipated. |

## 6.2 Other environmental factors

Other relevant environmental factors requiring consideration as part of the Mining Proposal and management plans are:

- noise
- dust and air emissions
- indigenous heritage
- non-mineral waste.

# 7. Environmental management framework

## 7.1 Overview

BC Iron has applied measures to avoid, minimise, rectify and reduce environmental impacts during planning and development of the proposal and in implementing the mitigation and management measures outlined for each of the environmental factors discussed in this report.

BC Iron has established an efficient and effective environmental management framework that is already implemented for the existing NIOP; this framework will be applied and implemented for the proposal. This management framework has been proven to be efficient and effective based on the results of periodic audits that have been undertaken by DEC and DMP since operations began in 2010; resulting in various improvements to the framework being implemented by the Proponent. Additionally, an independent audit of the NIOP was undertaken in late 2012 confirming that BC Iron is complying with the conditions administered under the EPBC Act for the NIOP.

Some components of the framework will be reviewed and updated for the proposal where necessary including the EMP and Mine Closure Plan. BC Iron will ensure that environmental impacts are minimised through:

- applying an Environmental and Heritage Management System (EHMS) that has been developed in accordance with International Standard ISO 14001 and maintaining it for the duration of the proposal as part of BC Iron's focus on continual improvement in environmental management.
- reviewing the EMP for the existing NIOP and implementing it for the proposal
- regularly reviewing the performance of the EHMS, EMP and Erosion and Surface Flow management plans and developing environmental improvement plans for priorities identified in the reviews
- continually reviewing and updating the Mine Closure Plan including progressive rehabilitation and monitoring rehabilitation success
- educating and training staff and contractors in environmental requirements and considerations of their work
- ensuring that stakeholder views are sought, respected and considered
- reporting regularly to stakeholders on performance
- aligning with the BC Iron Environmental Policy and Cultural Heritage Policy.

BC Iron will comply with all relevant current and future statutory requirements.

## 7.2 Environmental Policy

BC Iron operates in accordance with its Environmental Policy (Appendix 6), which includes the following policy actions:

- complying with all applicable legal requirements and other requirements to which the company subscribes
- setting environmental objectives and targets based on the prevention of pollution and environmental harm
- maintaining an EHMS to provide standards and processes to manage risks; achieve objectives and targets, and; ensure continual improvement in environmental performance
- providing employees and contractors with the necessary training to ensure they recognise the potential impact of their activities and to achieve a culture of responsible environmental management
- minimising environmental impact

- minimising waste disposal through waste avoidance, recycling and resource recovery
- ensuring the sustainable use of all water resources through water use reduction and re-use principles
- ensuring that decommissioning, rehabilitation, and closure occur in a cost-effective and timely manner
- establishing and maintaining a framework for reviewing environmental objectives and targets and monitoring environmental performance through audit and self-regulation
- regularly reporting on environmental performance and working closely with government and other key stakeholder groups
- communicating the policy to all employees and contractors and making the policy available to the public.

The BC Iron Cultural Heritage Policy has also been included in Appendix 6 for review.

## 7.3 Environmental Management Plan (EMP)

BC Iron is committed to:

- protecting the environment and minimising the effects of its operations
- avoiding disturbance to conservation significant species where practicable
- completing projects in compliance with conditions stated in approvals, agreements, permits/licences and leases
- complying with applicable legislation and relevant industry standards.

BC Iron will minimise environmental effects through the implementation of the EHMS supported by an EMP and procedures that address the key environmental aspects associated with the proposal.

In addition to ensuring compliance with approval conditions and legislative requirements, environmental management includes reporting and review mechanisms to ensure energy efficiency, improved environmental awareness of personnel, continuous improvement of environmental performance and regular communications with stakeholders on environmental matters.

The EMP for the existing NIOP describes specific environmental objectives and targets for each environmental factor, the management measures to be applied to avoid and minimise the environmental impact of the Project, monitoring measures to measure the performance of management against the targets, and contingency measures to mitigate unavoidable or accidental impact.

The EMP will be reviewed and updated as necessary for submission to DMP with the Mining Proposal for assessment under the Mining Act. The EMP will be reviewed as required throughout the duration of the proposal. Upon review, the document will be revised and re-issued where appropriate. In addition, continued improvement of the plan will occur in response to environmental incident resolutions, audit findings, monitoring results, continuous improvement and changes in regulatory and corporate requirements.

## 7.4 Summary of environmental control instruments

In reaching a decision as to whether a proposal is likely to have a significant effect on the environment, whether it is likely to meet its objectives for environmental factors and consequently and whether a referred proposal should be assessed under Part IV of the EP Act, the EPA may have regard to the following:

- values, sensitivity and quality of the environment which is likely to be affected
- extent (intensity, duration, magnitude and geographic footprint) of the likely impacts
- consequence of the likely impacts (or change)
- resilience of the environment to cope with the impacts or changes
- cumulative impact with other projects

- level of confidence in the prediction of impacts and the success of proposed mitigation
- objectives of the Act, policies, guidelines, procedures and standards against which a proposal can be assessed
- presence of strategic planning framework
- presence of other statutory decision-making processes which regulate the mitigation of the potential effects on the environment to meet the EPA objectives and principles for EIA
- public concern about the likely effect of the proposal, if implemented, on the environment.

A significance test for the proposal has been undertaken against each of these criteria as outlined by Table 13.

Table 13 Significance test for the proposal

| Criteria | Assessment |
|---|---|
| Values, sensitivity and quality of the environment which is likely to be impacted | The proposal is located within the Bonney Downs pastoral lease. The main land uses in the area are grazing and mining. The proposal does not affect any significant areas or land features.<br>The proposal will not impact any TECs or PECs, threatened or priority flora as none have been identified in the proposed disturbance envelope.<br>The only fauna species scheduled under the WC Act and/or listed under the EPBC Act that have been recorded in the proposed disturbance envelope is the Pilbara Leaf-nosed Bat and Australian Painted-snipe; however other conservation significant species have been historically recorded in the local area including the Northern Quoll, Pilbara Olive Python, Rainbow Bee-eater and White-winged Black Tern. 15 fauna species listed under the EPBC Act or Scheduled under the WC Act are considered likely to occur in the proposed disturbance envelope. An additional six species listed as Priority fauna potentially occur in the proposed disturbance envelope.<br>No confirmed short range endemic terrestrial fauna (SRE) were recorded in the proposed disturbance envelope. Subterranean fauna are not expected to be significantly affected by the proposal.<br>Fauna habitats and land systems in the proposed disturbance envelope are abundant in the adjacent areas. The loss of fauna habitat is not expected have a significant effect on fauna assemblages in a local or bioregional context. |
| Extent (intensity, duration, magnitude and geographic footprint) of the likely impacts<br>Consequence of the likely impacts (or change)<br>Resilience of the environment to cope with the impacts or changes | Up to 740 ha will be disturbed as a result of the proposal. Existing supporting infrastructure, cleared areas and access tracks will be used where possible to minimise disturbance. The total life of the mine is up to five years. The mine site will be rehabilitated in accordance with a Mine Closure Plan.<br>Impacts to land systems affected by the proposal are considered low, being less than 1% of the total area mapped.<br>Two vegetation communities mapped by Shepherd *et al.* 2002 occur within the proposal area; Chichester Plateau 173 and Abydos Plain – Chichester 173. The proposal will result in the removal of up to 0.04 and 0.07% of the pre-European extent of these vegetation communities respectively.<br>Impact to 18 of the 20 vegetation communities found in the proposed disturbance envelope by direct disturbance are negligible or less than 15% of the relevant total area of each community mapped locally. The impacts to vegetation communities H10a and PC1b is greater at nearly 25% and 32% respectively; however the vegetation extents are expected to be wider on a local and regional scale and therefore the impacts significantly less.<br>The overall effects of the proposal are not expected to be significant at a local or regional level. |
| Cumulative impact with other projects | Cumulative impacts of the proposal have been addressed under each key environmental factor in Section 6.1.7. Overall, cumulative impacts to the key environmental factors identified are generally low. |
| Level of confidence in the prediction of impacts and the success of proposed mitigation | The environmental impacts of this proposal will be addressed through the management measures identified in this document for each key environmental factor and those outlined by the revised EMP. |

| Criteria | Assessment |
|---|---|
| Objectives of the Act, policies, guidelines, procedures and standards against which a proposal can be assessed | Relevant legislation, policies, guidelines, procedures and standards have been considered.<br>BC Iron has considered relevant legislation and the principles of environmental protection in the design of the proposal and will continue to do so during subsequent implementation.<br>Relevant guidance statements have been considered in undertaking baseline surveys. |
| Presence of strategic planning framework | Not applicable |
| Presence of other statutory decision-making processes which regulate the mitigation of the potential effects on the environment to meet the EPA objectives and principles for EIA | A number of key regulatory controls can be applied to the proposal to ensure appropriate management including (but are not limited to):<br>• conditions of Mining Proposal approved by DMP, including a Mine Closure Plan<br>• conditions of the EPBC Act referral assessment to ensure management actions for conservation significant species including Northern Quoll and Pilbara Olive Python are implemented<br>• conditions of works approval(s) issued under Part V of the EP Act for construction of works on prescribed premises (crushing and screening plant)<br>• conditions of licence issued under Part V of the EP Act for the operation of activities on prescribed premises (crushing and screening)<br>• conditions of the licences and permits for activities relating to the abstraction of groundwater under the RIWI Act.<br>In the event that the proposal is not assessed, clearing of native vegetation will be undertaken in accordance with clearing permit(s) under Part V of the EP Act. Refer to Table 14 for further detail on the proposed regulatory framework. |
| Public concern about the likely effect of the proposal, if implemented, on the environment | A comprehensive stakeholder consultation programme has been implemented during the planning phase of the proposal to identify and address concerns; stakeholder consultation will continue to be undertaken for the remainder of the proposal including closure.<br>The proposal is not expected to generate any public concern. |

A number of key regulatory controls can be applied to the proposal to ensure appropriate management as outlined in Table 13. Table 14 provides an overview of the proposed regulatory framework for the proposal and applicable environmental approvals for each of the identified relevant factors.

Table 14 Proposed regulatory framework and environmental approvals

| Environmental factor | Proposed Approvals/ Management | Legislation | Agency |
|---|---|---|---|
| Vegetation and flora | A Clearing Permit application will be submitted to DMP for assessment under Part V of the EP Act if the proposal is not assessed under Part IV of the EP Act. Under this process, the proposed clearing will be assessed against the 10 clearing principles and any management, mitigation and residual impacts can be conditioned in any approved permit.<br>Closure and rehabilitation will be managed under a Mining Proposal and Mine Closure Plan which will be submitted to the DMP for assessment under the Mining Act.<br>The proposal was also referred to DSEWPaC on 30 May 2013 for assessment of the proposed clearing/disturbance to potential conservation significant habitat under the EPBC Act. | EP Act (Part V)<br>Mining Act<br>EPBC Act | DMP<br>DMP<br>DSEWPaC |

| Environmental factor | Proposed Approvals/ Management | Legislation | Agency |
|---|---|---|---|
| Terrestrial Fauna | A Clearing Permit application will be submitted to DMP for assessment under Part V of the EP Act if the proposal is not assessed under Part IV of the EP Act. Under this process, the proposed clearing will be assessed against the 10 clearing principles and any management, mitigation and residual impacts can be conditioned in any approved permit.<br>Closure and rehabilitation will be managed under a Mining Proposal and Mine Closure Plan which will be submitted to the DMP for assessment under the Mining Act.<br>The proposal was also referred to DSEWPaC on 30 May 2013 for assessment of the proposed clearing/disturbance to potential conservation significant habitat under the EPBC Act. The proposal was assessed against the DSEWPaC 'Test of Significance' criteria and the Northern Quoll Impact Assessment Guidelines and BC Iron determined that the proposal was unlikely to significantly affect any Matters of NES; however management actions developed for the protection of Northern Quoll and Pilbara Olive Python and approved under the EPBC Act will be implemented. | EP Act (Part V)<br>Mining Act<br>EPBC Act | DMP<br>DMP<br>DSEWPaC |
| Subterranean Fauna | The potential effects of the proposal on subterranean fauna will be managed in accordance with an EMP which will be submitted to DMP.<br>Hydrocarbons will also be managed in accordance with the Prescribed Premises Operating Licence and Dangerous Goods Licence. | Mining Act<br>EP Act (Part V)<br>*Dangerous Goods Safety Act 2004* | DMP<br>DEC<br>DMP |
| Surface water | Erosion and Surface Flow management plans have been developed and are implemented for the NIOP in addition to the EMP. The Erosion and Surface Flow management plans were prepared to meet the requirements outlined in the DoW Water Quality Protection Guidelines.<br>Stormwater management will be addressed in the Mining Proposal which will be submitted to the DMP; as part of this the Erosion and Surface Flow management plans will be reviewed.<br>Hydrocarbons will also be managed in accordance with the Prescribed Premises Operating Licence and Dangerous Goods Licence. | Mining Act<br>EP Act (Part V)<br>*Dangerous Goods Safety Act 2004* | DMP<br>DEC<br>DMP |
| Groundwater | A Groundwater Operating Strategy has already been prepared and approved for existing operation of the NIOP and a DoW abstraction permit (5C Licence) exists for proposed supply bores. The Groundwater Operating Strategy was recently revised to address inconsistencies within the former Groundwater Operating Strategy and develop a more consistent approach to the management of the NIOP water supply scheme, without diminishing BC Iron's demonstrated commitment to the preservation of its water resources.<br>If there is an unforeseen requirement for additional supply bores, applications for the construction of wells (26D Licence) and amendment of the 5C Licence will be submitted to DoW for assessment under the RIWI Act. | RIWI Act | DoW |
| Mine Closure and Rehabilitation | A Mine Closure Plan will be submitted to the DMP as a requirement of the Mining Proposal under the Mining Act; it will address mine closure and rehabilitation relevant to the proposal. | Mining Act | DMP |
| Aboriginal heritage | Section 18 application(s) will be made to the DAA where Aboriginal heritage sites are to be disturbed. | AH Act | DAA/Minister for Aboriginal Affairs |

| Environmental factor | Proposed Approvals/ Management | Legislation | Agency |
|---|---|---|---|
| Dust | Dust management in general will be outlined by the Mining Proposal and EMP.<br>Dust generation from activities prescribed under the Environmental Act Regulations 1987 (i.e. crushing and screening) will be managed under Part V of the EP Act. | Mining Act<br>EP Act (Part V) | DMP<br>DEC |
| Noise | Noise emissions are regulated under the Environmental Protection (Noise) Regulations 1997 (Noise Regulations).<br>Noise management in general will be outlined by the Mining Proposal; however as the proposal is remote and will not involve blasting it is not expected that noise will be a significant issue. | Mining Act<br>Environmental Protection (Noise) Regulations 1997 | DMP<br>DEC/Shire of East Pilbara |
| Geochemical risk | Geochemical characterisation of waste rock and ore has concluded that the materials are geochemically benign. AMD can be addressed under a Mining Proposal and Mine Closure Plan. | Mining Act | DMP |
| Hydrocarbons and hazardous materials management | Explosives storage, fuel storage, explosives transport and fuel transport will comply with relevant requirements/standards. | *Dangerous Goods Safety Act 2004* | DMP |
| Solid and liquid waste management | Solid and liquid waste can be managed under the provisions of Part V of the EP Act, local government and Department of Health (DoH).<br>Approvals were attained for the construction and operation of the existing landfill and Waste Water Treatment Plant for the NIOP; this supporting infrastructure is not within the proposed disturbance envelope but will be utilised for the proposal. | EP Act (Part V)<br>*Health Act 1911* | DEC<br>DoH<br>Shire of East Pilbara |

The key regulatory controls that will be applied to ensure appropriate management of the proposal include (but are not limited to):

- conditions of Mining Proposal approved by DMP, including a Mine Closure Plan
- conditions of works approval(s) issued under Part V of the EP Act for construction of works on prescribed premises (crushing and screening plant)
- conditions of licence issued under Part V of the EP Act for the operation of activities on prescribed premises (crushing and screening)
- conditions of the licences and permits for activities relating to the abstraction of groundwater under the RIWI Act.

The potential environmental impacts of the proposal can be adequately managed to meet EPA environmental objectives through the regulatory framework described above. In considering the above significance test, the regulatory controls that can be applied to the proposal and the implementation of relevant management plans, BC Iron is of the view that the proposal does not require formal environmental impact assessment under Part IV of the EP Act but will be managed under other legislation including the Mining Act and Part V of the EP Act.

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# List of appendices

**The following appendices are on CD-ROM inside the back cover of this report**

| | |
|---|---|
| Appendix 1 | Section 38 referral form |
| Appendix 2 | Nullagine Iron Ore Joint Venture Project Expansion Level 2 Flora and Vegetation Survey |
| Appendix 3 | BC Iron Nullagine Project Extension Areas – Bonnie East, Warrigal North and Coongan: Assessment of Fauna Values |
| Appendix 4 | BC Iron Nullagine Project – Extension Areas (Bonnie East, Warrigal North and Coongan): Northern Quoll Regional Analysis |
| Appendix 5 | Pilbara Leaf-nosed Bat Survey of the Warrigal North Deposit |
| Appendix 6 | BC Iron Environmental and Cultural Heritage Policies |