

CPM Ref: DR043774

21 April 2017

Dr Tom Hatton
Chairman
Environmental Protection Authority
Locked Bag 10
EAST PERTH WA 6892

Dear Dr Hatton,

SINO IRON MINE CONTINUATION PROPOSAL

I refer to your letter of 7 April 2017 seeking additional information relating to the Sino Iron Mine Continuation Proposal.

As requested, please find attached the following documents.

1. An additional chapter on Air Quality consistent with the EPA's air quality factor guideline.
2. Peer review by Ramboll Environ of the additional chapter on air quality, which we submit demonstrates that the chapter on Air Quality meets the EPA's objective for this factor.
3. A revised version of the terrestrial air environmental quality chapter.
4. Peer review by Ramboll Environ of the revised terrestrial air environmental quality chapter, which we submit demonstrates that the chapter on Air Quality meets the EPA's objective for this factor.
5. Final peer review letter by Ramboll Environ covering both air quality and terrestrial air environmental quality conclusions.
6. Additional information which we submit demonstrates how the EPA's objective for flora and vegetation has been met in the referral documentation.
7. In accordance the expectation set out in your letter, CITIC has consulted with both the Department of Health and the Department of Mines and Petroleum. We attach email correspondence from those departments confirming the outcomes of recent consultations undertaken with each of these agencies, being that they are satisfied with the fibrous materials management plan.

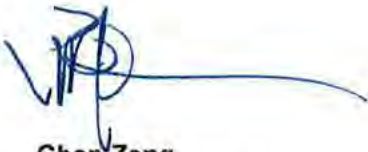
Also enclosed is a full revised environmental review document which includes the peer reviewed section on air quality and revised terrestrial air environmental quality chapter following on from the peer review comments.

I trust that the above information is now satisfactory to the EPA's requirements and will allow for the completion of the EPA's assessment of the project.

Please do not hesitate to contact Bruce Watson, CPM Manager Sustainability and Environment direct on (08) 9226 8316 or email Bruce.Watson@citicpacificmining.com should you require any additional information.

Yours sincerely

CITIC Pacific Mining Management Pty Ltd

A handwritten signature in blue ink, consisting of stylized initials and a long horizontal stroke extending to the right.

Chen Zeng
Chief Executive Officer

CC Anthony Sutton, Director Assessment and Compliance, Office of the EPA
Anthony.Sutton@epa.wa.gov.au

Peter Tapsell, A/Manager Mining and Industrial Assessment Branch (North) , Office of the EPA
Peter.Tapsell@epa.wa.gov.au

**ATTACHMENT 1 – Sino Iron Mine Continuation Proposal – Air Quality Review
[Strategen Environmental]**



intelligent outcomes | respected experience

Sino Iron Mine Continuation Proposal

Supplementary information - Air Quality

Prepared for
CITIC Pacific Mining
by Strategen

April 2017

Sino Iron Mine Continuation Proposal

Supplementary information - Air Quality

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April 2017

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Environmental conclusions

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Client: CITIC Pacific Mining

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1. Introduction

1.1 Background

The CITIC Pacific Mining Management Pty Ltd (CPM) Sino Iron Mine Continuation Proposal (the Proposal) was referred to the Environmental Protection Authority (EPA) under s 38 of the *Environmental Protection Act 1986* (EP Act) on 15 February 2017. The Referral included a detailed Environmental Review Document (ERD). The referral information (including the ERD) was available for public comment from 21 February 2017 to 27 February 2017.

The EPA determined on 10 April 2017 the level of assessment of the referral under s 39A of the EP Act to be Assessment on Referral Information. In addition, the EPA requested additional information under s 39A of the EP Act relating to air quality.

1.2 Purpose and scope of this document

This report addresses the EPA request to provide additional information to assess the potential impacts of the Proposal. The material in this Report has been provided in addition to the ERD prepared for the Proposal and therefore makes frequent reference to the ERD.

2. Air quality

2.1 EPA objective

To maintain air quality and minimise emissions so that environmental values are protected.

2.2 Policy and guidance

The relevant guideline for Terrestrial environmental quality is:

- *Environmental Factor Guideline – Air Quality* (EPA 2016)
- *Management of fibrous minerals in Western Australian mining operations – guideline* (DMP 2015)
- *Guidance Note on Public Health Risk Management of Asbestiform Minerals Associated with Mining* (DoH 2013).

EPA (2016) defines air quality as “the chemical, physical, biological and aesthetic characteristics of air” and identifies that “in the context of this factor and objective, the EPA’s primary focus is maintaining air quality and minimising emissions for human health and amenity”.

This section considers the risks of the Proposal to Air Quality as defined in terms of the chemical, physical, biological and aesthetic characteristics of air. Consistent with the EPA Factor Guideline for Air Quality (EPA 2016) the potential of the Proposal to modify these characteristics and the significance of any changes to air quality is addressed. Standards previously utilised for the assessment of potential air quality impacts for the existing mining operation have been applied to this Proposal. Those standards for air quality were developed in consultation with other agencies, as follows:

- Nitrogen oxides limit in consultation with DER as part of the Part V limit
- Greenhouse Gas Emissions as part of NGER requirements
- Dust in consultation with EPA as specified in the Operational Environmental Management Plan (OEMP) as part of the requirements under Statement 635
- Fibrous Minerals with DMP/DoH as part of the Fibrous Minerals Management Plan which was first submitted to DMP.

2.3 Receiving environment

2.3.1 Regional context

The climate of the Pilbara is characterised as arid-tropical with two distinct seasons including a hot summer (October to April) and mild winter (May to September). The summer season brings large amounts of rain with the possibility of tropical cyclones. Humidity is high with temperatures ranging from the high 30s to low 40s. The winter season is renowned for its pleasant winter climate with maximum temperatures in the mid-20s.

The Pilbara region has highly variable rainfall dominated by the occurrence of tropical cyclones mainly from January to March. Tropical cyclones bring sporadic and drenching rainfall events. With the exception of these large events, rainfall can be erratic and localised due to thunderstorm activity. Rainfall from a single site may not be representative of the spatial variability of rainfall over a wider area. During winter, cold fronts sometimes reach the Pilbara region producing light winter rains.

The nearest Bureau of Meteorology climate station to the project area is at Mardie (approximately 30 km to the southwest (Figure 1) (there is also a site meteorological station referred to in this report for site specific data). Mean monthly maximum temperatures at Mardie range from 28°C in July to 38°C in January and mean monthly minimum temperatures range from 12°C in July to 25°C in February (BoM 2017). Mean monthly rainfalls vary from 1 mm in October to 63 mm in February.

The limited hot dry climate and pastoral land use means that airborne dust is a common occurrence throughout the Pilbara.

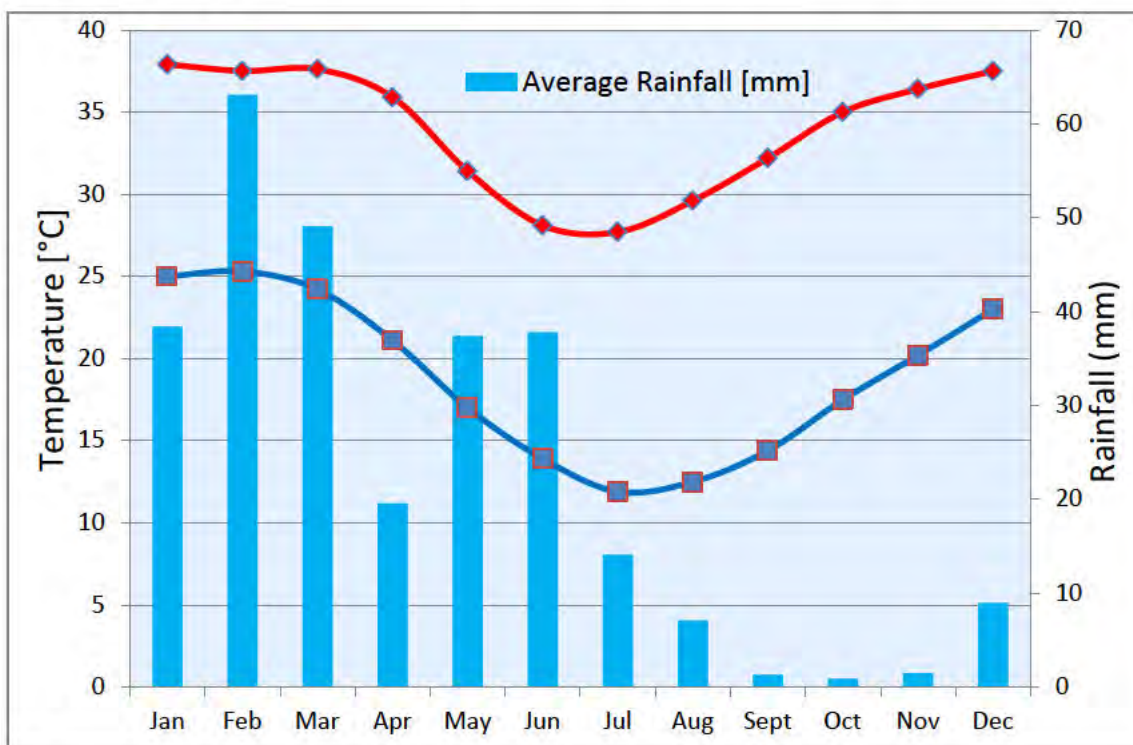


Figure 1: Climate at Mardie Station (BOM 005008)

2.3.2 Potential sensitive receptors

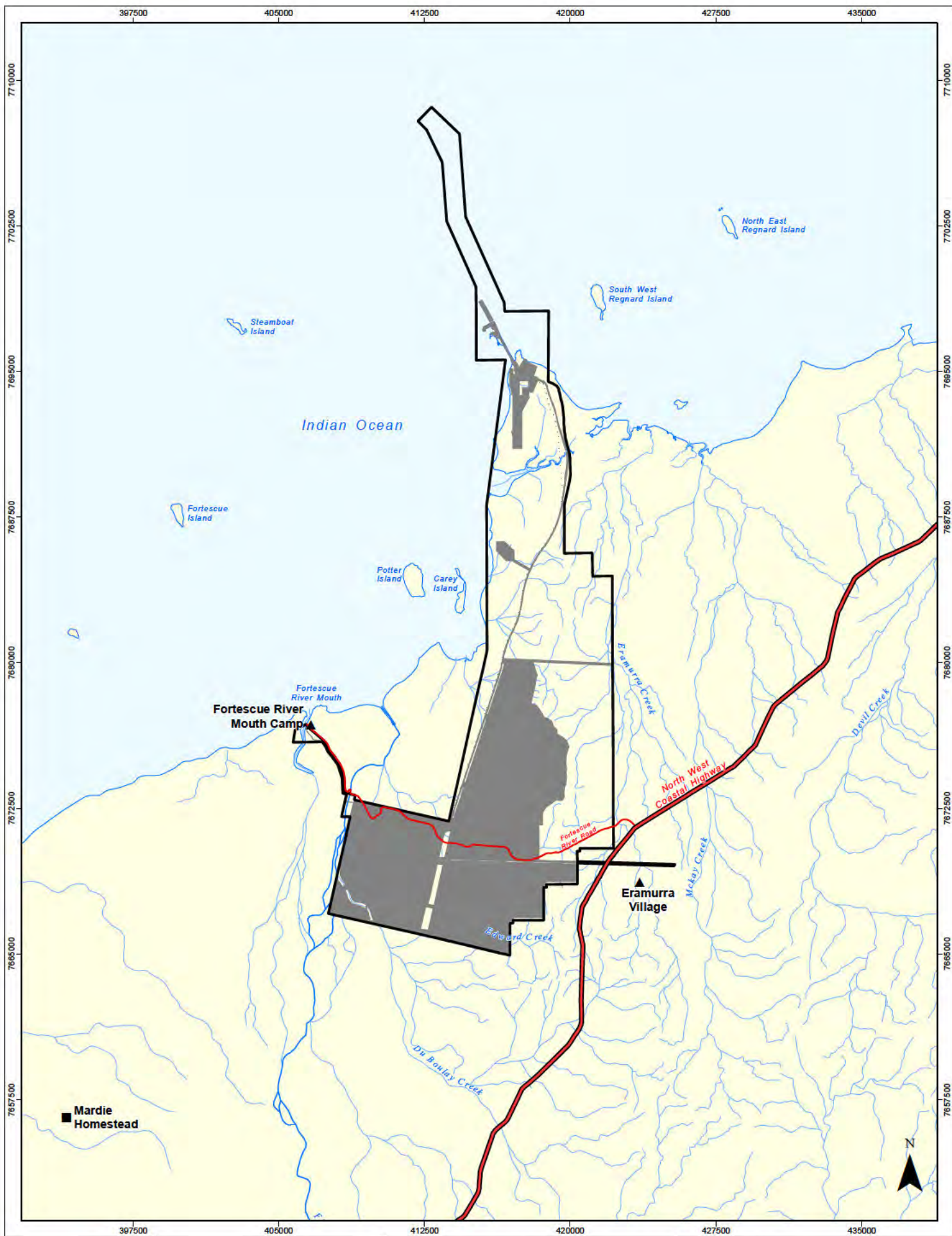
The Proposal is located within the Mardie Station Pastoral Lease (approximately 225 000 ha), which is operated by Pastoral Management Pty Ltd (PMPL) (also a subsidiary company of CITIC Limited) as a cattle station outside the approved mining areas. The Mardie homestead is the only residence on the Station and that residence is more than 30 km from the Development Envelope (Figure 2).

CPM will maintain access to the mouth of the Fortescue River (approximately 7 km), which is used for recreational activities from both day-trippers (locals and passing tourists) and long-term campers (although the area is not an authorised campground).

DER undertook an assessment of the potential impacts to sensitive receptors as a requirement of the Part V Licence for the Power Plant. DER determined that at the closest sensitive receptor:

"The Delegated Officer considers the distance to human receptors to be acceptable to prevent health impacts to occur. Fortescue River Mouth recreational area is at the recommended separation distance of 5,000 m. The area is utilized to access the boat ramp so visitation is typically only for short periods. In addition, commissioning activities will not extend for a long-term duration".

The Proposal's accommodation village (Eramurra) is also considered as a sensitive receptor and public health standards are applied to that location (Figure 2).



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Figure 2

Closest Sensitive Receptor

0 3 6
Kilometres
1:250,000
Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 19/04/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by BW Internal Reference 4550_01_2017_APP

- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Development Envelope
- Conceptual Footprint
- Homesteads

2.3.3 Existing operations

The existing operations approved under Statement 635 include the operation of a mine, power station, desalination plant, processing plant and accommodation and port facilities. The operation of the mine includes use of Waste Rock Dumps (WRD) and a Tailings Storage Facility (TSF). Statement 635 approves construction of a power plant with a capacity of up to 640 MW with the Part V licence approved to a capacity of up to 480 MW. The Power Plant has been constructed with a capacity of 480 MW.

Prior to construction of the power plant Condition 10 of Statement 635 required CPM to establish a meteorological station (shown in Figure 3) to gather site-specific data and then revise air emission modelling using detailed design emissions rates using at least twelve months of site-specific data. Air emission modelling was conducted in 2008 by Air Assessments to meet Condition 10.

The operation of the approved facilities as well as earth moving and material handling activities on-site has the potential to generate air quality impacts. The existing operations are subject to management and mitigation requirements as outlined in the Operational Environmental Management Plan (OEMP) and Fibrous Minerals Management Plan (FMMP), including ongoing monitoring and reporting arrangements.

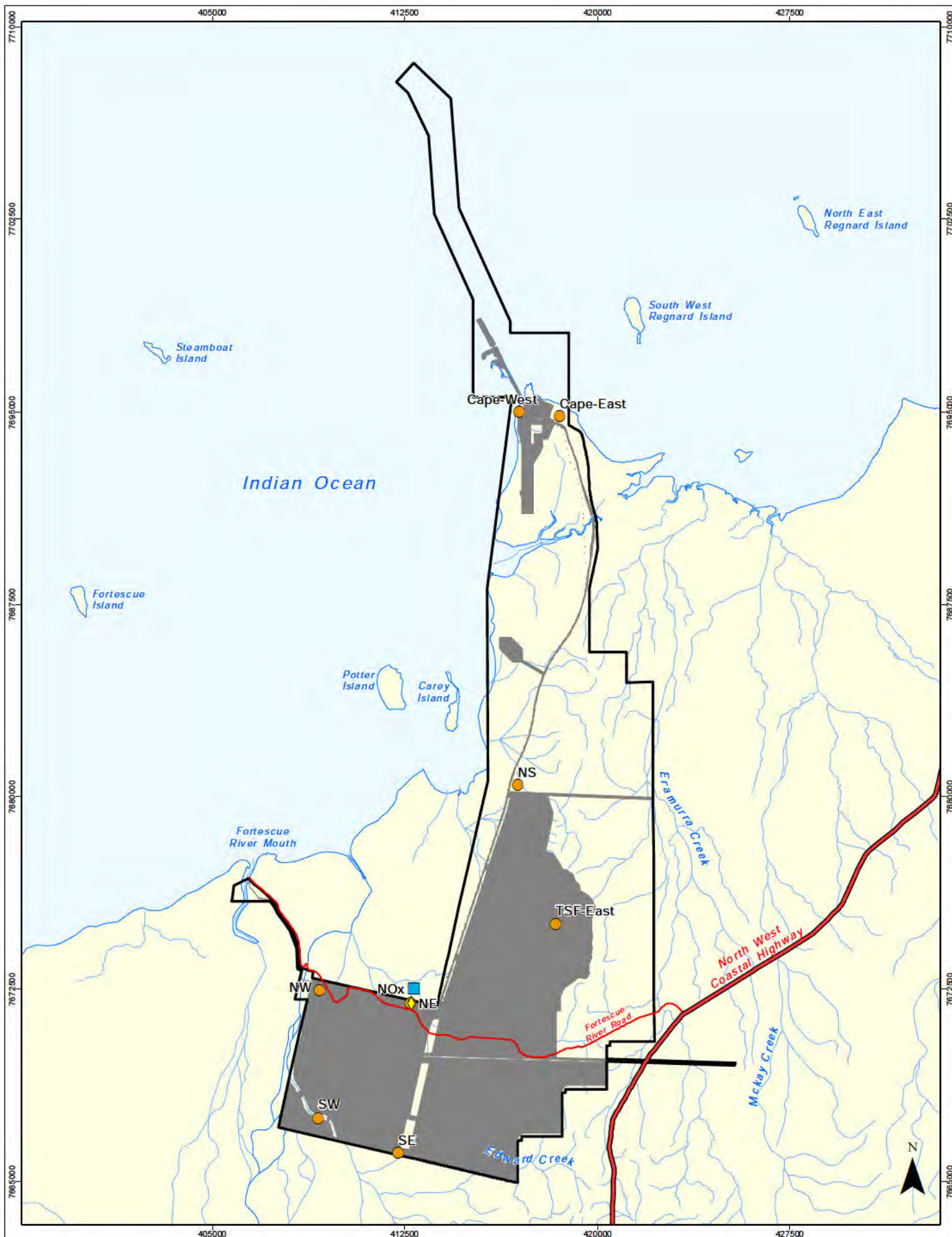
In addition to approval under the Part IV of the EP Act the operations are subject to three operational licences under Part V of the EP Act (*L8308/2008/2*, *L8758/2013/1* & *L8659/2012/2*). However, to avoid duplication Licences do not include limits or triggers that are already identified as a requirement of Statement 635 and are not considered further in this document.

2.4 Outcomes of existing monitoring

The OEMP specifies monitoring requirements for the existing operations related to:

- NO_x (as NO₂) (Section 2.4.1)
- Greenhouse Gas Emissions (Section 2.4.2)
- Dust (Section 2.4.3).

The FMMP monitoring is specified in Section 2.4.4. The location of air quality monitoring stations is shown in Figure 3.



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Figure 3

Air Quality Monitoring Locations

0 2.5 5
Kilometres
1:190,000
Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 7/04/2017

Sheet Size: A4 Status: Final

Drawn by CF Requested by BW Internal Reference 4547_00_2017_APP

- Weather
- ◆ NOx
- Dust PM₁₀
- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Development Envelope
- Conceptual Footprint

2.4.1 Nitrogen oxides

Emissions from the power station are regulated by the Department of Environmental Regulation (DER) as under a Part V Licence. A continuous emissions monitoring system (CEMS) monitors power station stack nitrogen oxides ($\text{NO} + \text{NO}_2$) and oxygen when turbine units are operating.

Monitoring targets

The objective of the OEMP is to ensure nitrogen oxides emissions meet acceptable standards and the requirements of the DER Part V licence. The monitoring is undertaken of both Continuous Emissions Monitoring System (CEMS) and ambient monitoring. The CEMS monitors power station stack gas temperature, gas emission velocity, carbon monoxide, carbon dioxide, nitrogen oxides ($\text{NO} + \text{NO}_2$) and oxygen when turbines are operating. A monitoring station (shown in Figure 3) has been established to monitor ambient NO_x .

The Part V Licence identifies that by 30 June 2018 the Proponent must demonstrate "that the point source air emission levels from each turbine unit of the Power Station for oxides of nitrogen (NO_x) and carbon monoxide (CO) of <25 ppmv and <50 ppmv, respectively, have been met at full load."

Gaseous emission modelling was conducted prior to the operation of the power station as a requirement of Condition 10 of Statement 635. The air quality assessments indicated that in comparison to human health criteria NEPM Standard (National Environment Protection Council, 1998), the predicted gaseous emission ground level concentrations are all below their respective criteria.

The EPA objective for Project adopts the National Environmental Protection Measure (NEPM) for assessment of ambient NO_2 concentrations. The NEPM has a stated guideline for NO_2 , which is 0.12 ppm (1-hour average) and 0.03 ppm (annual average) for NO_2 .

Results of monitoring

Current CEMS data has been observed to be unreliable and has resulted in the Proponent replacing the CEMS. This new CEMS will be certified by the manufacturer as compliant for use in accordance with the CEMS Code for Stationary Source Air Emissions (DER 2016). This shall be operational by Quarter 2 2017. The Proponent will work to demonstrate that the power plant can meet the Licence requirements by 30 June 2018.

Results of ambient NO_2 monitoring against NEPM guideline are provided to the OEPA through existing compliance reporting requirements and are shown here for the period 2014 – 2016 in Table 1. Nil exceedances of the 1 hour average and annual average NO_2 NEPM were observed from the monitoring.

Table 1: Summary NEPM NO_2 guideline (concentrations in ppm)

Year	NEPM Guideline	2014	2015	2016
Maximum monthly average concentration	0.12	0.030	0.036	0.041
Annual average concentration	0.030	0.003	0.003	0.007
Number of exceedances of NEPM (1-hour average)		0	0	0

Summary of Nitrogen oxides monitoring

The gas turbine power station discharges NO_x emissions to atmosphere. Delay to the commissioning of this plant, combined with issues associated with the previous CEMS means that limited monitoring data is available for discussion.

The data indicates that ambient NO_2 concentrations are well below the NEPM, meeting the EPA objective for air quality.

2.4.2 Greenhouse Gas Emissions

A 480 MW combined-cycle gas fired power station is installed at the Project and is considered the primary source of greenhouse gas (GHG) emissions. It is approximately 40 per cent more energy efficient than an equivalent size open-cycle gas turbine power station. At full capacity it saves greenhouse gas emissions of 440,000 t CO₂-e per year. The power station is the first of its kind in the Pilbara and was recognised by the Energy Efficiency Council as the “Best Industrial Energy Efficiency Project” in 2012.

Other sources of GHG emissions include mobile equipment and fixed plant such as the mining fleet, ancillary mobile equipment and conveyors. These are lesser contributors to overall GHG emissions.

GHG emissions are reported on in accordance with *National Greenhouse and Energy Reporting Act 2007* (NGER Act). The NGER Act requires greenhouse gas emissions to be reviewed and reported annually. The Existing Mine is covered under the Safeguard Mechanism of the NGER Act, where tracking of emissions against a baseline target is required and calculation of emission intensity is part of submissions to the Clean Energy Regulator.

Results of monitoring

The greenhouse gas monitoring results for financial years 2013/14, 2014/15 and 2015/16 are shown in Figure 4. Natural gas combustion within the Power Plant made up the majority of emissions (81 to 85 %), with diesel combustion at 15 to 19% and other minor emission sources less than 0.5% for the NGER reporting data presented below.

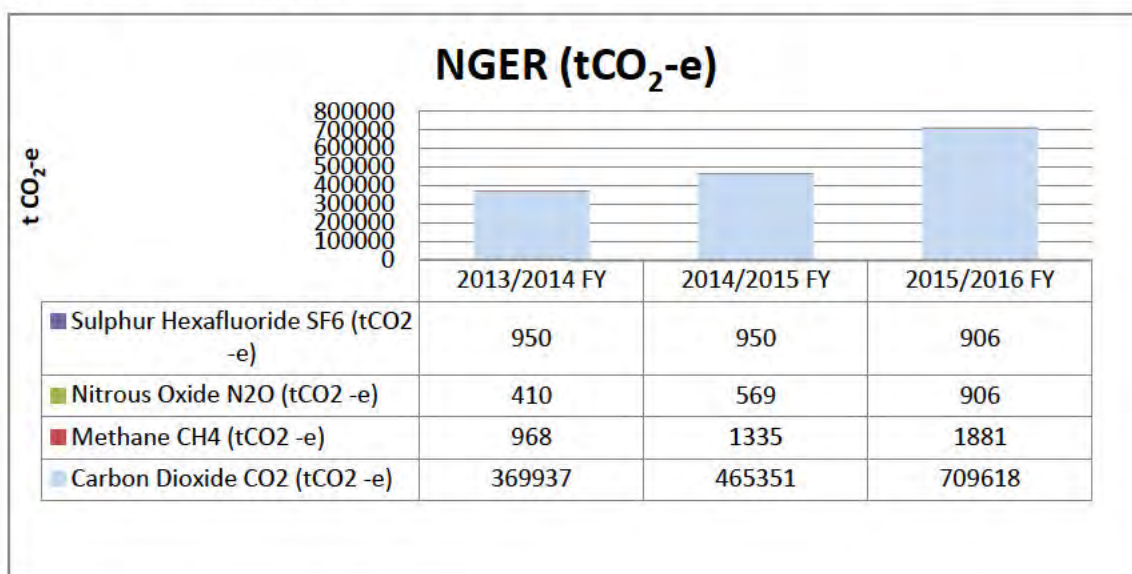


Figure 4: NGER monitoring results

The Project is characterised by a production ramp reflected in the increasing greenhouse gas emission profile as processing lines one to six were implemented. For example in 2013/14, Process Line 1 had commenced operations, in 2014/15 Process Line 2 operations commenced and by 2015/16 another two processing lines had begun commissioning. All lines are now commissioned and greenhouse gas emissions are expected to continue to increase over the coming years as peak production is reached. Optimisation of process lines is expected to be ongoing as the project works towards project design capacity.

A calculated emission baseline is to be submitted to the Clean Energy Regulator by CPM in October 2017. CPM as a responsible emitter will manage emissions according to a baseline issued by the Clean Energy Regulator under the Safeguard Mechanism. Greenhouse gas intensity per unit of product and electricity produced will be submitted to the Clean Energy Regulator in October 2017 as part of the calculated emission baseline application under the NGER Safeguard mechanism. This application will undergo an independent audit process to meet regulatory requirements.

Summary of greenhouse gas emissions

The mine continuation proposal does not seek to increase the capacity of the existing 480 MW power station nor seek an increase in its approved greenhouse gas emission profile.

The mine continuation changes are expected to be minimal, within the savings already made by implementing a Combined Cycle power Station and within currently approved amounts in the Greenhouse Gas Management Plan (approved in 2006).

2.4.3 Dust

Dust impacts as a result of the proposal, ore storage and transfer facilities are managed in accordance with the OEMP. The OEMP specifies the use of real time ambient monitoring to respond to elevated dust emissions associated with the project. The ambient dust monitoring program involves monitoring PM₁₀ dust level at eight locations across the mine site (refer to figure for location).

Monitoring targets

The targets services management objectives to ensure that environmental values are not adversely impacted by:

- complying with ambient dust concentration guidelines along premise boundary, and
- avoiding nuisance dust levels by minimising the probability of short-term dust events leading to exceedances of the daily target.

Internal PM₁₀ targets have been established and implemented through the Operations Dust Management Plan:

- an hourly average PM₁₀ concentration of less than 250 µg/m³ serves to avoid nuisance dust levels by minimising the probability of short-term dust events leading to exceedances of the daily target
- a daily average PM₁₀ concentration of less than 70 µg/m³ serves as a dust concentration guideline to be met at monitoring sites in proximity to the premise boundary.

Results of monitoring

Hourly average PM₁₀ concentrations

The most recent exceedances of the 250 µg/m³ hourly average PM₁₀ target concentration are shown in Table 2 for 2016.

Table 2: Exceedances of hourly average PM₁₀ target concentration

Sample Point	Sample date and time	PM ₁₀ concentration (µg/m ³ , 1-hour average)
EBAM 03 South East (SE)	17-02-2016 16:00	1350
EBAM 08 Cape West (CW)	17-02-2016 16:00	352
EBAM 04 South West (SW)	14-04-2016 10:00	259
EBAM 01 North West (NW)	11-05-2016 10:00	336
EBAM 04 South West (SW)	01-08-2016 19:00	326
EBAM 01 North West (NW)	06-08-2016 13:00	264
EBAM 01 North West (NW)	06-08-2016 14:00	284

Sample Point	Sample date and time	PM ₁₀ concentration (µg/m ³ , 1-hour average)
EBAM 04 South West (SW)	09-09-2016 10:00	275
EBAM 01 North West (NW)	16-09-2016 12:00	385
EBAM 01 North West (NW)	16-09-2016 13:00	434
EBAM 01 North West (NW)	16-09-2016 14:00	397
EBAM 07 Cape East (CE)	05-11-2016 14:00	260
EBAM 07 Cape East (CE)	05-11-2016 15:00	302
EBAM 06 TSF East (TSF-E)	13-12-2016 02:00	475
EBAM 02 North East (NE)	23-12-2016 11:00	1047
EBAM 04 South West (SW)	25-12-2016 14:00	299
EBAM 02 North East (NE)	28-12-2016 09:00	377
EBAM 02 North East (NE)	31-12-2016 09:00	333

The highest hourly average concentrations were associated with sudden wind shift associated with a thunderstorm event causing erosion of waste dump surface (17/2/2016), and a regional dust event on 23/12/2016 (further details provided in Table 3 below). CMP implemented various management responses across mining, stockpiling, processing and tailings operational areas (as described in the OEMP) to address these exceedances.

Daily average PM₁₀ concentrations

Daily average PM₁₀ concentrations for the 2014 to 2016 are presented for the two sites located near the port at the Cape Preston in Figure 5 (for 2014), Figure 6 (for 2015) and Figure 7 (for 2016), and at six sites around the mine in Figure 8 (for 2014), Figure 9 (2015) and Figure 10 (2016, the locations of the sites is shown in Figure 3). Exceedance of the daily average PM₁₀ guideline of 70 µg/m³ is recorded as an internal incident and investigated. This involves identifying the source, the proportion above background levels and the potential for additional dust control measures.

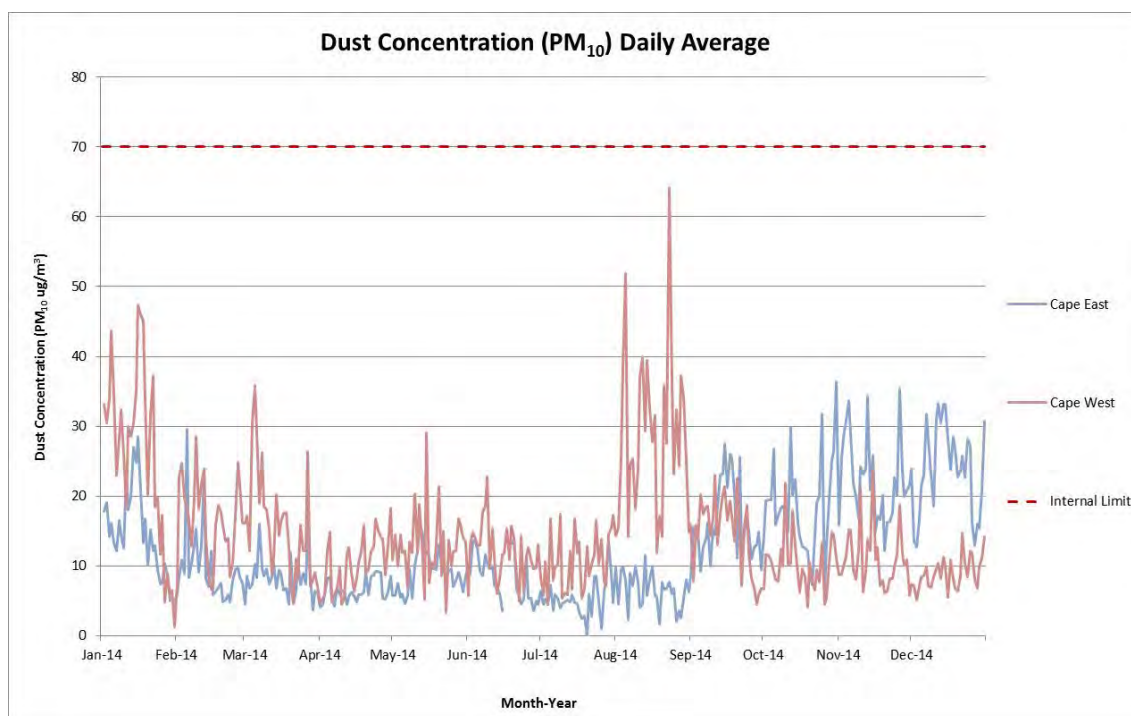
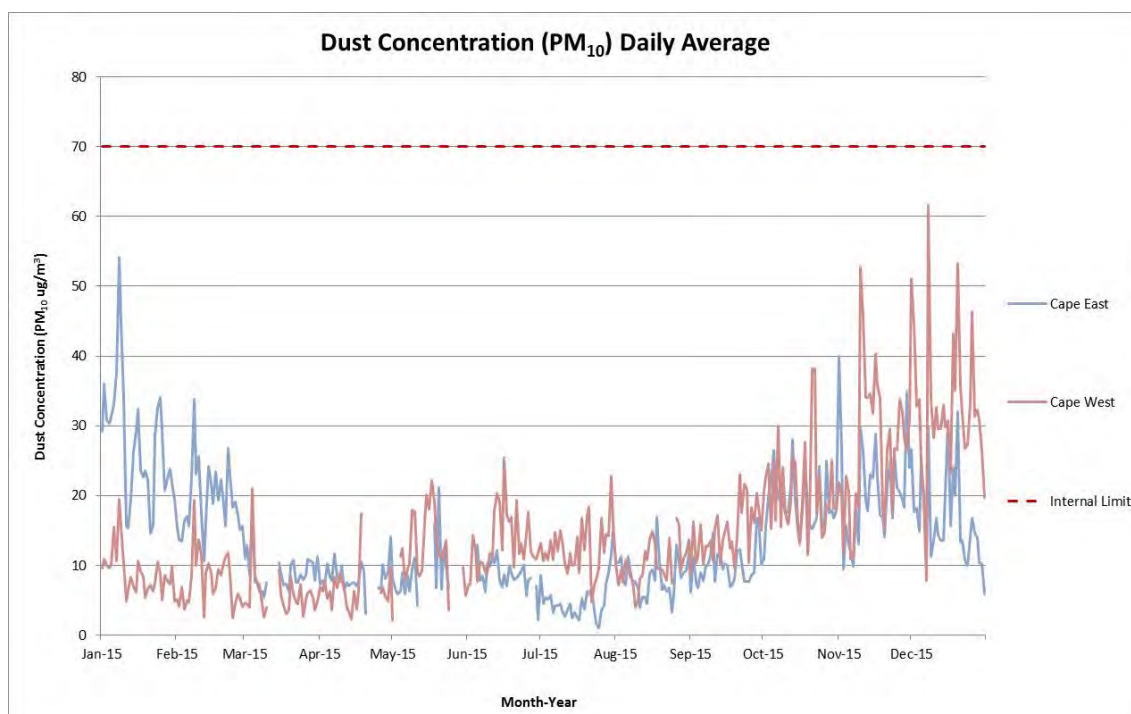
A summary of exceedances, outcomes from investigations and actions taken is presented in Table 3.

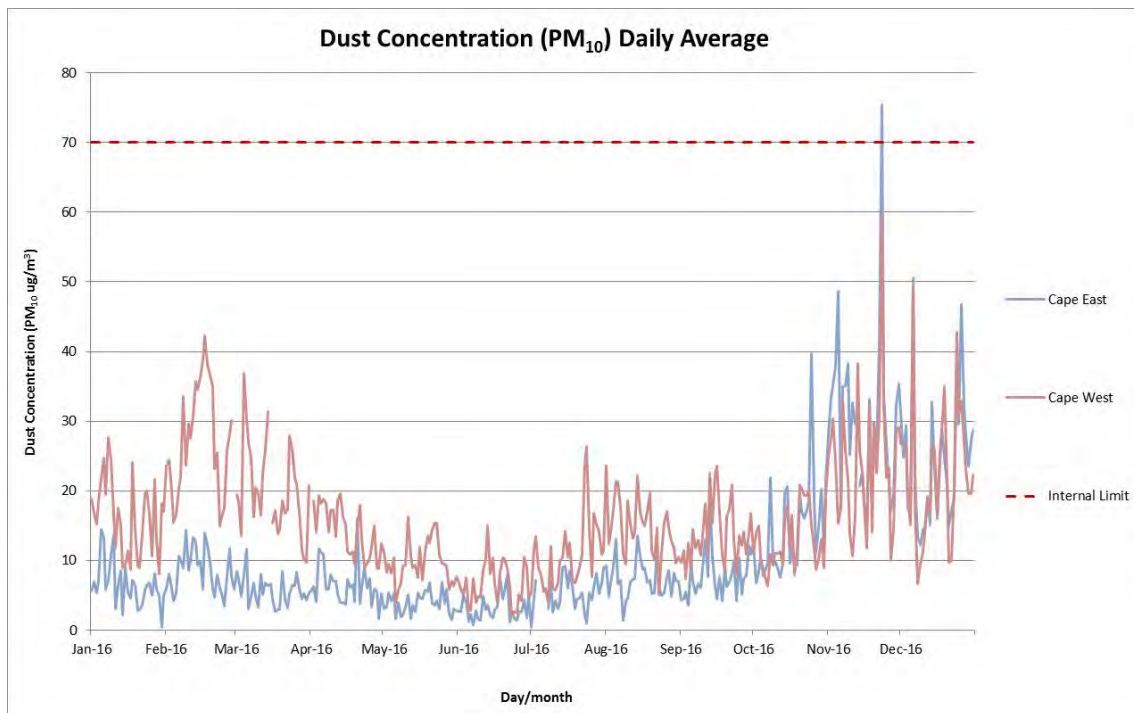
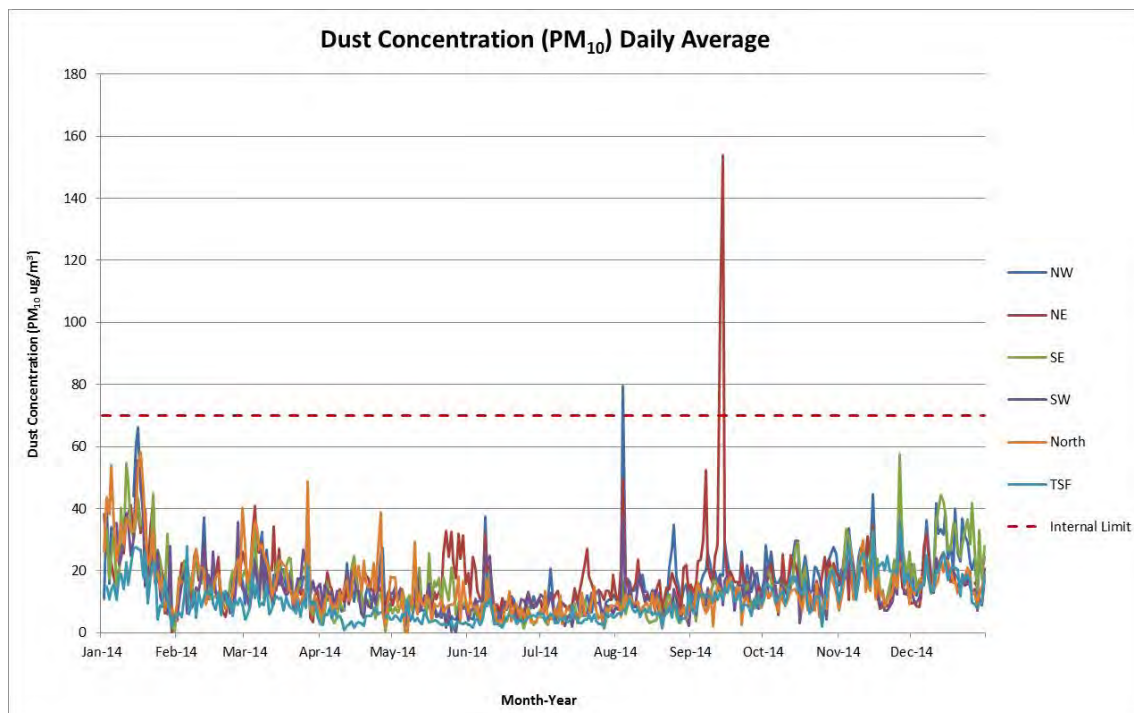
Table 3: Exceedances of daily average PM₁₀ limit

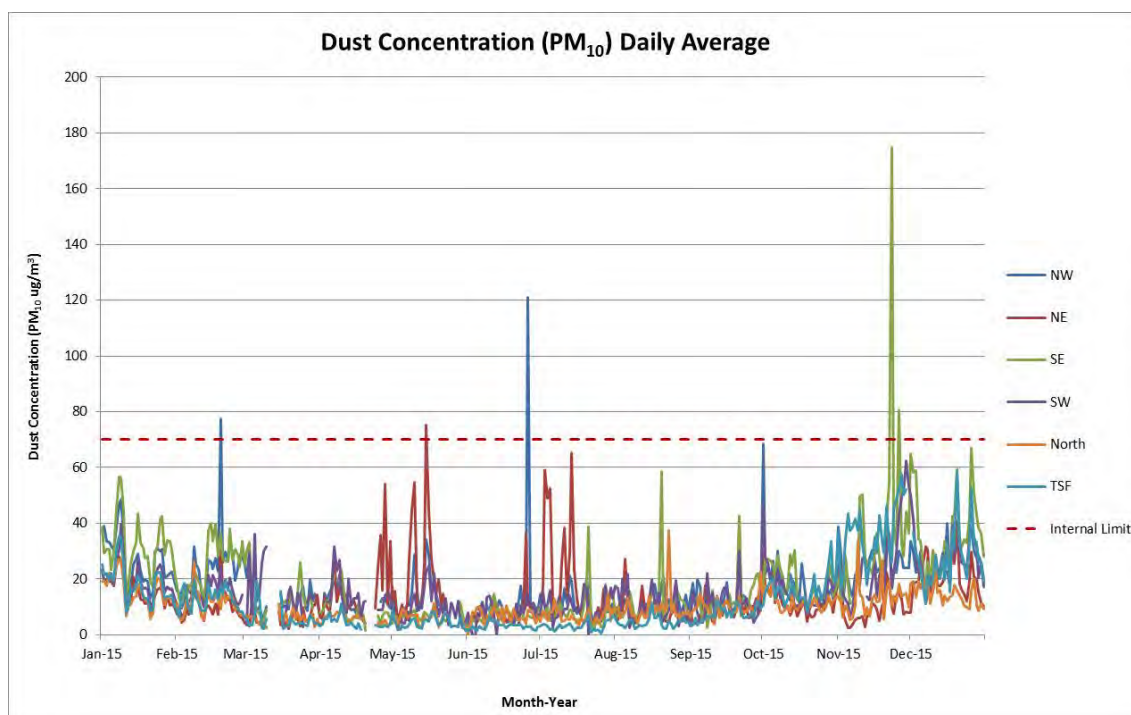
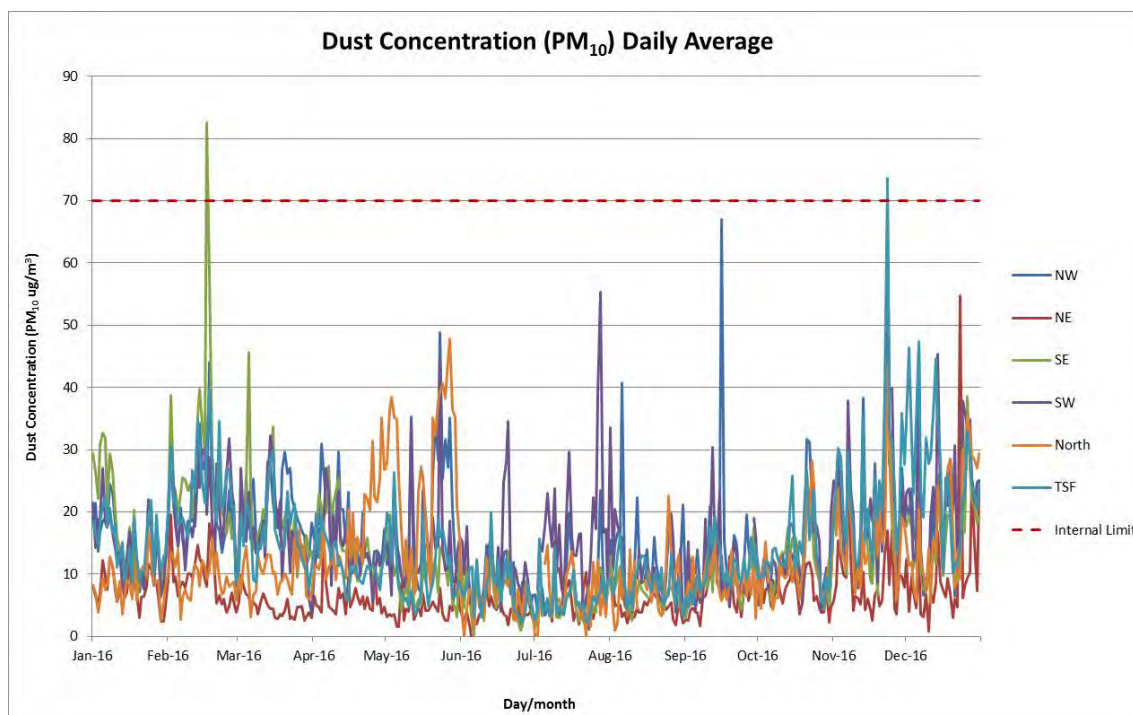
Incident date	Summary	Actions taken
4/08/2014	Dust exceedance at NW eBAM caused by strong winds creating dust storms.	Investigation finding was that exceedance caused by strong winds gusting to 22 m/s from the north east, raising dust from surrounding areas, possibly blowing dust from Fortescue River mouth road.
13/09/2014	Dust exceedance at NE eBAM (103.4 µg/m ³) caused by traffic on nearby Fortescue River Road.	Investigation findings were that high dust levels were recorded when the wind direction was from the south. No project activity on nearby north east waste dump, and wind speeds low to moderate. The conclusion that the source of dust was from traffic travelling on the Fortescue river mouth road.
14/09/2014	Dust exceedance at NE eBAM (154.6 µg/m ³) caused by traffic on nearby Fortescue River Road.	As above.
19/02/2015	Dust exceedance at NW eBAM due to strong easterly-north easterly winds raising dust across the project area.	Investigation conclusion was that strong winds associated with a sudden north easterly wind change due to thunderstorm activity was the cause of the elevated dust. The strong easterly winds raised dust associated with clearing activities at the TSF Stage 1B, and from disturbed and undisturbed areas across the project area.
15/05/2015	Dust exceedance at the NE eBam caused by strong easterly winds raising dust from topsoil stripping activities.	Investigation conclusion was that topsoil stripping activities together with strong easterly winds lead to elevated dust levels being recorded. Topsoil stripping activities will be shut down when strong winds are forecast, and where possible dust suppression methods will be employed.

Incident date	Summary	Actions taken
26/06/2015	Dust exceedance at the NW eBam caused by dust from vehicles travelling on the Fortescue river mouth road.	Investigation conclusion was that dust exceedance was caused by vehicles on nearby public Fortescue River mouth road. Recent grading of the road together with moderate northerly winds and heavy vehicle traffic had increased dust raised from this public road.
23/11/2015	Dust exceedance (147.7 $\mu\text{g}/\text{m}^3$) at SE eBAM due to clearing activity (disturbing topsoil for access road) within the SE Ebam location and prevailing wind conditions blowing dust directly over it.	Investigation conclusion was that during clearing activities (disturbing topsoil for access road) the prevailing wind conditions were such that the dust created was blown directly over the SE EBAM. Dust control was not possible as the area had not been cleared to bring water in nor is it effective on topsoil.
26/11/2015	Dust exceedance (80.6 $\mu\text{g}/\text{m}^3$) at SE eBAM due to moderate-strongly North Easterly winds flaring up dirt from recent clearing within the vicinity of the station.	Investigation concluded that the prevailing N/E winds caused dirt from recent clearing around the e-Bam site to flare up causing the elevated dust levels. Dust suppressant was applied to minimise the dust lift off and advised to develop dust governance.
26/12/2015	Dust exceedance (81.2 $\mu\text{g}/\text{m}^3$) at SE eBAM due to fluctuation in humidity and temperature.	Investigation concluded that elevated dust levels were caused by fluctuations in humidity and temperature affecting the e-Bam. All other parameters (wind speed & direction) did not indicate potential risk of dust event. Regular tracking of continuous data on Airodis/Envirosys systems and proactively attending to any potential trend of instrument fluctuation prior is paramount.
17/02/2016	Dust exceedance at SE eBAM (82.6 $\mu\text{g}/\text{m}^3$) due to strong wind speed/gusts raising dust across the project area.	Investigation conclusion was that strong winds associated with a sudden West South Westerly change due to thunderstorm activity were the cause of the elevated dust. The strong wind gusts raised dust associated with SE waste-dump and from disturbed and undisturbed areas across the project area.
23/11/2016	Dust exceedance at CE eBAM (75.4 $\mu\text{g}/\text{m}^3$) due to strong northerly winds blowing elevated regional dust across the project area.	Investigation conclusion was that high regional background dust levels and constant wind gust/speed (9.5 m/s) from Northerly direction experienced throughout the day across Sino Iron Project site caused the hourly PM_{10} dust levels to increase causing the 24-hour average to exceed (73.39 $\mu\text{g}/\text{m}^3$). All eight monitoring sites across the Sino Iron project recorded high PM_{10} levels. A dust haze was observed extending north east to Karratha indicating that the PM_{10} levels recorded across site were not project related.
23/11/2016	Dust exceedance at TSF East eBAM (73.6 $\mu\text{g}/\text{m}^3$) due to strong northerly wind blowing elevated regional dust across the project area.	Investigation conclusion was that high regional background dust levels and constant wind gust/speed (9.5 m/s) from Northerly direction experienced throughout the day across Sino Iron Project site caused the hourly PM_{10} dust levels to increase causing the 24-hour average to exceed (73.39 $\mu\text{g}/\text{m}^3$). All eight monitoring sites across the Sino Iron project recorded high PM_{10} levels. A dust haze was observed extending north east to Karratha indicating that the PM_{10} levels recorded across site were not project related.

The majority of exceedances were found to be due to either regional scale dust events (for example the event of 23/11/2016) and off-site vehicle movements on unsealed roads not related to the Project operations (for example the event of 26/6/2015). A number of exceedances were attributed to localised wind erosion events on the Project site, for example, the event of 17/2/2016 where waste dump dust emissions were generated from wind shift during thunderstorm activity, Land clearing activities also gave rise to exceedances, for example, the event of 15/5/2015.

Figure 5: Cape 24-hour Average Dust (PM₁₀) levels for 2014Figure 6: Cape 24-hour Average Dust (PM₁₀) levels for 2015

Figure 7: Cape 24-hour Average Dust (PM₁₀) levels for 2016Figure 8: Mine, Processing and TSF 24-hour Average Dust (PM₁₀) Levels for 2014

Figure 9: Mine, Processing and TSF 24-hour Average Dust (PM₁₀) Levels for 2015Figure 10: Mine, Processing and TSF 24-hour Average Dust (PM₁₀) Levels for 2016

Annual reports to OEPA provide a summary of the ambient monitoring program including the number of exceedances of the daily PM₁₀ guidelines together with a summation of the incident reports for each incident. The monthly average PM₁₀ trend (Figure 11) shows seasonal variations, with higher dust levels recorded when conditions are hot and windy (summer months before rainfall events) and lower dust levels when conditions are cooler (winter months May-July). Significant rainfall events reduce atmospheric dust levels and reduce the potential for dust to be generated from cleared areas and roads.

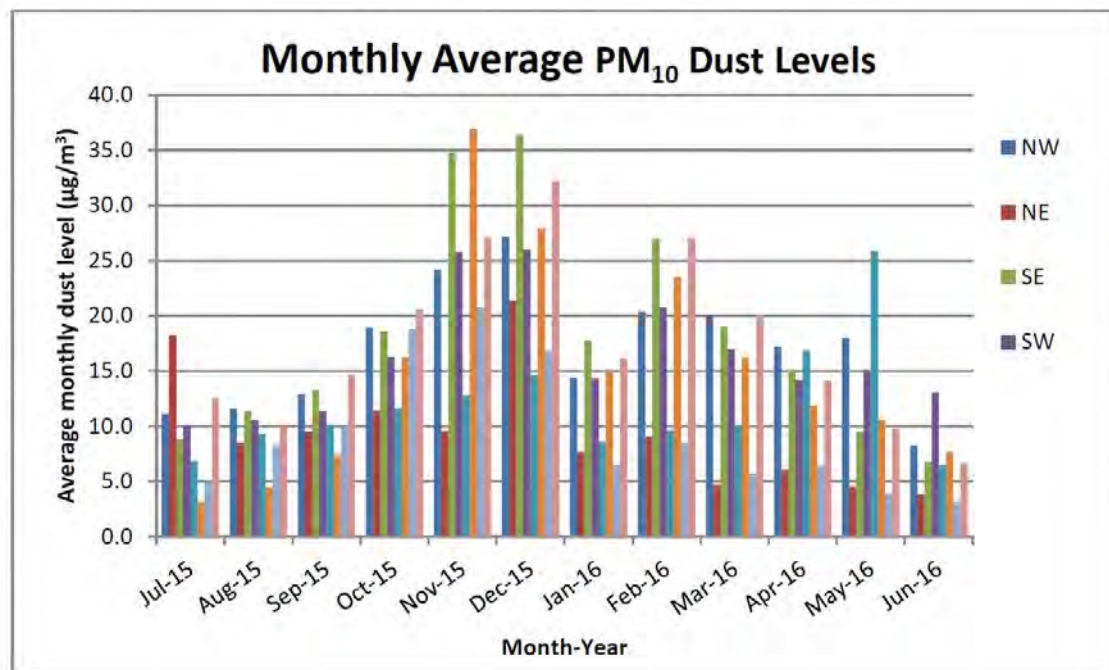


Figure 11: Monthly average dust levels

Summary of dust monitoring

Exceedance events of the hourly average PM₁₀ target are a trigger for various management responses across mining, stockpiling, processing and tailings operational areas. These are described in the OEMP. Review of the most recent data shows that 18 exceedance events of the hourly average PM₁₀ target occurred during 2016. Of these, three of the hourly average exceedance events corresponded with the three exceedance events of the daily average concentration targets. This indicates that in the remaining 15 instances, the exceedance of the hourly target did not manifest in an exceedance of the daily target. A review of the incident notes associated with the three daily target exceedances shows that those three events were characterised by strong wind conditions.

Monitoring shows that the targets and management measures are largely effective at maintaining ambient PM₁₀ concentrations below the daily target threshold. Exceedances of the threshold have occurred as a consequence of regional dust events, localised off-site vehicle movements and land clearing activities. As expected, higher PM₁₀ concentrations are observed across the hotter and dryer months of the year when the potential for wind erosion of exposed areas increases.

The relatively small number of Project related exceedances indicates the management measures specified in the ODMP are adequate for the continued management of operational dust emissions.

2.4.4 Fibrous minerals

Risks from Fibrous Mineral associated with mining, processing, ore storage and transfer facilities are managed in accordance with the FMMP. Section 10 of the Environmental Review considered the risks of Proposal to Terrestrial Environmental Quality, specifically related to exposure of fibrous minerals. In this report the risks of fibrous minerals to air quality is based on the potential for fibrous material to be spread as dust.

The predominant fibrous mineral encountered in the mining operations is massive (non-asbestiform) riebeckite. Although actinolite and tremolite may occur in trace amounts in transitional areas surrounding dolerite intrusions and, where encountered, are quarantined and transported to encapsulation cells within waste dumps. Massive riebeckite, is commonly encountered in all mining operations extracting ore in and around the Joffre and Dales Gorge Members and consists of densely packed acicular prismatic crystals. Crushing and milling of massive riebeckite can produce atmospheric concentrations of individual acicular crystals which meet the occupational health defined geometric criteria as a countable fibre.

While not meeting the formal definition of contaminant asbestos (under MSIA Regulation), based on precautionary principles CPM has chosen to include massive riebeckite in determining atmospheric fibre concentrations. Thus although the fibres are not asbestiform, CPM conservatively chooses to consider all fibres encountered on-site as having the potential to be asbestiform.

The primary sensitive receptors on-site are the workforce. CPM implements a comprehensive occupational hygiene monitoring program. A key component of the occupational hygiene monitoring program involves monitoring of personal sampling for fibrous mineral exposure. In addition to the personal exposure monitoring static or positional samples are also collected. Over a three year period from 2014 to 2016, 1204 personal and 2074 positional samples were collected and analysed for fibrous minerals.

Static atmospheric monitoring is undertaken to provide an indication of air quality and guide CPM's hierarchy of controls, including but not limited to:

- verify personal monitoring
- confirm location of designation PPE areas
- verify effectiveness of engineering controls.

Where elevated concentrations may be present, these areas are classified as designated areas where mandatory respiratory protection and decontamination is required. The static sampling is targeted in designated areas. Figure 12 and Figure 13 show the application of designated area at the Mine and concentrator and TSF, respectively.

Monitoring was undertaken at various locations around the operations including the mine, processing, tailings storage, village and port facilities.

Post closure requirements, as identified in the Mine Closure Plan require landforms with the potential to contain fibrous mineral (such as the tailings storage facility (TSF) and waste dumps) to be encapsulated. The Mine Closure Plan is required to conform to the requirements of the EPA and DMP for mine decommissioning, closure and rehabilitation.

Monitoring targets

The DoH (2013) *Guidance Note on Public Health Risk Management of Asbestiform Minerals Associated with Mining* identifies an occupational exposure standard and a limit for public exposure as follows:

- 0.1 f/mL standard for asbestos on a time weighted basis for occupational exposures
- 0.01 f/mL guideline limit for public exposure monitoring.

As the 0.1 f/mL exposure standard is for an average 8 hour day (and a 40 hour work week), this has been converted to a limit of 0.07 f/mL in accordance with the Department DMP guideline: *Management of fibrous minerals in Western Australian mining operations* for a 12 hour shift. In addition CPM apply a trigger to enact fibrous material controls in the workplace has been set at 0.04 – 0.06 f/mL. The 0.01 f/mL public exposure guideline limit is for limited duration activities (which DoH considers to be 6 months exposure).

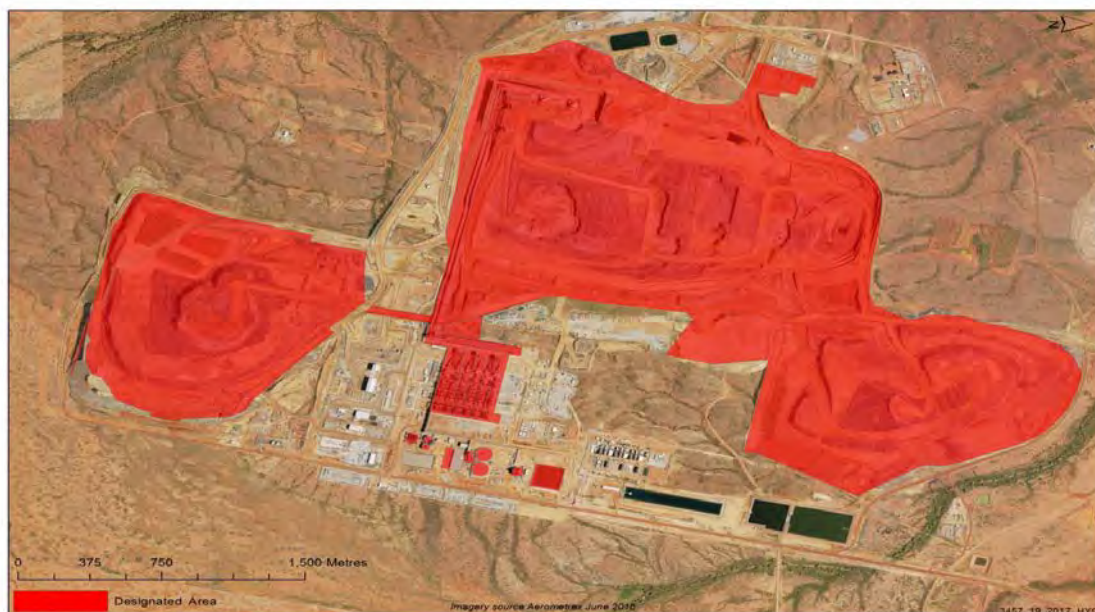


Figure 12: Designated area at Pit and Concentrator



Figure 13: Designated area at Tailings Storage Facility

Results of monitoring

Table 4 summarise the number of positional monitoring samples collected for the three year period from 2014 to 2016, categorised by project element. Over the three years of positional sampling (excluding voids) 1834 of the 1958 samples (93.6%) were below the 0.04 f/mL trigger level. The management trigger level of 0.04 f/mL was only exceeded in 94 samples (i.e. 4.8% of samples). The exposure limit of 0.07 f/mL limit was only exceeded on 31 occasions (i.e. 1.6% of samples).

The results of the positional monitoring samples demonstrates that even within the designated areas the potential exposure to fibres is low and that air quality parameters within the existing mine are well understood. The results also indicate that significant dilution of fibrous minerals occurs within a relatively short distance from point source emissions and are contained within areas that have been designated as being potentially hazardous.

Based on the location of the exceedances the key risk area is the processing facility, which recorded 26 of the 31 exceedances of the 0.07 f/mL limit (i.e. 83.9% of the exceedances) and 76 of the 94 exceedances of the 0.04 f/mL trigger level (i.e. 80.9% of the trigger level exceedances). The other key area that exceeded the trigger levels was the mine.

While the trigger levels at were exceeded at positional monitoring locations, employee safety was not at risk as these are restricted areas that require extensive PPE to protect employees. In addition, Scanning Electron Microscopy of atmospheric samples reveals that the predominant fibre released into the atmosphere is non-asbestiform, acicular, prismatic fibres of massive riebeckite.

Table 5 shows the results from positional monitoring conducted at the villages (i.e. workers camps within the mine leases). The guideline limit of 0.01 f/mL for public exposure has been applied at the mine villages. Of the 36 samples analysed from the villages 33 samples have been below the limit of 0.01 f/mL. One sample was recorded at the limit and two samples declared void. The sample at the limit was from the Fortescue Village, located approximately 25 km south of the mine operations. Advice from the technician who analysed that sample was that the fibres observed were not an asbestiform mineral.

Table 4: Positional monitoring sample results - operations

Location	< LOR	>LOR but <Trigger	>Trigger	>Limit	Void	Total
	<0.01 f/mL	0.01-0.03 f/mL	0.04-0.06 f/mL	>0.07 f/mL		
2014 sampling						
Mine	91	44	10	2	5	152
Processing	477	279	48	16	62	882
TSF	79	2	0	0	6	87
Port - Terrestrial	33	9	0	1	1	44
Port - Marine	4	3	0	0	2	9
General	3	2	0	0	1	6
Total	693	339	58	19	77	1186
2015 sampling						
Mine	16	35	5	0	1	57
Processing	66	97	11	7	3	184
TSF	25	8	0	0	2	35
Port - Terrestrial	57	11	0	0	0	68
Port - Marine	27	1	0	0	2	30
General	10	3	0	0	0	13
Total	222	157	14	7	8	408

Location	< LOR	>LOR but <Trigger	>Trigger	>Limit	Void	Total
	<0.01 f/mL	0.01-0.03 f/mL	0.04-0.06 f/mL	>0.07 f/mL		
2016 sampling						
Mine	67	15	4	0	6	92
Processing	91	131	17	3	18	260
TSF	48	8	0	2	2	60
Port - Terrestrial	15	3	0	0	0	18
Port - Marine	16	4	0	0	1	21
General	10	8	1	0	1	20
Total	253	169	22	5		479

Table 5: Positional monitoring sample results - villages

Monitoring year	< DoH guideline limit	>=DOH limit	Void	Total
	<0.01 f/mL	>=0.01 f/mL		
2014 sampling	6	0	0	6
2015 sampling	21	1	0	22
2016 sampling	6	0	2	8

Summary of fibrous mineral monitoring

Monitoring has identified that the main risk area for fibrous minerals is the processing facility, which requires extensive PPE and engineering controls. The Proponent has well established management practices to control this risk and ensure personnel are not exposed to fibrous minerals.

The current monitoring, management and reporting undertaken with respect to fibrous minerals is demonstrating risks and protecting employees.

2.5 Potential changes to emissions and impacts

As identified in Section 2.3 of the ERD, the Proposal involves an extension of existing activities. Specifically, the Proposal is for:

- increasing the area of the mine pit, WRD, TSF and associated infrastructure
- increasing the discharge of mine dewater into the Fortescue River mouth
- increasing the area of the product stockpile as well as the port infrastructure
- developing additional infrastructure corridors.

The Proposal does not change the production rate and does not introduce any new project elements. As the production will not increase the Proposal will not affect the output of operational elements. The demand on the power station will not change and as a consequence emissions associated with the operation of the power plant will not be affected. The Proposal provides potential for increase in dust emissions from the proposed increase in disturbance area.

In particular, the following sources of dust and fibrous material emissions have been identified which may increase with increase in area of mine pit, WRD, TSF and product stockpile from implementation of the Proposal:

- mining and construction activities have the potential to cause fibrous mineral to become airborne and affect air quality
- inappropriate management of potential asbestiform material (including post-closure storage, and mine pit wall exposures) has the potential to cause fibrous minerals to become airborne and affect air quality
- mining and construction activities have the potential to generate dust, which can affect air quality.

The primary air quality risks from the Proposal are therefore from human exposure to airborne PM₁₀ and fibrous materials.

2.6 Assessment of impacts

2.6.1 Potential for fibrous minerals to become airborne during mining and operational activities

Section 11 of the ERD assessed the potential impacts to Terrestrial Environmental Quality. Specifically, Section 11.3.1 of the ERD provided a summary of the potential for fibrous minerals to occur and concluded that:

1. The predominant fibrous mineral encountered in the mining operations (of the Joffre Member) is massive riebeckite, which is non-asbestiform.
2. The risks associated with fibrous minerals at the Project are similar to that experienced by other iron ore mining operations mining in and around banded iron formations within the Hamersley Group.

Section 11.3.2 of the ERD provided a summary of the occupational and public health considerations. Specifically, that section identified that while the fibrous minerals present are non-asbestiform, based on the fact that fibrous minerals are present, CPM have taken a conservative approach to the management of fibrous minerals by assessing all fibres as if they were contaminant asbestos. Therefore, on the basis of a potential hazard to human health a significant occupational hygiene monitoring program and the development of a comprehensive FMMP have been developed. Personal exposures to fibrous minerals are well controlled. Atmospheric concentrations of fibrous minerals recorded across the site are generally below the occupational exposure standard. Areas where elevated concentrations may be present (limited to mine pit, processing plant, TSF and parts of port operations) are classified as designated areas where engineering controls are included and mandatory respiratory protection and decontamination is required. Examples of the designated areas at the mine and concentrator and TSF are shown in Figure 12 and Figure 13, respectively.

Section 11.5.1 of the ERD assessed the risks of releasing fibres related to mining and processing to Terrestrial Environmental Quality. The objective for Terrestrial Environmental Quality is to “maintain the quality of land and soils so that environmental values are protected.” The assessment determined that the key measure in minimising risk of exposure to asbestiform minerals is to avoid known occurrences of asbestiform material where possible. Where asbestiform fibrous material is identified that cannot be avoided (transitional areas surrounding dolerite intrusion and Dales Gorge) this material is transported to designated encapsulation cells within WRDs.

Section 2.4.4 summarises the extensive ongoing occupational hygiene monitoring program that the existing project has undertaken to detect fibrous minerals. The Proponent will continue to implement this program to assist in protecting the health of employees on-site CPM. To date the monitoring program has been able to demonstrate that the fibrous minerals are contained in designated areas and that workers in the accommodation villages are protected from fibrous minerals.

Regular inspections and audits are conducted across site to ensure effectiveness of fibre controls is maintained.

As mentioned above, activities with the greatest risk of releasing fibres are related to mining and processing, and to a lesser extent activities at the port and marine operations. The FMMP has been developed by CPM to address these risks thereby ensuring fibrous minerals are appropriately managed on site.

This Proposal presents potential for increased risk to air quality associated with fibrous minerals. That risk will be managed by implementation of the FMMP such that the Proposal will continue to meet the EPA objective for Air Quality.

2.6.2 Potential for fibrous minerals to become airborne post-closure

Section 11.5.2 of the ERD assessed the risks of releasing fibres post-closure to Terrestrial Environmental Quality and identified that asbestiform mineral waste that is excavated from the mine is contained within designated encapsulation cell within waste rock landforms. The encapsulation cells are designed to include a minimum of 50 m of material along their sides and a 10 m deep capping layer of clean material on top.

The location of the cells within stable post-closure waste rock landforms will prevent the potential for fibrous minerals to affect air quality. The Proposal does not increase the risk to air quality associated with fibrous minerals from post-closure. By implementing the FMMP the Proposal will continue to meet the objective for Air Quality.

Potential exposure in final pit walls and TSF

The Project's pit design has minimised exposure of Dales Gorge member in the final pit shell. Based on the depth of the pit wall (i.e. ~400 m) it is very unlikely that any asbestiform material would leave the mine pit. The groundwater re-entering the pit void and forming a pit lake is expected to help mitigate the risk of any exposed material becoming airborne. Other management methods such as covering the exposures with clean fill or other material will be assessed to minimise the risk of exposing asbestiform material for long periods. In addition, the TSF will be encapsulated within a layer of clean material. For further information related to closure see the Conceptual Mine Closure Plan.

The Proposal does not increase the risk to air quality associated with fibrous minerals in the final pit walls and TSF. By implementing the FMMP the Proposal will continue to meet the objective for Air Quality.

2.6.3 Additional dust

Section 2.4.3 has demonstrated that the existing operations largely meet dust management requirements. Some exceedances of dust trigger levels have occurred from Project activities such as land clearing and operation of the waste dump. Other exceedances were due to significant weather events occurring in the Pilbara and not related to mine activities.

The Proposal will increase the life of the mine but not increase production rates. As the production rates will not increase, vehicle movements and operational activities are largely expected to remain similar. The Proposal will continue to apply existing dust measures and implement improvements where possible to the OEMP such that the Proposal will meet the EPA objective for Air Quality.

2.7 Mitigation

CPM's objective for air quality is to minimise impacts through the implementation of the hierarchical structure from the FMMP, as follows:

- prevention of fibre and related dust release as far as is practicable
- where prevention is not practicable, capture of emissions; if emissions cannot be captured, ensure as far as is practicable, suppressions of emissions when they do occur
- where prevention of fibre and related dust release is not practicable, prevention of worker exposure through use of other controls as provided for in the FMMP
- prevention of exposure to the public through use of controls as provided for in the FMMP
- prevention of environmental harm.

Specific actions proposed to achieve those outcomes are:

- mine planning that minimises the interaction with Dales Gorge material
- disposing of potentially asbestiform containing material in designated encapsulated cell within WRDs
- encapsulation and rehabilitation of TSF areas progressively when and where possible
- a rigorous program of preventing or suppressing fibre/dust release (e.g. by water spraying, misting and fogging, application of binders and surfactants, installation of extraction ventilation, etc.). Prevention and/or suppression methods will be used for drilling and blasting, loading, transfer of ore and waste, crusher operations and conveyor transport of ore, processing operations including management of tailings, stockpile management and transfer of concentrate through to transfer onto export vessels
- conducting workplace inspections and audits to ensure controls are maintained to a required standard.

As identified in Section 11.4 of the Sino Iron Mine Continuation Proposal Environmental Review the potential for public and occupants of the accommodation village to experience reduced air quality is minimised by:

- the isolation nature in terms of distance from populated areas
- security measures that prevents unauthorised access to the lease areas
- separation (including realignment) of public roads from processing and mining areas.

2.8 Predicted outcome

The ongoing implementation of existing management measures (described above) will ensure the Proposal will not result in any significant risk to Air Quality and impacts at sensitive receptors.

3. References

Environmental Protection Authority (EPA) 2016, Environmental Factor Guideline – Air Quality, Environmental Protection Authority, Western Australia.

Department of Mines and Petroleum (DMP) 2015, *Management of fibrous minerals in Western Australian mining operations – guideline*. Department of Mines and Petroleum, Western Australia.

Department of Health (DoH) 2013, *Guidance Note on Public Health Risk Management of Asbestiform Minerals Associated with Mining*. Department of Health, Western Australia.

**ATTACHMENT 2 – Sino Iron Mine Continuation Proposal – Air Quality Review:
Peer Review (Ramboll Environ)**

CITC Pacific Mining Management Pty Ltd
45 St Georges Terrace
Perth, WA, 6000.

Attention: Mr Bruce Watson

**PEER REVIEW
AIR QUALITY
SINO MINE CONTINUATION PROPOSAL**

Date 15/04/2017

Ramboll Environ Australia Pty Ltd (Ramboll Environ) was engaged by CITIC Pacific Management Pty Ltd (CPM) to undertake a peer review of the following document:

- Sino Iron Mine Continuation Proposal. Supplementary Information – Air Quality. Prepared by Strategen Environmental, April 2017 (hereinafter the Document)

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The review was completed by Mr Brian Bell who is a Principal with Ramboll Environ and has over 35 years' experience in the fields of air quality and environmental impact assessment and management. Mr Bell has previously worked for the Department of Environment and Conservation (now the Department of Environment Regulation [DER]) and has been a consultant for over 25 years working for Dames & Moore/URS and ENVIRON/Ramboll Environ. He has been involved in the preparation of many formal air quality and environmental impact assessments for major mining and industrial projects.

In reviewing the Document, relevant sections of the following documents were also considered:

- Sino Iron Mine Continuation Proposal Environmental Review. Prepared by Strategen Environmental, February 2017.
- Air Quality Assessment for Citic Pacific Mining Power Station at Cape Preston. Prepared by Air Assessments, August 2009.
- Air Quality Assessment for Citic Pacific Mining Power Station at Cape Preston – 2009 Update. Prepared by Air Assessments, April 2008.
- SINO Iron Fibrous Minerals Management Plan, 24 May 2016, Document No. DR030318.
- SINO Iron Project Draft Operational Environmental Management Plan, 23 January 2017, Document No. DR029968.
- SINO Iron Project Conceptual Closure Plan, January 2017, Document No.

DR042921.

- SINO Iron Project Dust (Environmental) Management Procedure, June 2016, Document No. DR018861.
- SINO Iron Project Dust Operational Management Plan, 15 June 2012, Document No. DR027769.

The peer review has also considered the Environmental Protection Authority (EPA) Environmental Factor Guideline (EFG) for Air Quality, dated December 2016. The EFG for Air Quality specifies that the EPA's objective for this factor is "to maintain air quality and minimise emissions so that environmental values are protected".

The Document is structured with an introduction which includes the purpose and scope of the Document which is stated as:

"This report addresses the EPA request to provide additional information to assess the potential impacts of the Proposal. The material in this Report has been provided in addition to the ERD [Environmental Review Document] prepared for the Proposal and therefore makes frequent reference to the ERD."

The air quality section of the Document (i.e., Section 2) is structured as follows:

- EPA objective
- Policy and guidance
- Receiving environment
- Outcomes of existing monitoring
- Potential impacts
- Assessment of impacts
- Mitigation
- Predicted outcome

Reviewer's comment: This structure is a clear and logical way of presenting the information associated with air quality. The EPA's objective for the Air Quality Factor is presented in Section 2.1 of the Document. Section 2.2 of the Document specifically refers to the EPA's EFG for Air Quality, the Department of Mines and Petroleum guideline for the management of fibrous minerals in WA mining operations, and the Department of Health (DoH) guidance note on public health risk management of asbestiform minerals associated with mining.

The information presented in Section 2.3.1 of the Document on regional context is considered to be a reasonable summary of the climate of the Pilbara region.

Section 2.3.2 of the Document identifies potential sensitive receptors.

Reviewer's comment: Section 10 of the ERD noted that the Sino Iron Project's accommodation village should be considered as an area requiring public health standards to be applied. The reviewer considers that this is appropriate and it is recommended that the accommodation village be considered as a sensitive receptor.

The reviewer agrees with the assessment by the DER that the separation distance from the Project to the Fortescue River Mouth recreational area is sufficient to prevent health impacts occurring as a result of the Sino Iron Project emissions.

Section 2.3.2 of the Document discusses mitigation of potential public health impacts and the reviewer considers that these would be more appropriate to be presented in the mitigation section of the Document.

Section 2.3.3 of the Document provides a brief summary of the Sino Iron Project and some aspects of the approvals.

Reviewer's comment: The ERD provides more detail and the information presented in the Document is considered sufficient if read together with the ERD as is intended.

Section 2.4.1 of the Document presents the monitoring results for oxides of nitrogen. No information was available regarding the atmospheric emissions of oxides of nitrogen (NO_x) or carbon monoxide (CO) from the Power Station but CPM has until 30 June 2018 to provide this and demonstrate compliance with the emission limits specified in the operating licence. The Document does not present any data on ambient NO_x concentrations but states that these are well below the National Environment Protection (Ambient Air Quality) Measure (NEPM) standard.

Reviewer's comment: The Document does not provide any data to support the ambient monitoring statements and this should be addressed. However the reviewer has been provided with plots of the maximum 1-hour nitrogen dioxide (NO₂) concentrations recorded at the monitoring station between 2014 and 2016. These plots confirm that the measured NO₂ concentrations are well below the NEPM standard.

The reviewer notes that the Document states that the ambient NO_x concentrations are well below the NEPM standard when in fact the NEPM standard is only associated with the NO₂ component of NO_x. The Document should be change to reflect this.

The reviewer also notes that the measured 1-hour ambient NO₂ concentrations are of a similar magnitude to those predicted by the air dispersion modelling conducted for the Power Station emissions in 2009 and referenced in the Document.

The reviewer considers that the Document could conclude that the ambient monitoring data indicates that the emissions of NO_x associated with the Sino Iron Project provide no issue of concern with regards to the EPA's objective for air quality.

Section 2.4.2 of the Document provides information on the Sino Iron Project greenhouse gas emissions (sulphur hexafluoride, NO_x, methane, and carbon dioxide (CO₂)) for three years between 2013 and 2016 for CO₂ equivalent emissions (CO_{2e}).

Reviewer's comment: It is unclear to the reviewer what time period the greenhouse gas emissions correspond to for each of the three "years" presented (e.g., financial years, calendar years). This should be clarified in the Document.

The greenhouse gas emissions data also have no context around the intensity of the emissions per MWhr of electricity produced, or per tonne of product exported. Without this sort of information, the reviewer cannot determine a clear reason as to why the emissions have increased.

It is recommended that this section be revised to include details of the greenhouse gas intensity per unit of product or MWhr of electricity produced (whichever is most relevant). It is also recommended that the sources that contributed to these emissions be noted with an order of magnitude contribution (e.g., Power Station, haul trucks, shipping, mining (e.g., blasting, diggers), and vegetation clearing).

Section 2.4.3 provides information associated with the existing monitoring programs for dust. Dust is monitored as PM₁₀ (particulate matter with an equivalent aerodynamic diameter of ten microns) at eight monitoring sites at the Project. The Dust Operational Management Plan (DOMP) defines trigger levels for 1-hour and daily averaging periods for PM₁₀. The Document presents daily and monthly averaged data for 2016 and within this period identifies three days where the daily target was exceeded which resulted in investigation of these events.

Reviewer's comment: It is not clear why the Document only presented PM₁₀ data for 2016 and only for the daily averages and did not consider the hourly averaged data for which the DOMP has defined a trigger level.

Based on the description of the information presented in the Document, the reviewer considers that two of the events (that both occurred on 23 November 2016 at separate monitoring sites) were not caused by the Sino Iron Project and were associated with a regional scale event. If this is the case then the Document should be revised to clearly state this.

CPM has provided the Reviewer with summaries of the PM₁₀ monitoring data and daily exceedance events for the 2014 to 2016 calendar years. There were three daily exceedance events in 2014, none of which were associated with the Sino Iron Project based on the daily exceedance report provided. In 2015 there were five events identified and four of these were determined by CPM to be associated with land clearing for the Sino Iron Project and resulted in investigations and consideration of the need to change any mitigation measures.

The locations of the majority (seven of eight) of the PM₁₀ monitoring sites are near the boundary of project areas and the reviewer considers that this should provide a good understanding of the dust emissions from the current Sino Iron Project operations.

The reviewer has not been provided with any air dispersion modelling report that covers the fugitive operations from the Project and it is not clear that any such modelling was conducted. However, while this type of dispersion modelling is a potentially useful tool, the reliable quantification of emissions is difficult and this affects the reliability of the model predictions. The reviewer considers that the real time PM₁₀ monitoring program provides a more realistic basis on which to assess the ambient PM₁₀ concentrations from the Sino Iron Project.

The monitoring results associated with the fibrous minerals are presented in Section 2.4.4. This also identifies the exposure standards.

Reviewer's comment: The DoH guideline for public exposure to asbestos is 0.01f/ml in conjunction with limited duration activities (six months) and the limited duration aspect should be noted in the Document. Similarly, it should also be noted that the occupation exposure standard of 0.1f/ml is based on 8 hour days and a 40 hour work week.

There appears to be a small error and inconsistency in the Document with regards to the summary of the fibrous minerals monitoring between the text and Table 1. For example, the Document states that there were no exceedances of the public exposure standard at the mine village but the data in Table 1 shows one exceedance in 2015. The reviewer was provided with the data files by CPM and these data indicate that the Document text is correct but the data point in Table 1 is incorrect. The data in Table 1 should be reviewed against the monitoring data spreadsheets to ensure that this is the only error.

The fibrous minerals monitoring is primarily associated with the designated areas and the highest frequency of exceedances of the modified exposure limit occurs at the processing plant. The percentage occurrence of the monitoring results where exceedance of this limit were recorded was at its lowest level in 2016 for the processing plant over the three years of data reviewed.

The reviewer considers that the fibrous minerals monitoring program is demonstrating the effectiveness of the FMMP and CPM's continuous improvement program.

Section 2.5 presents the potential impacts and outlines that the Proposal involves an extension of the existing activities including increasing the area of the mine pit, waste rock dump (WRD), tailings storage facility (TSF) and associated infrastructure, increasing product stockpiles, and developing additional

infrastructure corridors. The Document states that as production rates will not increase the Proposal will not affect the output of the operational elements.

Reviewer's comment: The ERD shows a significant increase in the area of disturbance from 2,734 ha to no more than 10,100 ha. Therefore, while the statements in the Document that there are no production rate increases and no new elements to the Project are correct, the reviewer considers that there will be changes to the operational elements simply through the change in location of some of these elements (e.g., TSF, WRD, mine pit). These changes will result in an increased risk to air quality and potential associated impacts.

CPM has demonstrated through monitoring for the existing project that it is able to effectively manage its air quality impacts from the existing operations but it should present information on how the proposed changes to the Project will increase the air quality risks (e.g., increase in disturbed areas) and how these will be managed through its management plans and procedures including progressive rehabilitation. The reviewer considers that this Section is currently inadequate for such a significant change to the Project.

The Document also states that the Continuation Proposal does not have the potential to generate new or different impacts to greenhouse gas and NO_x emissions. It is not clear to the reviewer why these emissions will not change so the basis for this statement needs to be supported by more information. For example if the expanded facilities result in greater haulage, conveying and/or piping distances then the greenhouse gas and NO_x emissions could reasonably be expected to be different. Further additional clearing will also increase greenhouse gas emissions. The reviewer considers that more information is required to support the Document's conclusion if in fact these emissions are not expected to change.

The reviewer considers that the impacts that have been identified in Section 2.5 are not actually impacts; they relate to the generation of the emissions that may affect air quality. The impacts are what actually occurs as a result of this potential change in air quality. The reviewer considers that that potential impacts that may occur as a result of any changes in air quality need to be included in the Document.

Section 2.6 of the Document presents the assessments of impacts resulting from the Project. This Section refers heavily to the Terrestrial Environmental Quality (TEQ) section of the ERD (Section 10).

Reviewer's comment: The reviewer has also reviewed the TEQ section of the ERD and has provided a separate letter presenting the outcomes of that review. The review of the TEQ section recommended a number of changes. However, the overall reviewer's finding was that it was considered that the EPA's objective for TEQ with regards to fibrous minerals will be achieved as long as CPM continues to maintain its strong focus on the implementation of the FMMP and other plans and procedures including the Dust (Environmental) Management Procedure,

the DOMP and the Conceptual Closure Plan. The reader is referred to that review for further information.

At the end of Section 2.6.1 of the Document, it is stated that “this Proposal does not increase the risk to air quality associated with fibrous minerals”. The reviewer does not agree with this statement as the additional area of disturbance will result in an increase in the inherent risk to air quality. The Document does not provide any information on how these increased risks will be managed through the FMMP and CPM's other management plans and procedures and what changes will be required to these to achieve the same or lower residual risk outcomes. Based on CPM's demonstrated performance in managing the current risks associated with fibrous minerals, the reviewer considers that CPM will likely be able to manage these increased risks but that further information is required to demonstrate this, particularly with regard to fugitive emission from cleared and active areas such as the TSFs and WRDs.

Section 2.6.3 of the Document states that where dust trigger levels were exceeded they were not related to the mine activities. Based on the information presented in Section 2.4.3 of the Document and additional exceedance data provided by CPM, the reviewer does not consider this statement to be correct. It is clear that some of the measured exceedances of the daily trigger levels were associated with the mine activities (where these activities included activities such as clearing and operation of the WRD). The Document should be modified to correct this statement. The Document should also note that occasional exceedances of the dust trigger levels will occur and these are generally unavoidable for such a large project; the DOMP has a performance indicator of not exceeding the daily guideline (or trigger) on more than 10 days per year as a result of emissions from the Project. This performance indicator has been met for the three years (2014 to 2016) of PM₁₀ monitoring data made available to the reviewer. Each exceedance of a dust trigger results in an investigation aimed at determining the underlying cause and considering if any corrective actions are required.

Section 2.7 of the Document provides information on the mitigation measures.

Reviewer's comment: This Section appears to incorrectly refer to TEQ rather than air quality. As per the comments from the TEQ review, the reviewer considers that this section of the Document should follow the hierarchical mitigation structure used within the FMMP. This is also in line with the EPA EFG for the Air Quality factor. The FMMP mitigation structure is:

- prevention of fibre and related dust release as far as is practicable;*
- where prevention is not practicable, capture of emissions;*
- if emissions cannot be captured, ensure as far as is practicable, suppressions of emissions when they do occur;*

- *where prevention of fibre and related dust release is not practicable, prevention of worker exposure through use of other controls as provided for in the FMMP;*
- *prevention of exposure to the public through use of controls as provided for in the FMMP; and*
- *prevention of environmental harm.*

Reviewer's Finding

The reviewer considers that the EPA's objective for air quality is likely to be met for the Continuation Proposal as long as CPM continues to maintain its strong focus on the implementation of the FMMP and other plans and procedures including the Dust (Environmental) Management Procedure, the DOMP and the Conceptual Closure Plan, including review and continuous improvement of these to address the changes from the Continuation Proposal. The reviewer also considers that the ongoing monitoring programs are very important to the achievement of the EPA's objective for air quality.

The Document has a number of information gaps, contains some simplistic assumptions, and incorrect statements that should be addressed.

The reviewer considers that the Project's:

- Emissions of NO_x will continue to result in ambient air quality impacts that are well below the NEPM standards.
- Greenhouse gas emissions may change as a result of the Continuation Proposal and that this has not been quantified in the Document. The reviewer also considers that the greenhouse gas emissions need to be presented as tCO_{2e} per tonne of product or per MWhr so that there is some context around the magnitude of the emissions in terms of greenhouse gas efficiency.
- Dust and fibrous mineral emissions are currently being well managed based on the monitoring results and the low number of exceedances of the triggers and guidelines that are occurring. With regards to the Continuation Proposal, the reviewer considers that the significant increase in the area of disturbance will result in an increased risk to air quality (dust and fibrous minerals) as a result of fugitive emissions. While it is considered likely that CPM will be able to continue to manage these risks the reviewer considers that the Document should present information on topics such as the change in the size of the cleared and active areas and progressive rehabilitation. The Document should then discuss the expected changes to the relevant management plans and procedures to provide improved confidence in this outcome. The reviewer expects that some of the dust and fibrous minerals monitoring programs will need to be modified to enable ongoing effective management due to the locational changes to Project elements as a result of the Continuation Proposal.

CPM has demonstrated its ability to comply with the EPA's objective for air quality for the existing Sino Iron Operations and the reviewer considers that this can continue to be achieved with the Continuation Proposal.

Yours sincerely

Ramboll Environ Australia Pty Ltd



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**ATTACHMENT 3 – Sino Iron Mine Continuation Proposal – Terrestrial Air
Quality Review [Strategen Environmental]**

10. Terrestrial environmental quality

10.1 EPA objective

To maintain the quality of land and soils so that environmental values are protected.

10.2 Policy and guidance

The relevant guideline for Terrestrial environmental quality is:

- *Environmental Factor Guideline – Terrestrial Environmental Quality* (EPA 2016I)
- *Management of fibrous minerals in Western Australian mining operations – guideline* (DMP 2015).

10.3 Receiving environment

10.3.1 Geology

The Hamersley Group contains one of the largest iron ore deposits in the world, covering more than 600 km from east to west. Numerous large scale operations mine haematite, goethite and limonite deposits found within the Brockman and Marra-Mamba Iron Formations situated within the Hamersley Group (Figure 10-1).

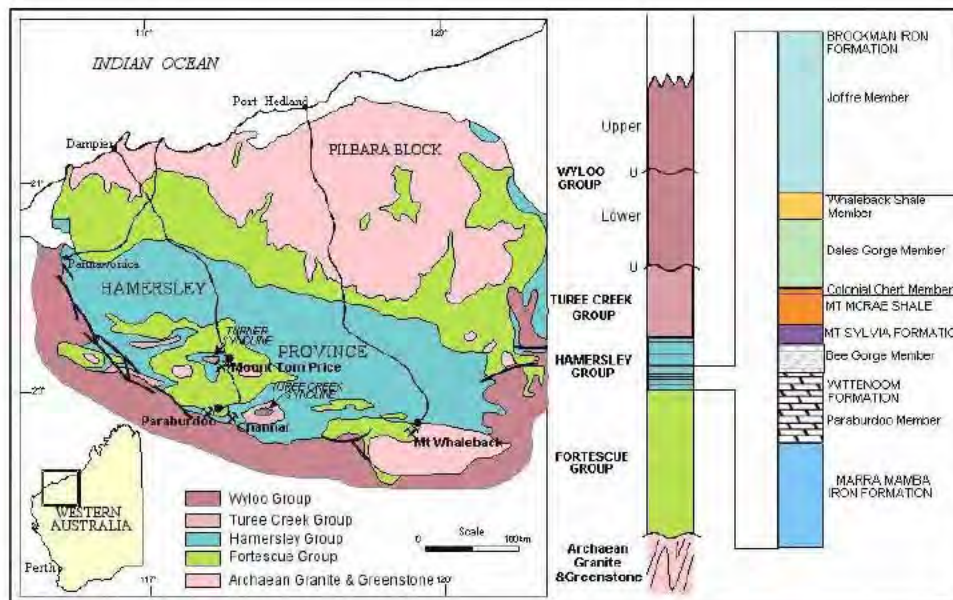


Figure 10-1: Regional geological context

The Joffre and Dales Gorge geological members of the Brockman Iron Formation as well as the Marra Mamba Iron Formation contain banded iron formations that typically consist of alternating sedimentary layers of chert matrix and iron rich bands. These members also contain massive reserves of iron as magnetite.

Fibrous minerals in the Hamersley Iron Group

Fibrous minerals including Actinolite, Tremolite and Riebeckite are ubiquitous throughout the Brockman and Marra-Mamba Iron Formations, each of which may occur in asbestiform and non-asbestiform habits.

While the Dales Gorge Member is known for its occurrence of asbestiform Riebeckite (otherwise known as Crocidolite or “Blue Asbestos”) particularly near the centre of the Hamersley Province, the Joffre Member is notable for its absence of crocidolite seams. However, instances of filiform sprays of crocidolite may be encountered in the chert matrix. Asbestiform Actinolite and Tremolite can also be found in the transitional areas around dolerite intrusions.

Fibrous minerals at Sino Iron Ore Operations

The predominant fibrous mineral encountered in the mining operations (of the Joffre Member) is, as would be expected, massive (non-asbestiform) riebeckite. Actinolite and tremolite may occur in trace amounts in transitional areas surrounding dolerite intrusions and, where encountered, are quarantined and transported to encapsulation cells within waste dumps.

The magnetite orebody being mined lies within the Joffre Member of the Brockman Iron Formation which in turn forms part of the Hamersley Group. The orebody overlies the Whaleback Shale and Dales Gorge Members. Dolerite intrusions are present in all geological units as indicated in Figure 10-2.

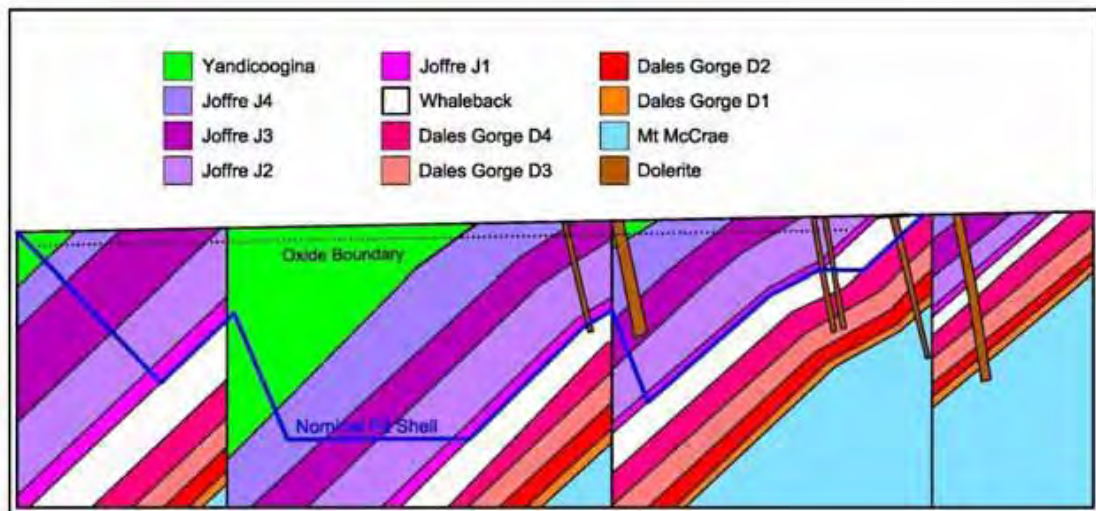


Figure 10-2: Indicative cross sectional view of the geological units within the mine plan.

Although the Dales Gorge does not form part of the target ore body, for economic as well geotechnical stability reasons, planned removal of this material involves quarantine and transport to waste (to be capped).

Massive (non-asbestiform) riebeckite

Massive riebeckite, is commonly encountered in all mining operations extracting ore in and around the Joffre and Dales Gorge Members and consists of densely packed acicular prismatic crystals. Crushing and milling of massive riebeckite can produce atmospheric concentrations of individual acicular crystals which meet the occupational health defined geometric criteria as a countable fibre. While not meeting the formal definition of contaminant asbestos (under MSIA Regulation), based on precautionary principles CPM has chosen to include massive riebeckite in determining atmospheric fibre concentrations.

Fibrous minerals and environmental health

The risks associated with fibrous minerals at the Project are similar to that experienced by other iron ore mining operations mining in and around banded iron formations within the Hamersley Group. The primary concern that arises is the potential effect on human health, both occupational and public.

Atmospheric monitoring for fibrous minerals at the Project indicates that significant dilution occurs within a relatively short distance from point source emissions within areas that have been designated as being potentially hazardous.

Scanning Electron Microscopy of atmospheric samples reveals that the predominant fibre released into the atmosphere is non-asbestiform, acicular, prismatic fibres of massive riebeckite.

10.3.2 Consultation with DMP

As outlined within Section 3 above, CPM has participated in a series of consultations with DMP on the management of this issue and ensuring the provision of a safe work environment is provided. DMP, as regulator for mine safety, has previously requested CPM to provide evidence to demonstrate the risks associated with fibrous material are being managed appropriately. Submissions made by CPM to the DMP has included copies of CPM's FMMP (Appendix 3) and data and information collected from CPM's ongoing monitoring and investigation of this matter. To date, DMP's Resources Safety Division has not raised any further issues since the submission of this material.

CPM met with DMP Resources Safety Division on 12 April 2017 to discuss the Proposal and CPM's ongoing approach to fibrous material management. DMP confirmed at this the meeting that the FMMP is appropriate for management of fibrous materials risks associated with the Proposal.

10.3.3 Summary

CPM's Sino Iron Ore operations extract and beneficiate magnetite from the banded iron formation of the Joffre Member of the Brockman Iron Formation.

The Joffre contains iron rich sedimentary layers as well as bands of chert and massive (non-asbestiform) riebeckite.

Crushing and milling of massive (non-asbestiform) riebeckite (as a small proportion of the ore processed) releases fibres into the atmosphere.

Scanning Electron Microscopy reveals that the predominant fibre released into the atmosphere is non-asbestiform, acicular, prismatic fibres of massive riebeckite

Trace amounts of actinolite are encountered in transitional areas of dolerite intrusions, which is not processed as ore.

Unlike Dales Gorge Member encountered in central regions of the Hamersley Group, overall percentages of crocidolite observed at Cape Preston (at the periphery of the Group) are considerably lower.

The Dales Gorge Member is not mined for ore. However, for economic as well geotechnical stability reasons, any removal involves quarantine and transport to waste (to be capped).

CPM has taken a conservative approach to fibrous minerals by assessing all fibres as if they were contaminant asbestos. Accordingly, a comprehensive FMMP has been developed and implemented to reduce fibrous minerals emissions through the application of engineering controls and the protection from personal exposures.

An ongoing program of personal, and area monitoring for fibrous minerals.

Dedicated management plans for the closure and rehabilitation of the TSF and WRD (Appendix 3).

10.4 Potential impacts

The following impacts have been identified:

- mining activities have the potential to cause fibrous mineral to become airborne

- inappropriate management of potential asbestiform material (including post-closure storage, and mine pit wall exposures) has the potential to cause fibrous minerals to become airborne.
- Potential for occupational and public health exposures
- Potential long term contamination of land

Public exposure to fibrous minerals is minimised by:

- the isolation nature in terms of distance from populated areas
- security measures that prevents unauthorised access to the lease areas
- separation (including realignment) of public roads from processing and mining areas.

Public exposure to fibrous minerals outside of the lease area is limited to contact with potentially contaminated vehicles, plant and equipment. CPM mitigate these risks by requiring:

- inspections and, if necessary, decontamination of vehicles, plant and equipment leaving designated areas
- a requirement to inspect and, if necessary, decontaminate vehicles, plant and equipment leaving site
- provision of decontamination facilities for both personnel and plant operating in designated areas
- atmospheric monitoring for fibrous minerals at the project and Eramurra Village and the application of additional controls if required.

10.5 Assessment of impacts

10.5.1 Mining and operational activities

As mentioned above, activities with the greatest risk of releasing fibres are related to mining and processing, and to a lesser extent activities at the port and marine operations. The FMMP has been developed by CPM to address these risks thereby ensuring fibrous minerals are appropriately managed on site.

The key measure in minimising risk of exposure to asbestiform minerals is to avoid known occurrences of asbestiform material where possible. Where asbestiform fibrous material is identified that cannot be avoided (transitional areas surrounding dolerite intrusion and Dales Gorge) this material is transported to designated encapsulation cells within WRDs.

As mentioned above, the existing project has a rigorous ongoing occupational hygiene monitoring program to detect fibrous minerals. To assist in protecting the health of employees on-site CPM has implemented a substantial occupational hygiene monitoring program since the commencement of mining operations.

Regular inspections and audits are conducted across site to ensure effectiveness of fibre controls is maintained.

10.5.2 Post-closure

Asbestiform mineral waste that is excavated from the mine (e.g. dolerite intrusions and any Dales Gorge overburden) is contained within designated encapsulation cell within waste rock landforms. The encapsulation cells are designed to include a minimum of 50 m of material along their sides and a 10 m deep capping layer of clean material on top (as shown in Figure 10-3).

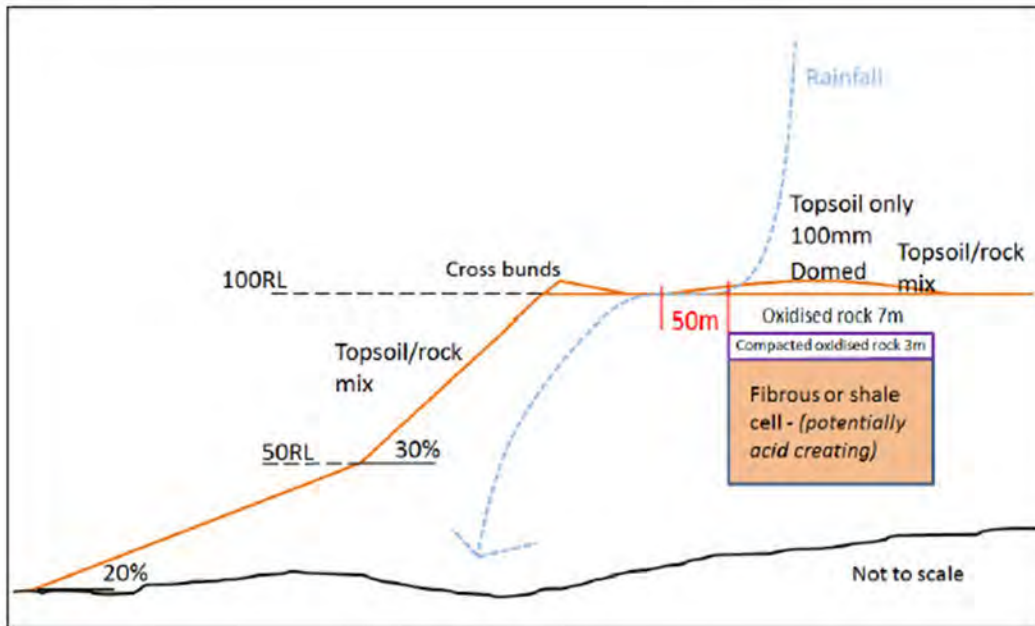


Figure 10-3: Schematic cross-section of encapsulation cell within a waste rock landform

Potential exposure in final pit walls and TSF

The Project's pit design has minimised exposure of Dales Gorge member in the final pit shell. Figure 10-4 presents the areas where the Dales Gorge member will be exposed.

Based on the depth of the pit wall (i.e. ~400 m) it is very unlikely that any asbestiform material would leave the mine pit. The groundwater re-entering the pit void and forming a pit lake is expected to help mitigate the risk of any exposed material becoming airborne. Other management methods such as covering the exposures with clean fill or other material will be assessed to minimise the risk of exposing asbestiform material for long periods. In addition, the TSF will be encapsulated within a layer of clean material. The low erosion potential of the closure landforms following the proposed surface treatment and rehabilitation trials further reduce the risk. For further information related to closure see the Conceptual Mine Closure Plan at Appendix 3.

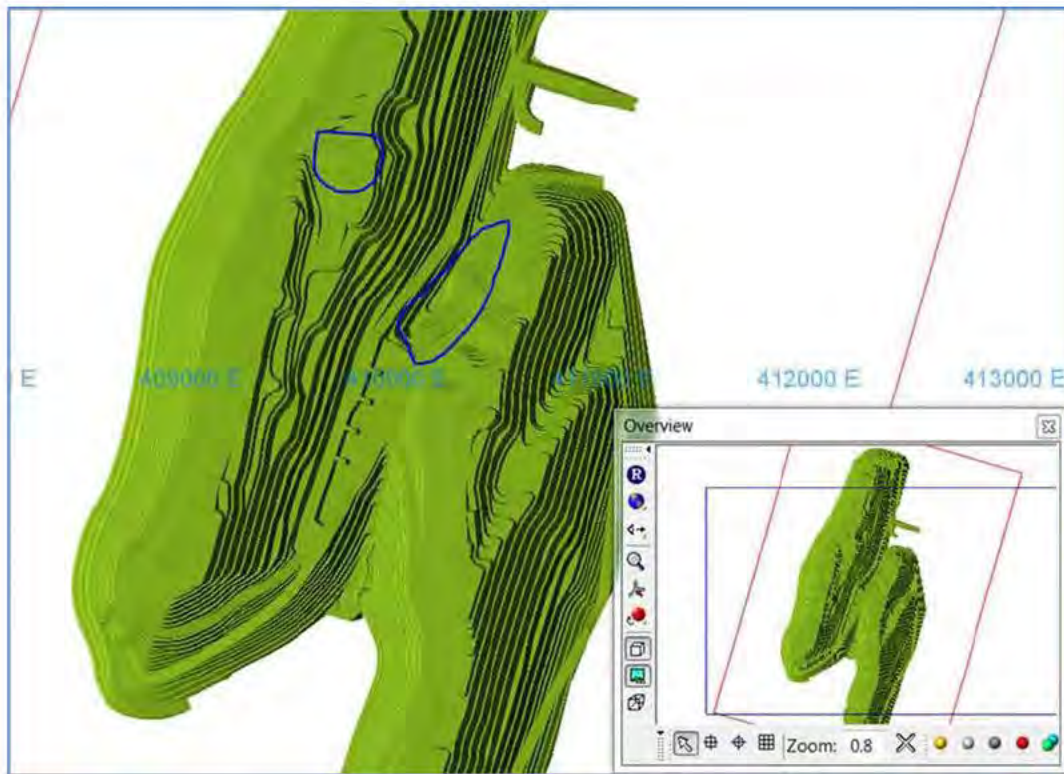


Figure 10-4: Final pit shell and location of potential fibrous material exposure associated with the Dales Gorge member

10.6 Mitigation

CPM's objective for air quality is to minimise impacts through the implementation of the hierarchical structure from the FMMP, as follows:

- prevention of fibre and related dust release as far as is practicable;
- where prevention is not practicable, capture of emissions; if emissions cannot be captured, ensure as far as is practicable, suppressions of emissions when they do occur;
- where prevention of fibre and related dust release is not practicable, prevention of worker exposure through use of other controls as provided for in the FMMP;
- prevention of exposure to the public through use of controls as provided for in the FMMP; and
- prevention of environmental harm.
- Specific actions proposed to achieve those outcomes are: mine planning that minimises the interaction with Dales Gorge material
- disposing of potentially asbestiform containing material in designated encapsulated cell within WRDs
- encapsulation and rehabilitation of TSF areas progressively when and where possible
- a rigorous program of preventing or suppressing fibre/dust release (e.g. by water spraying, misting and fogging, application of binders and surfactants, installation of extraction ventilation, etc.). Prevention and/or suppression methods will be used for drilling and blasting, loading, transfer of ore and waste, crusher operations and conveyor transport of ore, processing operations including management of tailings, stockpile management and transfer of concentrate through to transfer onto export vessels
- conducting workplace inspections and audits to ensure controls are maintained to a required standard.

As mentioned in Section 10.4 the risk for public and occupants of the accommodation village from air quality impacts is minimised by:

- the large separation distance from populated areas
- security measures that prevents unauthorised access to the lease areas
- separation (including realignment) of public roads from processing and mining areas

10.6.1 Occupational health

The presence of fibrous minerals and the potential hazard to human health has resulted in a significant occupational hygiene monitoring program from which evidence based statements of risk can be made and from which a comprehensive management plan has emerged (see Fibrous Minerals Management Plan (FMMP) in Appendix 3). The FMMP has been developed by CPM using DMP's guideline: Management of Fibrous Minerals in the Western Australian Mining Industry.

Key areas within the FMMP that address occupational health risks include:

- mine planning that limits mining of Dales Gorge material
- Dales Gorge and transitional areas surrounding dolerite intrusions encountered are quarantined from processing and transported to encapsulation cells within waste dumps
- the delineation of designated areas where respiratory protection and decontamination is mandated
- provision of in-pit dust control and suppression
- crushing and conveyor transport dust suppression systems
- restricting (and recording) access to designated areas to essential personnel
- fitting HEPA systems to heavy plant and buildings
- decontamination facilities for personnel and equipment
- unprecedented respiratory protection program (including fit testing)
- fibrous minerals training and awareness sessions for all personnel
- ongoing occupational hygiene monitoring for fibrous minerals including assessment of similar exposure groups through representative sampling and ongoing revision of the program as required.

Personal (occupational) exposures to fibrous minerals are well controlled. Atmospheric concentrations of fibrous minerals recorded across the site are generally below the occupational exposure standard. Areas where elevated concentrations may be present (limited to mine pit, processing plant, TSF and parts of port operations) are classified as designated areas where mandatory respiratory protection and decontamination is required.

10.6.2 Public health

The presence of controls that reduce dust and fibre emissions, coupled with the dispersion of emissions with distance from sources ensures that the greater risk from fibrous minerals occurs within designated operational areas. The Eramurra accommodation village is considered a sensitive location where public health standards apply to ensure there are no additional exposures to mine workers as well as ensuring the protection of the non-mining workforce. Area and personal monitoring is regularly carried out at the village; results from 2014-2016 were at or below the DoH guideline limit of 0.01 f/mL with the exception of one result from the Fortescue Village, which is located approximately 25 km south of the mine operations. Anecdotal evidence from the technician who analysed that sample was that the fibres observed were **not an asbestiform mineral**. The monitoring results suggest that the controls implemented and the dispersion of residual emissions with increasing distance from the sources effectively manage the risks from fibrous material emissions.

10.7 Predicted outcome

The ongoing implementation of existing management measures (described above) will ensure the Proposal will not result in any significant impact to terrestrial environmental quality.

**ATTACHMENT 4 – Sino Iron Mine Continuation Proposal – Terrestrial Air
Environmental Quality: Peer Review (Ramboll Environ)**

CITC Pacific Mining Management Pty Ltd
45 St Georges Terrace
Perth, WA, 6000.

Attention: Mr Bruce Watson

**PEER REVIEW
TERRESTRIAL ENVIRONMENTAL QUALITY
SINO MINE CONTINUATION PROPOSAL**

Date 15/04/2017

Ramboll Environ Australia Pty Ltd (Ramboll Environ) was engaged by CITIC Pacific Management Pty Ltd (CPM) to undertake a peer review of the Terrestrial Environmental Quality (TEQ) section of the Sino Iron Continuation Proposal. The review was completed by Mr Brian Bell who is a Principal with Ramboll Environ and has over 35 years' experience in the fields of air quality and environmental impact assessment and management. Mr Bell has previously worked for the Department of Environment and Conservation (now the Department of Environment Regulation [DER]) and has been a consultant for over 25 years working for Dames & Moore/URS and ENVIRON/Ramboll Environ. He has been involved in the preparation of many formal air quality and environmental impact assessments for major mining and industrial projects.

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The document subject to the review is:

- Terrestrial Environmental Quality which is Section 10 of the Sino Iron Mine Continuation Proposal document number SIT16097_01 R0003 Rev 1 (hereinafter the Document).

In reviewing the Document, relevant sections of the following documents were also considered:

- SINO Iron Fibrous Minerals Management Plan, 24 May 2016, Document No. DR030318
- SINO Iron Project Draft Operational Environmental Management Plan, 23 January 2017, Document No. DR029968
- SINO Iron Project Conceptual Closure Plan, January 2017, Document No. DR042921
- SINO Iron Project Dust (Environmental) Management Procedure, June 2016, Document No. DR018861
- SINO Iron Project Dust Operational Management Plan, 15 June 2012, Document No. DR027769

The peer review has also considered the Environmental Protection Authority (EPA) Environmental Factor Guideline (EFG) for TEQ, dated December 2016. The EFG for TEQ specifies that the EPA's objective for this factor is "to maintain the quality of land and soils so that environmental values are protected".

In undertaking this review Ramboll Environ has only focussed on aspects associated with fibrous minerals as specified by CPM. CPM Fibrous Mineral Management Plan (FMMP) defines the various types of fibrous minerals that are associated with the Sino Iron Project (the Project) and the geological formations in which these fibrous minerals are found. The FMMP's purpose is to:

- "identify the risks associated with the fibrous mineral in terms of emission, transmission and exposure
- streamline the framework for the management of fibrous minerals, hazards and risks in terms of control strategies
- establish a program of governance that ensures the goals of the fibrous minerals management plan are achieved and sustained
- ensure compliance with obligations under the Mines Safety and Inspection Regulations 1995 (WA) in relation to contaminant asbestos." (Section 2 of the FMMP).

In a recent meeting with CPM (12 April 2017), the Department of Mines and Petroleum (DMP) (Simon Ridge, Director Resource Safety) confirmed that the DMP:

- was of the view that CPM has implemented a fully functional FMMP;
- is satisfied with the efficiency of this plan based on its assessment of data presented to date; and
- will continue to monitor CPM's implementation of the FMMP to ensure that it remains effective.

The DMP also noted:

- the importance of the mitigation hierarchy with a focus on avoiding Dales Gorge; and
- that CPM's mine plan avoids Dales Gorge and commits to encapsulation of material that has potential to contain fibrous minerals which would help in managing post closure issues.

The TEQ Section 10 of the Sino Iron Continuation Proposal (i.e., the Document) is structured as follows:

- EPA objective
- Policy and guidance
- Receiving environment
- Potential impacts
- Assessment of impacts
- Mitigation
- Predicted outcome

Reviewer's comment: This structure is a clear and logical way of presenting the information associated with fibrous minerals. The EPA's objective for the TEQ factor is presented in the first section of the Document. The second section specifically refers to the EPA's EFG for TEQ and the DMP guideline for the management of fibrous minerals.

The following provides information on the receiving environment (Section 10.3) from the Document and the reviewer's comments:

- A summary of the geology of the Hamersley Group including subsections on fibrous minerals in this group and specifically at the Sino Iron Ore operations. The Dales Gorge Member is identified for its known occurrence of asbestiform Riebeckite (or Crocidolite or "Blue Asbestos") particularly near the centre of the Hamersley Province. It also identifies the risks associated with exposure to fibrous minerals.

Reviewer's comment: The information presented in this section is consistent with information provided in other CPM documents including the FMMP.

- Information on the occupational and public health aspects:
 - With regards to the occupational health aspect, specific reference is made to the FMMP and this plan is well structured and is accepted by the DMP (as noted earlier).
 - With regards to the potential public health impacts, the Document states that the occupational health controls and dilution of emissions will ensure that fibrous minerals are contained within designated areas.

Reviewer's comment: The reviewer does not agree that dilution will ensure that fibrous minerals are contained within the designated areas. Dilution will reduce the concentration of the fibres beyond the designated areas but will not result in containment.

- The environmental controls for the protection of public health.

Reviewer's comment: This section draws on information from the FMMP and many of these management measures are more focussed on occupational health and safety and not on protecting public health.

The reviewer does not consider that this section is appropriately placed in the Document and would be better suited to the mitigation section.

- Consultation with the DMP.

Reviewer's comment: This section should be updated to incorporate the outcomes of the most recent meeting with the DMP which was very supportive of the FMMP.

- Summary which highlights a number of key facts regarding the Sino Iron Ore Operations.

Reviewer's comment: The reviewer considers that the majority of the information in the summary is consistent with information presented in other CPM documents. However, it is also stated in the summary that "The majority of fibrous minerals are not released into the atmosphere but are delivered to the TSF where they are bound in the matrix of the tailings." The reviewer has not identified any information in any of the other documents made available that would support this statement. In any event, the reviewer does not consider that the

statement is meaningful with regards to potential environmental impacts and potentially provides a false sense of security. In general only a small percentage of material (e.g., ore, waste) being moved is actually emitted to the environment and this is often in the form of fugitive emissions for mining operations. That is, in nearly all instances the majority of a material will be received at its intended destination (e.g. ore stockpiles, waste rock dumps, TSF, product stockpile) and it is often the fugitive emissions that can contribute significantly to on-site and off-site impacts. Therefore, while the majority of a material may be delivered to a particular location or facility, this does not mean that there are no emissions of concern from those facilities that need to be mitigated or managed. The reviewer considers that the identified sentence should be deleted from the document.

The potential impacts section of the Document provides a high level overview of what it describes as the potential key impact which is the mobilisation of fibrous minerals to the atmosphere due to mining related activities or through inappropriate management of the asbestiform minerals.

Reviewer's comment: The reviewer does not consider that these are the potential impacts associated with the Sino Iron Project but rather potential emissions that may occur from the Project. The reviewer considers that the potential impacts from the Project in terms of fibrous minerals may include potential impacts on occupational and public health, and potential long term contamination of an area that would make it unsuitable for a future land use. Section 10.4 of the Document should be revised to address the potential impacts that may occur due to the mobilisation of the fibrous minerals.

Mitigation measures are also discussed in this section of the Document and the reviewer believes that it would be more appropriate that these were included in the Mitigation section of the Document.

The assessment of impacts section of the Document is broken into two sub-sections, one covering mining and operational activities and the other post-closure:

- Within the mining and operational activities section, the prime focus in the Document is on the FMMP.

Reviewer's comment: The reviewer considers that the FMMP in combination with other plans and procedures including the Dust (Environmental) Management Procedure, and the Dust Operational Management Plan will mitigate the emissions and result in the management of the emissions to a level where the resulting impacts achieve the required environmental, occupational, and public health outcomes. The reader is also referred to the reviewer's comments on the supplementary air quality document review and the expected need to modify these management plans and procedures as a result of the increased inherent risks to air quality (dust and fibrous minerals) due to fugitive emissions.

The occupational and environmental monitoring programs provide data to demonstrate these outcomes on an ongoing basis and identify any issue that needs to be addressed if elevated concentrations are measured. As outlined in the air quality review, it is expected that these monitoring programs may need to change as a result of the Continuation Proposal.

- The post-closure sub-section of the Document primarily focuses on the encapsulation of material containing asbestiform minerals including material from the Dales Gorge Member. It also discusses the potential exposure of the Dales Gorge Member in the open pit void.

Reviewer's comment: Other aspects presented in the Conceptual Closure Plan such as the low erosion potential of the closure landforms following the proposed surface treatment and rehabilitation trials could be added to the post-closure sub-section in the Document to strengthen it.

The mitigation section of the Document (Section 10.6) presents a brief summary mitigation measures.

Reviewer's comment: The reviewer considers that the mitigation section of the Document would be improved if it followed the hierarchical mitigation structure used within the FMMP. This is also in line with the EPA EFG for the TEQ factor. The FMMP mitigation structure is:

- *prevention of fibre and related dust release as far as is practicable;*
- *where prevention is not practicable, capture of emissions;*
- *if emissions cannot be captured, ensure as far as is practicable, suppressions of emissions when they do occur;*
- *where prevention of fibre and related dust release is not practicable, prevention of worker exposure through use of other controls as provided for in the FMMP;*
- *prevention of exposure to the public through use of controls as provided for in the FMMP; and*
- *prevention of environmental harm.*

It is also recommended that the mitigation measures covered in the earlier sections of the Document be integrated into this section and that it be extended to include closure planning including reference to the trials that are being conducted as outlined in the Conceptual Closure Plan.

The predicted outcome of the Document (Section 10.7) finds that the Project will not result in any significant impact to the TEQ.

Reviewer's comment: The reviewer agrees with the predicted outcome presented in the Document which is that the Sino Iron Project can be managed to ensure that there are no unacceptable impacts to the TEQ resulting from fibrous minerals. However, CPM needs to ensure that it maintains a strong focus on the implementation of the FMMP and other plans and procedures including the Dust (Environmental) Management Procedure, the Dust Operational

Management Plan and the Conceptual Closure Plan to achieve this outcome. The occupational and environmental monitoring programs provide data that can be used to demonstrate these outcomes on an ongoing basis and to identify any issue that needs to be addressed if elevated concentrations are measured.

Reviewer's Finding

The reviewer considers that the EPA's objective for TEQ with regards to fibrous minerals will be achieved as long as CPM continues to maintain its strong focus on the implementation of the FMMP and other plans and procedures including the Dust (Environmental) Management Procedure, the Dust Operational Management Plan and the Conceptual Closure Plan.

The reviewer has recommended some changes to the Document.

Yours sincerely

Ramboll Environ Australia Pty Ltd



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**ATTACHMENT 5 – Sino Iron Mine Continuation Proposal – Air Quality and
Terrestrial Air Environmental Quality Conclusions: Final
Peer Review (Ramboll Environ)**

CITC Pacific Mining Management Pty Ltd
45 St Georges Terrace
Perth, WA, 6000.

Attention: Mr Bruce Watson

**PEER REVIEW - UPDATE
TERRESTRIAL ENVIRONMENTAL QUALITY AND AIR QUALITY
DOCUMENTS - SINO MINE CONTINUATION PROPOSAL**

Date 21/04/2017

On 15th April 2017, Ramboll Environ Australia Pty Ltd (Ramboll Environ) provided CITIC Pacific Management Pty Ltd (CPM) with the following letters relating to its peer review of the following documents:

- Terrestrial Environmental Quality which is Section 10 of the Sino Iron Mine Continuation Proposal document number SIT16097_01 R0003 Rev 1.
- Sino Iron Mine Continuation Proposal. Supplementary Information – Air Quality. Prepared by Strategen Environmental, April 2017.

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Following receipt of these peer review letters CPM has revised the above documents to address the peer reviewer's comments. The revised documents were provided to Ramboll Environ for its further review. This letter provides further comments on the revised documents.

Terrestrial Environmental Quality (TEQ) – Fibrous Minerals

The reviewer has found that the comments from the initial review letter have been addressed. The reviewer's conclusion remains that the EPA's objective for TEQ with regards to fibrous minerals is expected to be met under the Continuation Proposal.

Supplementary Information – Air Quality

The reviewer has found that the majority of the review comments from the initial review letter have been addressed by CPM in the revised document.

The revised Supplementary Air Quality document identifies risks associated with its current operations. The Mine Continuation Proposal will increase these risks with increased materials movement and management, and increased clearing. CPM will rely on the implementation of its management plans (including the Fibrous Minerals Management Plan) and the associated procedures, including continuous improvement of these, to enable the EPA's air quality objective to be met. CPM, through its current operation, has

demonstrated that it is able to manage the air quality risks through these management plans and the associated procedures.

With regards to greenhouse gas, the reviewer notes CPM has not undertaken a reassessment of the Sino Iron Project's greenhouse gas emissions. However, CPM has advised the reviewer that the total greenhouse gas emission from the Sino Iron Project will be below those originally approved primarily due to the installation of a combined cycle gas fired power station. CPM will be determining the greenhouse gas emission intensity later this year under the NGER Safeguard mechanism.

The reviewer's conclusion remains that the EPA's objective for Air Quality is expected to be met under the Continuation Proposal.

Yours sincerely

Ramboll Environ Australia Pty Ltd



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**ATTACHMENT 6 – Sino Iron Mine Continuation Proposal – Supplementary
Flora and Vegetation Information [Strategen
Environmental]**



intelligent outcomes | respected experience

Sino Iron Mine Continuation Proposal

Supplementary Flora and Vegetation information

Prepared for
CITIC Pacific
by Strategen

April 2017

Sino Iron Mine Continuation Proposal

Supplementary Flora and Vegetation information

Strategen is a trading name of
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April 2017

Limitations

Scope of services

This report ("the report") has been prepared by Strategen Environmental Consultants Pty Ltd (Strategen) in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen has also not attempted to determine whether any material matter has been omitted from the data. Strategen will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen. The making of any assumption does not imply that Strategen has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

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.

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1. Introduction

1.1 Background

CITIC Pacific Mining Management Pty Ltd (CPM) manage the iron ore mine and export facilities at Cape Preston, collectively referred to as the Sino Iron Project. On 15 February 2017, CPM referred a proposed expansion of the Sino Iron Project (the Sino Iron Mine Continuation Proposal, the Proposal) to the Environmental Protection Authority (EPA) under s 38 of the *Environmental Protection Act 1986* (the EP Act). The referral was supported by an Environmental Review Document (ERD).

On 7 April 2017, the EPA determined the Proposal would be assessed at an 'Assess – Referral Information' level of assessment. To complete their assessment the EPA requested additional information regarding air quality and vegetation. Specifically, the EPA requested:

- further information to demonstrate that the EPA's objective for Flora and Vegetation can be met, including information on how the Flora and Vegetation surveys meet the EPA's technical guidance or a justification of why this guidance has not been able to be met.

The proposal was also referred to the Commonwealth Department of the Environment and Energy pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* in January 2017. The delegate to the Minister for the Environment and Energy decided that the action was not a controlled action on 29 March 2017.

1.2 EPA guidance

On 13 December 2016, the EPA released the following revised guidelines for flora and vegetation:

- *Environmental Factor Guideline – Flora and Vegetation* (EPA 2016a)
- *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016b).

Prior to the above, the following relevant policies and guidelines applied:

- Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004)
- Position Statement No. 3 *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002).

1.3 Outcome of Peer Review

The ERD included Table 8-1 which provided a summary of environmental studies and survey effort. Table 8-1 of the ERD identified that a substantial amount of survey work has been undertaken to describe and map the flora and vegetation of the Cape Preston area.

To confirm the validity of the survey work a Peer Review of the previous studies was undertaken by Mattiske (2016). The Peer Review (dated 7 December 2016) summarised that:

"The methodologies have been relatively consistent and most authors have tried to align mapping with previous investigations (Table 2). Several of the reports are more comprehensive and the merged interpretation in the more recent documents provides a comprehensive summary; and in particular the Maunsell (2008), Astron 2009 AECOM (2009) reports appear to address many of the issues and provide the most comprehensive summaries on the wider project areas."

Despite some variations in scope and coverage by the different specialists it is apparent that a substantial amount of flora and vegetation studies have been undertaken over a range of seasons (both following the rainfall cyclonic months and the drier months). The specialists involved with the work have had many years of experience in botanical and ecological studies in the Pilbara and therefore this has not been a limitation on the efforts at various times in this project area. The unreliability of seasonal rains in the Pilbara region is an ongoing issue. In this instance any concerns related to the timing are minimized by a few favorable rainfall events prior to several of the assessments (Maunsell 2008; Astron 2009b) and through the experience level of the specialists undertaking the studies at Cape Preston.

The data collection for the flora and vegetation studies was based mainly on the accepted standard of 50m x 50m quadrats. The consistency in interpretation also extended to the data analyses for the more extensive studies in the project area and used either PATN or PRIMER with underlying similarities in some of the analytical techniques.

Although not all areas were assessed in multiple seasons, the broad nature of the plant communities and consistency in mapping approaches enabled the correlation and interpretation of data between survey areas. The consistency of mapping units was used by the different specialists and consequently this improved the alignment of mapping units."

In summary, the Peer Review concluded:

"In relation to the need to meet the requirements of the Environment Protection Authority Guidance Statement 51 (Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia) and Position Statement 3 (Terrestrial Biological Surveys as an Element of Biodiversity Protection) currently a substantial amount of work has been undertaken on the various lease areas and the reports by Astron 2009 and AECOM in 2009 which built on the earlier Maunsell (2003 and 2008) studies in particular bring the majority of the work to date in summaries. As such the suggested refinements in relation to the flora species will improve the clarity and currency of information for the impact assessment. To date the survey effort fulfils the Level 1 needs and in view of the depth of experience of the specialists, the extent of the coverage and with some desktop integration and alignment of the known values on the flora and vegetation into the impact assessment report the coverage should then be accepted as addressing the Level 2 needs of the EPA process for the Cape Preston area."

1.4 Assessment of flora and vegetation in Environmental Review Document

The ERD assessed impacts to Flora and Vegetation using reports prepared prior to the release of the new guidelines. The ERD provided the following introduction to the consideration of impacts to Flora and Vegetation:

The Cape Preston area has been studied in detail since 2003, including nine flora and vegetation surveys (Table 8-1 of the ERD). Mattiske Consulting conducted a peer review of all surveys completed to date to determine the adequacy of work undertaken in relation to current guidelines, summarise survey results and provide advice on any additional work required to meet current guidelines (Mattiske 2016).

The survey work to date covers detailed Level 1 studies (now known as Reconnaissance Surveys), targeted work on species, targeted work on communities, targeted work on groundwater dependent ecosystems and Level 2 studies (now known as Detailed Surveys) for the majority of the Cape Preston area. Mattiske (2016) determined that the level of work completed to date across the broader area was sufficient to meet the requirements of Guidance Statement 51 (EPA 2004) and Position Statement 3 (EPA 2002), due to work completed by Astron (2009a) and AECOM (2009) which built on and integrated the earlier studies from the region. To enable the work to meet current Level 2 survey standards Mattiske (2016) identified the requirement to:

1. Update and refine the species list
2. Identify local conservation significance of vegetation communities.

Based on the advice from Mattiske, the following tasks were undertaken with regard to Item 1 above:

- verified currency of all individual species names using Florabase (WA Herbarium 1998-)
- cross-checked information provided in Table 3 of the Mattiske (2016) advice
- updated species names in cases where names had been superseded
- removed species that have been excluded by the WA Herbarium, where no alternative name is provided by Florabase
- removed species that are considered out of range by the WA Herbarium, where no alternative name is provided by Florabase
- replaced misapplied species names with a genus only, where a species name has been deemed to have been misapplied against multiple species, e.g. *Mukia maderaspatana* / *Cucumis maderaspatanus* has been deemed to have been misapplied against *Cucumis argenteus*, *C. althaeoides* and *C. variabilis*, therefore has been replaced with *Cucumis* sp.
- combined records where multiple 'species affinis' (aff.) were recorded. This notation indicates a very close affinity with the species named, and could potentially be recognised as a separate species. Species recorded in the reports consolidated above that have this notation are not currently recognised as separate species by the WA Herbarium; as such, for the purpose of this document, they have been included with the confirmed species, where present, e.g. *Tephrosia* aff. *supina* is included with *Tephrosia supina*
- combined instances where multiple 'confer' (cf.) or '?' notations were recorded. These notations indicate that the species name provided the best possible identification given the available material. For the purpose of this document, species with these notations have been included with the confirmed species, e.g. *Senna ?notabilis* included with *Senna notabilis*, *Rhynchosia* cf. *minima* included with *Rhynchosia minima*
- prepared an updated species list (provided in Appendix 1 of ERD).

With regard to Item 2 above, the following task was completed:

- reviewed local conservation status of vegetation types in consolidated flora and vegetation reports (Table 8-3 of the ERD).

The results of the additional work undertaken to meet the Level 2 survey requirements are provided in Appendix 1 of the ERD and Table 8-3 of the ERD (conservation status of vegetation units).

On the basis of undertaking the above work to meet the requirements of the Peer Review, it is considered that the requirements of a Level 2 survey have been met.

1.5 Flora and Vegetation reports assessed in ERD

Table 8-1 of the ERD (provided below) identified that a substantial amount of survey work has been undertaken to describe and map the flora and vegetation of the Cape Preston area. As identified in the Peer Review of the surveys undertaken, the main surveys are Astron 2009 and AECOM 2009 (which built on the earlier Maunsell surveys [2003 and 2008]).

Table 8-1 of the ERD: Summary of environmental studies and survey effort

Author	Survey/ investigations name	Study area, type and timing	Study standard/guidance and limitations
Recently completed work			
Mattiske 2016	<i>Review of Flora and Vegetation Reports for the Mineralogy project at Cape Preston</i>	Peer Review of previously completed work	NA.
Previously completed work			
Maunsell AECOM 2003	<i>Cape Preston Iron Ore Development. Seasonal Biological Survey – Threatened Flora</i>	- mine footprint - threatened flora survey - June and July 2003	Seasonal conditions led to some limitations in assessment of flora. Also some areas supported degraded vegetation. In part overcome by July assessment in targeted areas.
Astron Environmental Services 2007a	<i>General Purpose Leases G08/52 and G08/53 Additional Vegetation Survey and Mapping</i>	- leases G08/52 and G08/53 - flora and vegetation survey - June 2007	Some limitations on flora coverage due to drier seasonal rainfall conditions prior to the June 2007 assessment.
Mattiske Consulting Pty Ltd 2007a	<i>Flora and Vegetation Survey of Cape Preston Potential Campsites and Airstrips</i>	- flora and vegetation survey - February 2007	Some limitations due to seasonal conditions. Coverage of localized areas only (as requested).
Mattiske Consulting Pty Ltd 2007b	<i>Comparison of Flora and Vegetation Values on Preferred and Original Campsites Cape Preston</i>	February 2007	Some limitations due to seasonal conditions. Coverage of localized areas only (as requested).
Maunsell AECOM 2008	<i>Cape Preston Mining Estate Consolidated Vegetation, Flora and Fauna Assessment</i>	consolidation of surveys by HGM (2001), Maunsell (2003), Maunsell AECOM (2006), Mattiske (2007a), Astron (2007a)	Desktop study only.
Astron Environmental Services 2008a	<i>Sino Iron Project – Cape Preston. Mapping and Surveying of Groundwater Dependent Ecosystems</i>	- leases E08/1414, E08/660, E08/1451, E08/1331, and some adjoining areas to the Northeast on Mardie Station - groundwater-dependent vegetation survey - September – October 2008	Groundwater-dependent vegetation only; limitations due to drier seasonal conditions prior to assessment.

Author	Survey/ investigations name	Study area, type and timing	Study standard/guidance and limitations
AECOM 2009	<i>Balmoral North and Balmoral South Stage 2. Flora and Vegetation Assessment</i>	- desktop, reconnaissance and detailed field survey. Flora and vegetation on Balmoral North and South. Some re-assessment of selected 2000 and 2006 quadrats - August – September 2008	Limitations due to timing of assessments in drier months.
Astron Environmental Services 2009a	<i>Mineralogy Expansion Proposal Desktop Flora and Vegetation Study.</i>	desktop extrapolation of unsurveyed areas based on previous surveys of HGM (2001), Maunsell AECOM (2008), AECOM, (2009), Astron (2007a, 2007b, 2007c), Astron, (2008a, 2008b, 2008c)	Some limitations associated with no field studies and difficulty of covering flora and vegetation values without ground-truthing.
Astron Environmental Services 2009b	<i>Waste Rock Dump and Tailings Expansion Areas Vegetation, Flora and Fauna Survey</i>	- flora and vegetation survey - WRD expansion area and TSF expansion area - May 2009	- Level 2 survey - some limitations associated with seasonal conditions; although good rains in January and early February 2009 the months leading up to the assessment in May 2009 were drier.

2. Review of previous surveys

As identified in Section 1.5, the main surveys are Astron 2009 and AECOM 2009 (which built on the earlier Maunsell surveys [2003 and 2008]). The Maunsell 2008 report identifies that the report is based on previously unsurveyed areas as well as reviewing results gathered during the 2000 survey in the overlapping areas. This survey summarised and consolidated the work of:

- Austeel, *Biological Survey Phase 1* (Biota Environmental and MF Trudgen and Associates, 2001, also referred to as HGM 2001)
- Cape Preston Iron Ore Development, *Seasonal Biological Survey – Threatened Flora* (Maunsell AECOM Australia Pty Ltd, 2003)
- *Balmoral South Environmental Impact Assessment, Flora and Fauna Survey, Balmoral South* (Maunsell AECOM Australia Pty Ltd, 2006)
- *Flora and Vegetation Survey of Cape Preston Potential Campsites and Airstrips* (Mattiske Consulting, 2007)
- *General Purpose Leases G 08/52 and G08/53 Additional Vegetation Survey and Mapping* (Astron Environmental Services, 2007).

The Astron 2009, AECOM 2009 and Maunsell 2008 surveys have been assessed in detail against the new *EPA Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016b) in Table 1. In assessing these surveys against this guideline this report meets the EPA request for further information.

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Table 1: Assessment of key surveys against EPA survey guidelines

Guidance reference		Guidance requirement	Astron 2009	AECOM 2009	Maunsell 2008	Assessment of surveys
Title of survey			Waste Rock Dump and Tailings Expansion Areas Vegetation, Flora and Fauna Survey.	Balmoral North and Balmoral South Stage 2 Flora and Vegetation Assessment.	Cape Preston Mining Estate Consolidated Vegetation, Flora and Fauna Assessment.	
2.0 Preparation		- Flora and vegetation surveys should be coordinated and led by botanists with experience in systematic sampling and analysis methods - The botanist leading the survey should have at least five years' experience in botanical survey in the bioregion in which the survey is to be conducted.	Section 3.1 states: "The flora and vegetation field survey was undertaken in accordance with a Level 2 survey as specified in the <i>Environmental Protection Authority's (EPA) Guidance Statement No. 51</i> (EPA, 2004) and <i>EPA Position Statement No. 3</i> (EPA, 2002). Two qualified Astron botanists, Julia Mattner and Linda Vaughan, conducted the flora and vegetation survey."	Section 3.2 states: "Experienced AECOM Botanists Gaby Martinez and Lisa Chappell, assisted by graduate Environmental Scientist Alexandra Sleep, conducted a Level 2 Flora and Vegetation survey between 26 August 2008 and 4 September 2008 and then again from 9 September 2008 to 10 September 2008."	This report reviewed results gathered from previous surveys and included undertaking surveys in the previously unsurveyed areas. The earlier work was conducted by M.E. Trudgen and Michi Maier. The additional survey work was undertaken by experienced AECOM Botanists, Gaby Martinez and Lisa Chappell. In addition, in December 2007 a peer review stated "It was noted from the peer review that the survey effort and timing of flora surveys carried out in the project area has been extensive and comprehensive and the flora work conducted for the project exceeds many others with similar impacts."	Surveys have all been completed by highly experience personnel. The surveys have all met this requirement.
3.0 Desktop		A desktop study should be undertaken before making a decision on an appropriate survey type and the information should be used to provide background information for the field survey and subsequent reporting.	Section 1.3 states: "The scope and objectives of the flora and vegetation survey is as follows: Verify the accuracy of the desktop study" The report considered the finding of previous surveys (Halpern Glick Maunsell, 2001; Mattiske, 2007; Maunsell AECOM, 2009; Astron, 2008).	Section 3.1. States: "A literature review of available information documenting the flora and vegetation of the project area and the Pilbara region was conducted prior to the commencement of each field investigation. This review concentrated primarily on the original Biological Survey of the Austeel project area (HGM, 2001). A search of the Department of Environment and Conservation's (DECs) Declared Rare and Priority Flora database was undertaken to identify flora of conservation significance that could potentially occur in the project area. The database search was conducted over an area that encompassed the Balmoral North and Balmoral South Stage 2 survey. The following databases were interrogated: - DEC Threatened Flora Database; - Western Australian Herbarium records; and - DEC Declared Rare Flora and Priority Flora List. A search of the DEC Threatened and Priority Ecological Communities database was also conducted for the project area."	Section 3.1.1 states: "A literature review of available information documenting the flora and vegetation of the project area and the Pilbara region was conducted prior to the commencement of each field investigation. This review concentrated primarily on the original Biological Survey of the Austeel project area (HGM, 2001)."	The surveys have been built on existing survey reports, with each report referencing previous reports. The surveys have all met this requirement.
4.0 Survey	4.3 Detailed survey	- A detailed survey requires comprehensive survey design. Survey design should pay particular consideration to optimal survey timing for the botanical province (Section 6.4), disturbance events that may affect survey results (such as fire) and supplementary survey requirements - Survey effort should include multiple quadrats located at representative points throughout each preliminary vegetation type.	Section 3.3.2 states: "Vegetation types were tentatively delineated on high resolution aerial photographs. These preliminary units were refined during the field survey. During the survey, up to five quadrats (50 m by 50 m, or equivalent 2500 m ² rectangular plots) were installed in each vegetation type. The information recorded for each quadrat included: - location (easting and northing, Datum MGA, Zone 50), - habitat, - date of recording (indicating seasonal conditions), - soil (texture, colour, surface mantle if present), - vegetation description (Table 7), - vegetation condition rating (Table 8), - fire history (estimate of time since last fire), - additional notes, and - species list with all terrestrial flora (except mosses)."	Section 3.2 states: "The broad scale mapping involved defining vegetation community types by recording accurate information at various locations. Where marked changes in species composition occurred, all flora species encountered were identified and recorded. These proportions were then used to describe the vegetation communities, which could then be delineated on aerial photography for extrapolation of distribution. Areas that were of the same visual appearance and within similar positions in the landscape were interpreted to be the same community. The extent of newly mapped vegetation communities were manually delineated onto electronic aerial photography of the project area, using a Geographic Information System (Arc GIS). Each vegetation community was quantitatively assessed using permanent 50m x 50m quadrats. Each quadrat was established in a north south orientation. At the north-west corner of each quadrat, GPS locations and quadrat reference photos were taken. In vegetation communities where establishment of 50m x 50m quadrats was not possible, such as riverine communities, 10m x 50m (or similar) quadrats were established, where the 50m length runs parallel with the community or landform, regardless	Section 3.1.2 states: "Collectively, a total of 155 quadrats were established and recorded across the project area. The locations of the detailed recording sites were chosen to represent the major vegetation types occurring within the project area. The majority of sites were concentrated in areas proposed for development, whilst still sampling a representative suite of vegetation types. Detailed assessment of the flora and vegetation was carried out within permanent vegetation quadrats established in a range of locations and within a range of vegetation communities, representative of the floral composition of the project area. Quadrats of 50m x 50m were established, which is in line with the recommended dimensions for Pilbara vegetation which has relatively low diversity.	Surveys have all involved consistent survey techniques (50 x 50 m quadrats), have recorded substantial amount of data, considered timing of surveys and were undertaken in representative vegetation types. The surveys have all met this requirement.

Guidance reference	Guidance requirement		Astron 2009	AECOM 2009	Maunsell 2008	Assessment of surveys
				of orientation. All flora species within the quadrats were recorded. A thorough site walkover was conducted in addition to each quadrat, to record additional species occurring within the vegetation community that may not have been recorded within the quadrat. During the 2008 survey, 53 vegetation quadrats were established. The majority of the sampling effort focused on Area 1 – GO800053, Area 2 – M0800118 to M0800122, Area 3 – E0801023of the three Balmoral North and Balmoral South Stage 2 project areas. The quadrat samples consisted of: • 33 quadrats within the Balmoral North and Balmoral South Stage 2 Project Area; • nine quadrats within the existing Balmoral South project area to verify previous vegetation surveys; • six quadrats within the CPMM Offset area; and • five Regional quadrats (Figure 5). Selected quadrats surveyed during 2000 and 2006 were revisited during the 2008 assessment. This will be used to provide comparison between surveys conducted at different times of the year for the same location. Standardised data sheets were used to ensure consistent data records for the following: • location; • flora species; • dominance of each species; • average height of each species; • projected foliage cover; • soil type and soil colour; • topography; and • vegetation condition."	Information was collected systematically using standardised data sheets, ensuring accurate and consistent data records. The following records were made at each location: • quadrat number; • vegetation community or quadrat location, based on broad scale mapping; • GPS co-ordinates of the north-west corner peg; • all flora species, • dominance of each species; • average height of each species; • soil type and colour; • outcropping rocks and their type; • topography; • percentage litter cover; • percentage bare ground; • degree of disturbance/weed invasion; and • type of disturbance, if other than weed invasion (e.g. cattle, erosion, etc.)."	
5.0 Sampling	• A combination of systematic and informal sampling techniques such as quadrats, transects, traverses and opportunistic sampling can be used for targeted and detailed surveys.		Refer above: quadrats were used with opportunistic recordings of species noted in Appendix B.	Refer above: quadrats were used with opportunistic recordings of species noted in Appendix C.	Refer above: quadrats were used with opportunistic recordings of species noted in Appendix B.	A combination of sampling techniques were applied, including the use of quadrats in all surveys. The surveys have all met this requirement.
	5.6 Vegetation condition	• Vegetation condition should be mapped across a site using the scales outlined in Trudgen (1988) for the Eremaean Province.	Section 3.3.2 states: "The vegetation condition rating follows Trudgen (1988)."	Section 3.2 states: "The condition of each vegetation community was assessed. The categories used to determine vegetation condition consisted of a combination of methods developed by Keighery (1994) and the Braun – Blanquet Scale (Mueller – Dombois and Ellenberg, 1974)." The vegetation scale uses specified percentage weed cover (i.e. excellent condition has a 1 – 5% weed cover) in consideration of the pastoral use of the area.	Section 3.1.2 states: "The condition of each vegetation community was assessed. The categories used to determine vegetation condition consisted of a combination of methods developed by Keighery (1994) and the Braun – Blanquet Scale (Mueller – Dombois and Ellenberg, 1974)." The vegetation scale uses specified percentage weed cover (i.e. excellent condition has a 1 – 5% weed cover) in consideration of the pastoral use of the area.	The Astron survey used the Trudgen scale whereas the other surveys used the Keighery (1994) and the Braun – Blanquet Scale (Mueller – Dombois and Ellenberg, 1974). However, overall the results are still similar, considering the pastoral use of the area.
6.0 Survey	6.1 Survey area	• The area surveyed should be sufficient to provide adequate information to assess direct and indirect impacts.	The area of the surveys were sufficient to assess the impacts of the Project.	The area of the surveys were sufficient to assess the impacts of the Project.	The area of the surveys were sufficient to assess the impacts of the Project.	The surveys have provided sufficient data upon which to base an assessment. The surveys have all met this requirement.
	6.2 Survey effort	• Quadrat sampling is necessary for a detailed survey. The number of quadrats required will be dependent on the diversity of vegetation units present, heterogeneity within these vegetation units, the size of the vegetation units mapped and the size of the survey area. A minimum of three quadrats should be sampled in each vegetation unit.	Refer above: during the survey up to five quadrats (50 x 50 m, or equivalent 2500 m ² rectangular plots) were installed in each vegetation type.	Refer above: each vegetation community was quantitatively assessed using permanent 50x 50 m quadrats. In vegetation communities where establishment of 50 x 50 m quadrats was not possible (such as riverine communities), 10 x 50 m (or similar) quadrats were established, with the 50 m length running parallel with the community or landform, irrespective of orientation.	Refer above: during the survey up to five quadrats (50 x 50 m) were established. A total of 155 quadrats were established and recorded across the project area.	The survey effort for all surveys meet the requirements.

Guidance reference		Guidance requirement	Astron 2009	AECOM 2009	Maunsell 2008	Assessment of surveys
	6.3 Site selection	In a detailed survey, sampling sites should be placed at representative locations throughout the survey area considering landform, geology, elevation, slope, aspect, surface or groundwater expression, and soil type, as well as structure, composition and condition of vegetation.	Refer above: environmental elements were considered in placing quadrats and details were recorded for each site.	Refer above: environmental elements were considered in placing quadrats and details were recorded for each site.	Refer above: environmental elements were considered in placing quadrats and details were recorded for each site.	The surveys have all met this requirement.
	6.4 Survey timing	Optimal survey timing may vary from year to year according to the occurrence of major 'break of season' rainfall events in the Eremaean Provinces.	The flora and vegetation survey was conducted from 12 - 18 May 2009, while the fauna survey was undertaken from 19 - 23 May 2009. Rainfall recorded at Mardie (the nearest long-term weather station) during the 12 months prior to the survey totalled 311 mm, compared to the long-term average of 272 mm (Figure 3). Significant rainfall (255 mm) was received in January and early February 2009; however, little rain was received in the three months prior to the survey. Therefore, the conditions reflected the beginning of the dry season and were sub-optimal for identifying annual grasses, herbs and short-lived perennials. The dry conditions also reduced the quality of specimens for identification.	Section 4.0 states: "The Level 2 Flora and Vegetation Assessment was conducted during late August and early September 2008. For the Pilbara region this time of the year represents suitable timing for the assessment of perennial species and also coincides with spring flowering of many local species, including important grasses. However, the timing does not represent the "main flowering season" and proliferation of most annual and ephemeral species in the region that occurs usually 4 to 6 weeks following cyclonic rainfall (post-wet season), optimally during April and May (Stephen van Leeuwin, <i>pers. comm.</i> , 2008). The timing of only a single sampling event during August and September is likely to have resulted in some annual and ephemeral taxa not being recorded."	Section 3.1.2 states: "The field survey within the project area was conducted immediately after the peak rainfall season (July). This is considered to be the optimal time for flowering and for detecting the presence of annual and ephemeral species within the Pilbara."	The Peer review identified that: "a substantial amount of flora and vegetation studies have been undertaken over a range of seasons (both following the rainfall cyclonic months and the drier months). The specialists involved with the work have had many years of experience in botanical and ecological studies in the Pilbara and therefore this has not been a limitation on the efforts at various times in this project area. The unreliability of seasonal rains in the Pilbara region is an ongoing issue. In this instance any concerns related to the timing are minimized by a few favorable rainfall events prior to several of the assessments (Maunsell 2008; Astron 2009b) and through the experience level of the specialists undertaking the studies at Cape Preston."
	6.5 Flora population census	Detailed counts and an understanding of area of occupancy of significant flora are generally required; however estimates (using appropriate techniques) may be sufficient for large or widespread populations.	Appendix B provides a species cover for all species recorded in the quadrats. No Declared Rare Flora, or Priority Flora were recorded during the survey.	Appendix C provides a species cover for all species recorded in the quadrats. No Declared Rare Flora, or Priority Flora were recorded during the survey.	Appendix D provides a summary of Vascular Flora Species Recorded within the Cape Preston Iron Ore Project Area – 2000 to 2007.	The surveys have all met this requirement.
7.0 Flora	7.1 Collection and identification of specimens	Identification of specimens should be undertaken using taxonomic keys (published in books, journals and CDs), comparison with herbarium specimens and consultation with taxonomic experts.	Section 3.4 states: "Common species which were known to the botanist were identified in the field. Specimens of other species were collected, pressed in the field and assigned a unique collection number to facilitate tracking of data. Voucher specimens were subsequently identified by keying out, reference to appropriate publications, use of reference collections and comparison to the collections held at the Western Australian Herbarium. Most specimens were identified by Julia Mattner and Jenifer Alford of Astron Environmental Services; and Malcolm Trudgen of M.E. Trudgen and Associates. Nomenclature was checked against current listing of scientific names recognised by the Western Australian Herbarium and updated as necessary. Environmental and floristic data for each vegetation plot were entered into a data base, from which a comprehensive species list was generated, and numbers of taxa per genus and family were calculated."	Section 3.2 states: "Species that were unidentifiable in the field were systematically collected, pressed, dried and fumigated in accordance with the requirements of the Western Australian Herbarium. The plant species were then identified and compared with pressed specimens and nomenclature of the species recorded follows protocols of the West Australian Herbarium."	Section 6.1.1 states: "Within the entire project area a total of 500 vascular flora species, from 64 families and 196 genera were recorded. This total includes 482 (96.4%) native species and 18 (3.6%) introduced (weed) or non-endemic species" None of the species recorded during the flora surveys conducted between 2000 and 2007 were found to be exhibiting a range extension from recorded occurrences, as documented by the WA State Herbarium. The following Priority flora were recorded: <i>Goodenia</i> sp. East Pilbara (aA Mitchell PRP 727) Priority 1 <i>Phyllanthus aridus</i> Priority 3 <i>Goodenia pascua</i> Priority 3. No DRF were recorded.	The surveys have all met this requirement.
	7.2 Vouchering	The following should be vouchered in all surveys: - specimens of new populations of threatened and priority flora; - specimens of key species in new occurrences of TECs and PECs; - specimens that appear to represent new species or that have atypical characteristics; and, - specimens of bioregional range extensions, including introduced (weed) species.	Refer above regarding vouchering. No Declared Rare Flora, or Priority Flora were recorded during the survey. No TECs or PECs were recorded.	Refer above regarding vouchering. No Declared Rare Flora, or Priority Flora were recorded during the survey. No TECs or PECs were recorded.	WA State Herbarium procedures were followed.	The surveys have all met this requirement.
	7.3 New species	The Western Australian Herbarium should be consulted on all specimens considered to have potential to be new species or anomalous flora specimens.	No new species were recorded.	No new species were recorded.	No new species were recorded.	The surveys have all met this requirement.

Guidance reference		Guidance requirement	Astron 2009	AECOM 2009	Maunsell 2008	Assessment of surveys
8.0 Vegetation		The aim of vegetation classification in EIA is to identify and describe the vegetation units present within a survey area, identify the local or regional significance of the identified units and to provide sufficient information to enable analysis of the significance of impacts.	Section 4.1.1 states: "Based on habitat and floristic composition, 19 vegetation types derived from four land systems were delineated in the survey area."	Section 5.2 states: "A total of 40 vegetation communities were recorded during the 2008 Flora and Vegetation Assessment. The vegetation communities were described primarily based on floristic composition and structure, regardless of Land System Unit."	Section 6.2 states: "A collective total of 80 distinct vegetation communities were described and mapped within the project area. These communities included but are not limited to; hummock and tussock grasslands, annual herblands on cracking clays, <i>Acacia</i> shrublands over hummock grasslands, tall <i>Acacia</i> shrublands and low <i>Corymbia</i> woodlands over <i>Acacia</i> shrublands."	The surveys have all met this requirement.
9.0 Mapping		The results of a survey should be mapped to present information such as survey effort, distribution of vegetation units, significant vegetation and populations of significant flora in the survey area and provide complementary information to determine the significance of impact.	Vegetation mapping is included in Appendix A.	Vegetation mapping is included in Section 5.2.	Vegetation mapping is included in Appendix E.	The surveys have all met this requirement.
10.0 Reporting	10.1 Introduction	The introduction should contain a clear statement of the objectives of the survey, the proposal and the area (hectares) of survey.	Requirements are all specified in Section 1.	Requirements are all specified in Section 1.	Requirements are all specified in Section 1.	The surveys have all met this requirement.
	10.2 Methods	All reports should contain a section outlining the scope of the survey, the methods used and limitations of the survey	Requirements are all specified in Section 3.	Requirements are all specified in Section 3.	Requirements are all specified in Section 3.	The surveys have all met this requirement.
	10.3 Results	Survey results should be presented in text and tabular format summarising relevant flora and vegetation values within the survey area.	Requirements are all specified in Section 4.	Requirements are all specified in Section 5.	Requirements are all specified in Section 6.	The surveys have all met this requirement.
	10.4 Discussion	A discussion should be provided on the values and significance of flora and vegetation identified within the survey area at a local and regional context.	Requirements are all specified in Section 5.	Requirements are all specified in Section 6.	Requirements are all specified in Section 7.	The surveys have all met this requirement.
	10.5 Conclusions	The survey report should conclude with a summary of the findings of the survey and any recommendations.	Requirements are all specified in Section 8.1.	Requirements are all specified in Section 7.	Requirements are all specified in Section 7.3.	The surveys have all met this requirement.
	10.6 Appendices	Appendices should include: - a complete list of all the species recorded during the survey grouped by family; - a summary of database search results (if not already included in the report); - a clear description of each sampling site with flora recorded, allocated vegetation unit, location - details (GPS waypoints with datum), site photographs and any other relevant information; - a matrix of all species recorded during the survey by either vegetation type (reconnaissance, targeted and detailed survey) and vegetation type by quadrat (detailed survey); and - any other information relevant to the survey.	Appendices included are as follows: - Appendix A Vegetation Maps - Appendix B Descriptions of Vegetation Types - Appendix C Plates of Vegetation Types - Appendix D Records of Threatened Flora held at the Perth Herbarium - Appendix E Vascular Flora Species List	Appendices included are as follows: - Appendix A Systematic Vascular Flora Species List - Appendix B Flora Species Recorded to Occur within Individual Vegetation Communities - Appendix C Individual Quadrat Data - Appendix D Recommended Department of Agriculture and Food Control measures for <i>*Prosopis</i> spp. (Mesquite) and <i>*Datura leichhardtii</i> (Native thornapple) - Appendix E Current Florabase distribution for species exhibiting a Range Extension - Appendix F Cape Preston Mining Precinct, Balmoral South and Regional Quadrat species presence comparison.	Appendices included are as follows: - Appendix A: PATN Analysis Report - Appendix B: Individual Quadrat data used for PATN Analysis - Appendix C: Review of Survey Effort at Cape Preston - Appendix D: Summary of Vascular Flora Species Recorded within the Cape Preston Iron Ore Project Area – 2000 to 2007 - Appendix E: Vegetation Community Maps - Appendix F: DEC and EPBC Database Search Enquiry - Appendix G: Summary of Vegetation Community Areas within the Project Area - Appendix H: 2006 Fauna Survey Report - Appendix I: Recommended Weed Control Methods - Appendix J: Targeted Fauna Desktop Assessment.	The surveys have all met this requirement.

3. Conclusion

As identified in Table 1, the key surveys have all met the requirements of the Detailed Survey in accordance with *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016b). This is consistent with the advice of the Peer Review which identified that combined with the additional work (that was completed and contained in Appendix 1 of the ERD), the cumulative effort of the surveys would meet a Level 2 survey under the previous guideline.

The assessment of impacts included in the ERD was based on substantial survey data and determined that there would be no significant impacts to Flora and Vegetation values.

In addition, the level of survey was considered suitable to support a non-controlled action decision pursuant to the *Environment Protection and Biodiversity Conservation Act 1999*.

4. References

- AECOM 2009, *Balmoral North and Balmoral South Stage 2 Flora and Vegetation Assessment*.
- Astron 2009, *Waste Rock Dump and Tailings Expansion Areas Vegetation, Flora and Fauna Survey*.
- Astron Environmental Services, 2007, *General Purpose Leases G 08/52 and G08/53 Additional Vegetation Survey and Mapping*.
- Biota Environmental and MF Trudgen and Associates, 2001, *Austeel, Biological Survey Phase 1* (also referred to as HGM 2001)
- Environmental Protection Authority 2002, *Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection*.
- Environmental Protection Authority 2004, *Guidance Statement No. 51 Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*.
- Environmental Protection Authority 2016a, *Environmental Factor Guideline – Flora and Vegetation*.
- Environmental Protection Authority 2016b, *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*.
- Mattiske 2016, *Review of Flora and Vegetation Reports for the Mineralogy project at Cape Preston*.
- Mattiske Consulting, 2007, *Flora and Vegetation Survey of Cape Preston Potential Campsites and Airstrips*.
- Maunsell 2008, *Cape Preston Mining Estate Consolidated Vegetation, Flora and Fauna Assessment*.
- Maunsell AECOM Australia Pty Ltd, 2003, *Cape Preston Iron Ore Development, Seasonal Biological Survey – Threatened Flora*.
- Maunsell AECOM Australia Pty Ltd, 2006, *Balmoral South Environmental Impact Assessment, Flora and Fauna Survey, Balmoral South*.

**ATTACHMENT 7 – Consultation with Department of Mines & Petroleum and
Department of Health**

From: RIDGE, Simon [<mailto:Simon.RIDGE@dmp.wa.gov.au>]
Sent: Wednesday, 12 April 2017 11:56 AM
To: Damien Mcalinden
Cc: GRIFFIN, Tim
Subject: RE: CITIC Pacific - Mine Continuation Proposal

Hi Damien

This is a true and correct outline of our deliberations.

Regards

Simon Ridge | Executive Director Resources Safety | Resources Safety

Department of Mines and Petroleum

Tel: +61 8 9358 8143 | **Mob:** 0401 802 649 | simon.ridge@dmp.wa.gov.au
www.dmp.wa.gov.au

From: Damien Mcalinden [<mailto:damien.mcalinden@citicpacificmining.com>]
Sent: Wednesday, 12 April 2017 11:37 AM
To: RIDGE, Simon
Cc: Bruce Watson; Mat Brook
Subject: CITIC Pacific - Mine Continuation Proposal

Simon,

Thanks again for making the time to meet today.

To ensure that we don't misrepresent your closing comments, which we would like to quote in our submission to EPA, I thought it appropriate to bounce our interpretation off yourself. If you could confirm our interpretation is acceptable or not we would be very grateful. Our interpretation follows.

DMP confirmed that it:

- *was of the view that CPM has implemented a fully functional Fibrous Minerals Management Plan (FMMP);*
- *based on its assessment of data presented to date is satisfied with the efficiency of this plan; and*
- *will continue to monitor CPM's implementation of the FMMP to ensure that it remains effective.*

DMP noted:

- *importance of the mitigation hierarchy with a focus on avoiding Dales Gorge;*
- *that CPM's MCP avoids Dales Gorge and commits to encapsulation of material that has potential to contain fibrous minerals which would help in managing post closure issues.*

Thanks again for your time on this matter.

Warm regards

Damien McAlinden | Consultant
CITIC Pacific Mining | Level 8 | 45 St Georges Terrace | PO Box 2732 Perth WA 6000
M [REDACTED] | **E** damien.mcalinden@citicpacificmining.com

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From: Otness, Pierina <Pierina.Otness@health.wa.gov.au>
Sent: Thursday, 13 April 2017 12:43 PM
To: Damien Mcalinden
Cc: Darren Walsh; Bruce Watson; Dodds, Jim
Subject: RE: CITIC Pacific - Mine Continuation Proposal

Thank you Damien

I can confirm the items in your email below reflect the outcomes from the meeting.

Regards

Pierina Otness
Snr Scientific Officer
Environmental Health Directorate

From: Damien Mcalinden [damien.mcalinden@citicpacificmining.com]
Sent: Thursday, 13 April 2017 12:01 PM
To: Otness, Pierina
Cc: Darren Walsh; Bruce Watson; Dodds, Jim
Subject: CITIC Pacific - Mine Continuation Proposal

Hi Pierina

Thanks again for making the time to review the MCP referral to EPA and to meet yesterday at such short notice. We are very grateful for your and Lindy's time.

To ensure that we don't misrepresent DoH's position, which we would like to quote in our submission to EPA, we would be grateful if you could confirm our interpretation of the key outcomes from our meeting. Our interpretation follows:

CPM presented the MCP and information within the attached presentation.

DoH response:

- Satisfied with CPM's conservative approach to monitoring and managing fibrous minerals
- Satisfied with the mine continuation proposal presented
- Although not mandatory, suggested that CPM consider the following:
 - o health surveillance of workforce feeding into research by independent third party
 - o further background air sampling using lower limits of detection (in accordance with international accepted methodology using electron microscopy)

Note: we will remove reference to use of 0.01f/mL as "a standard", as a public health exposure guideline has not been set.

Thanks again for your time on this matter.

Damien McAlinden | Consultant

CITIC Pacific Mining | Level 8 | 45 St Georges Terrace | PO Box 2732 Perth WA 6000 M [REDACTED] | E
damien.mcalinden@citicpacificmining.com<mailto:damien.mcalinden@citicpacificmining.com>

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**ATTACHMENT 8 – Sino Iron Mine Continuation Proposal – Consolidated
Environmental Review Documentation**



intelligent outcomes | respected experience

Sino Iron Mine Continuation Proposal

Environmental Review

Prepared for
Citic Pacific Mining
by Strategen

April 2017



Sino Iron Mine Continuation Proposal

Environmental Review

Strategen is a trading name of
Strategen Environmental Consultants Pty Ltd
Level 1, 50 Subiaco Square Road Subiaco WA 6008
ACN: 056 190 419

April 2017

Limitations

Scope of services

This report ("the report") has been prepared by Strategen Environmental Consultants Pty Ltd (Strategen) in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen has also not attempted to determine whether any material matter has been omitted from the data. Strategen will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen. The making of any assumption does not imply that Strategen has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

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: Citic Pacific Mining

Filename: Sino Iron Mine Continuation Proposal Environmental Review - 21 April 2017

Endorsement:

Chen Zeng, Chief Executive Officer
on behalf of:

- Sino Iron Pty Ltd ACN: 058 429 708
- Korean Steel Pty Ltd ACN: 058 429 600

Signed:



Date:

21st April 2017

Executive Summary

CITIC Limited (formerly named CITIC Pacific Limited) is the ultimate owner of Sino Iron Pty Limited (Sino Iron) and Korean Steel Pty Limited (Korean Steel). Sino Iron and Korean Steel each hold mining rights and subleases authorising the extraction of a combined two billion tonnes (Bt) of magnetite ore, from an orebody known as the George Palmer deposit, located in the West Pilbara region of Western Australia, and contained entirely within Mining Leases M08/123, M08/124 and M08/125.

In 2006, CITIC Limited established CITIC Pacific Mining Management Pty Ltd (CPM) to manage development and ongoing operation of its iron ore mine and export facilities at Cape Preston collectively referred to as the Sino Iron Project. CPM conducts those activities on behalf of Sino Iron and Korean Steel, the proponents for the Sino Iron Project authorised pursuant to Statement 635 (which was granted by the Minister for the Environment under Part IV of the *Environmental Protection Act 1986* (EP Act) in 2003, as amended from time to time).

The existing Sino Iron Project (the existing project) is located at Cape Preston, 80 km south west of Karratha, within the Pilbara region of WA.

The existing project involves the open cut mining, processing and export of magnetite ore and includes:

- mining and crushing of ore and associated groundwater drawdown and waste rock disposal
- ore processing facilities that include pellet and hot briquette plants (yet to be constructed), concentrators, and tailings disposal areas
- infrastructure including power station, desalination plant, workforce accommodation, roads, conveyors, pipelines, bore fields, site drainage structures, flood protection and waste disposal facilities, workshops and administration facilities
- port terminal infrastructure including product stockyards, conveyors, barge loading and transshipment facility, rock causeway and breakwater structure, trestle jetty and dredge berth (yet to be constructed).

The Sino Iron Mine Continuation Proposal (the Proposal) is an expansion of the existing project required to accommodate 2 Bt of mine operations. The Proposal does not seek to alter existing mining, processing and tailings production rates or increase throughput of the desalinisation plant. The Proposal is limited to addressing constraints which are contained within the existing project approvals. The Proposal will ensure continuous operation of the existing project by expanding current facilities including tailings storage facilities (TSF), waste rock landforms, the mine pit (area and depth), product stockyard capacity and other supporting infrastructure. The Proposal will increase discharge of mine dewater into the Fortescue River mouth from two gigalitres per annum (GLpa) to up to 8 GLpa.

In implementing the Proposal, the proponents will use the existing processing and operating infrastructure and administration facilities in accordance with current management practices approved under Statement 635.

Table ES1 provides a summary of the Proposal. Table ES2 provides a description of the location and proposed extent of physical and operational elements of the existing project and the Proposal. Table ES3 provides a summary of potential impacts, proposed mitigation and outcomes for the Proposal.

Table ES1: Summary of the proposal

Proposal title	Sino Iron Mine Continuation Proposal
Proponents name	Sino Iron Pty Ltd and Korean Steel Pty Ltd.
Short description	The proposal will expand an existing iron ore mine, processing and export facility at Cape Preston.

Table ES2: Location and proposed extent of physical and operational elements

Element	Location	Approved extent (existing project under Statement 635)	Proposed change (this Proposal)	Proposed extent (revised Proposal)
<i>Physical elements</i>				
Mine and associated infrastructure	Mine area	• 360 ha • 600 ha • 987 ha • 48 ha • 739 ha • total	Increase in disturbance of 7366 ha	No more than 10 100 ha within a Development Envelope of 22 737 ha.
<i>Operational elements</i>				
Depth of Pit	Figure 1	Up to 220 m	Additional 180 m	Approximately 400 m.
Rate of mining (Ore)		Up to 95 Mtpa	No change	Up to 95 Mtpa.
PROCESS PLANT				
Concentrator Rate		Up to 27.6 Mtpa	No change	Up to 27.6 Mtpa.
Produced waste to tailings storage		Up to 67.4 Mtpa	No change	Up to 67.4 Mtpa.
Pellet production		Up to 13.8 Mtpa	No change	Up to 13.8 Mtpa.
Direct reduced/hot briquetted iron	Figure 1	Up to 4.7 Mtpa	No change	Up to 4.7 Mtpa.
<i>Infrastructure</i>				
Power Station capacity; gas usage		640MW	No change (Note: only 450 MW constructed to date)	640 MW.
Product conveyor/haul road Mine to Port Service corridor	Figure 1	25 km from mine site to port at Cape Preston – average width 55 m, 81 m at crossing from mainland to Cape Preston Road. Buried slurry pipeline Dewatering plant at the port Additional buried pipelines Power transmission lines	No change	25 km from mine site to port at Cape Preston – average width 55 m, 81 m at crossing from mainland to Cape Preston Road. Buried slurry pipeline. Dewatering plant at the port. Additional buried pipelines. Power transmission lines.
Groundwater bore field		Amount to be determined by relevant decision making authority	No change	Amount to be determined by relevant decision making authority.

Element	Location	Approved extent (existing project under Statement 635)	Proposed change (this Proposal)	Proposed extent (revised Proposal)
Pit dewatering		In accordance with DoW Licence	No change	In accordance with DoW Licence.
Dewater discharge	Mouth of the Fortescue River	2 GLpa	Increase in discharge by up to 6 GLpa	Up to 8 GLpa.
Desalinated seawater	Figure 1	Up to 44 GL per annum	No change	Up to 44GL per annum.
Brine disposal	Figure 1	Up to 57.8 GL per annum	No change	Up to 57.8GL per annum.
Accommodation Village	Figure 1	Accommodation village: One permanent village – located on mainland north of the mine, opposite Carey Island (up to 970 people). Village also used as construction camp. Two construction camps located onsite, on ML08/123 and at permanent village sites	No change (Note: only M08/123 construction camp implemented to date)	Accommodation village: One permanent village – located on mainland north of the mine, opposite Carey Island (up to 970 people). Village also used as construction camp. Two construction camps located onsite, on ML08/123 and at permanent village sites.
<i>Port</i>				
Product stockyard capacity		Approximately 1 Mt	Approximately 2 Mt	Approximately 3 Mt.
Bridging structures or rock causeway to Preston Island	Figure 1	Approximately 1.1km, bridging structures or rock causeway to island, then trestle jetty	No change	Approximately 1.1km, bridging structures or rock causeway to island, then trestle jetty.
Dredging		Up to 4.5 million metres cubed (Mm3) disposed offshore	No change (Note: berth pocket, shipping channel and direct ship loading jetty yet to be constructed)	Up to 4.5 million metres cubed (Mm3) disposed offshore.

Table ES3: Summary of potential impacts, proposed mitigation and outcomes

Element	Description
Hydrological processes	
EPA objective	To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.
Policy and guidance	<i>Environmental Factor Guideline - Hydrological Processes.</i>
Potential impacts	- groundwater drawdown from dewatering has potential to modify groundwater and surface water flows - discharge of groundwater has potential to modify surface water flows in the Fortescue River - diversion of Edwards Creek will modify surface water flows - construction of physical elements will alter surface water flows.
Mitigation	Avoid: incorporate flood modelling data and surface flow data into the design of the Proposal to avoid impacts to hydrological processes. Minimise:

Element	Description
	- discharging groundwater to the Fortescue River on outgoing tides to minimise changes to hydrological processes - a naturally vegetated buffer will be maintained between the bunds around the Proposal elements and floodplain channels to limit increases in flood levels and velocities, and minimise erosion - monitoring will be undertaken to continue to assess potential impacts to nearby creeklines - an Operating Strategy shall detail the monitoring and adaptive management measures for of the groundwater drawdown aspects - realignment of the southern branch of Edwards Creek into two sections to enable the minimisation of the disturbance area of the infrastructure.
Outcomes	Residual Impact: - the extent of the 0.5 m, 5.0 m and 10.0 m drawdown contours will decrease relative to the existing project - the recovery of groundwater is expected to result in a pit lake of approximately 250 m deep in the west pit and 20 m deep in the east pit - the regional groundwater levels are not expected to be substantially affected - no permanent pools will be significantly affected - the modelled cumulative impacts of all proposed mining operations at Cape Preston do not substantially affect groundwater levels. Should it be constructed in the future the Balmoral South bore field will increase the extent of the 1.0 m drawdown contour - during mining the predicted inflows that will need to be dewatered are 8.0 GLpa - the discharge of 8.0 GLpa will not substantially affect flows of the Fortescue River - the development of a WRD adjacent to Du Boulay Creek is not expected to affect the volumes or substantially increase the velocity of flow. Offset: As the Proposal will meet EPA objective for Hydrological processes no offset is required.
Inland waters environmental quality	
EPA objective	To maintain the quality of groundwater and surface water, sediment and biota so that the environmental values are protected.
Policy and guidance	<i>Environmental Factor Guideline - Inland Waters Environmental Quality.</i>
Potential impacts	- diversion of Edwards Creek has the potential to increase stream velocity, which may affect water quality - physical development of the site and use of infrastructure will generate runoff which has the potential to affect surface water quality - following the formation of a pit lake after closure, evaporation and groundwater flow into the pit has the potential to affect water quality within the pit lake and surrounding environmental values.
Mitigation	Avoid: - maintain the same length and natural design (8 – 10 m bed width) for the diversion of Edwards Creek. Minimise: - discharge groundwater on outgoing tides - pass all runoff from disturbed areas through sediment traps prior to discharging downstream (during both construction and operation) - collect seepage from the tailing dam and use it on the mine site for ore-processing, dust control purposes and road-making - remove sediment from sediment basins prior to the wet season to the extent needed to maintain capacity. As required dispose of sediments to bio-remediation facility - monitoring will be undertaken including visual inspection of water quality and quantity in major creeklines and Fortescue River pools. Rehabilitate: - contain and cleanup any spill in accordance with DR017219 Hydrocarbons - Hazardous Materials Spill Response Procedure - Land.

Element	Description
Outcomes	Residual Impact: - diversion of Edwards Creek will not significantly alter either flow or velocity within the creek and therefore is not expected to affect water quality of either Edwards Creek or Fortescue River downstream - collection of surface runoff in sedimentation ponds will prevent surface water contamination - pit lake will act as a terminal sink and likely become hypersaline over time although surrounding groundwater quality will not be adversely affected. Offset: As the Proposal will meet EPA objective for Inland waters environmental quality no offset is required.
Marine environmental quality	
EPA objective	To maintain the quality of water, sediment and biota so that the environmental values are protected.
Policy and guidance	<i>Environmental Factor Guideline - Marine Environmental Quality</i> <i>Technical Guidance Protecting the Quality of Western Australia's Marine Environment.</i>
Potential impacts	discharge of groundwater has the potential to affect the water quality of the Fortescue River estuary.
Mitigation	Avoid: - undertake monitoring in accordance with DER discharge licence to ensure the groundwater salt, metal and nutrient concentrations are consistent with discharge licence requirements. Minimise: - discharging groundwater on outgoing tides to ensure discharge water is rapidly diluted to achieve the target dilution - discharging via a diffuser in accordance with dilution modelling (RPS APASA 2017) - to ensure the integrity of infrastructure any debris or other blockages will be cleared as required - implement DR017219 Hydrocarbons - Hazardous Materials Spill Response Procedure - Land.
Outcomes	Residual Impact: - target dilution for salinity (TDS) is a dilution level of 27 times, which will be achieved throughout the model for both a median and 80th percentile assessment of an 8 GLpa discharge - an 8 GLpa discharge is rapidly diluted on the falling tide and modelling shows no sign of build-up of salinity. Offset: As the Proposal will meet EPA objective for Marine environmental quality no offset is required.
Flora and vegetation	
EPA objective	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.
Policy and guidance	<i>Environmental Factor Guideline – Flora and vegetation</i> <i>Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment.</i> Policies and guidelines prior to 13 December 2016: <i>Guidance Statement No. 51 Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004)</i> <i>Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002).</i>
Potential impacts	- clearing of native vegetation has the potential to affect the regional representation of vegetation communities and flora species - clearing has the potential to introduce/spread weeds - groundwater drawdown from dewatering has the potential to affect groundwater dependent ecosystems.
Mitigation	Avoid: - inspection of the site for the presence of Mesquite or Parkinsonia prior to any machinery being moved to a site - maintenance of adequate fire breaks across the mine site and around working areas.

Element	Description
	Minimise:
	- restricting clearing to approved areas through the implementation of an internal ground disturbance permit system - restricting all vehicles and equipment to within designated tracks and parking areas - restricting all earthworks and movements of machinery and vehicles to within marked clearing or disturbance boundaries - requirements for all earthmoving machinery to be inspected as clean and free of weed and seed prior to entry and exit from a site - monitoring of GDE vegetation as outlined in the GDVMP (Astron 2015) will be conducted and contingency responses activated when trigger levels are exceeded.
	Rehabilitate:
	Disturbed areas (excluding the mine pit) will be rehabilitated to provide environmentally safe and stable landforms.
Outcomes	Residual Impact:
	- approximately 7366 ha of vegetation will be cleared by the Proposal with the majority of this occurring in habitat of low to moderate conservation significance and well represented in the region - loss of 121.51 ha of vegetation from the Horseflat Land System, a Priority 3iii Ecological Community although this will not result in a significant reduction in the extent of this community with total clearing in the Roebourne Subregion less than 0.5% - no Threatened Flora species listed under either the WC Act or EPBC Act will be affected by the Proposal - no Priority Flora species as listed by Parks and Wildlife will be affected by the Proposal - no change to GDE health is predicted with implementation of the GDE the monitoring plan and related adaptive management actions; and as a result of minimal changes to of groundwater levels (0.5 m) - the Proposal will not conflict with the WC Act as no flora species will significantly affected or have its conservation status affected by the Proposal's implementation.
	Offset:
	As the Proposal will meet EPA objective for Flora and vegetation no offset is required.
Terrestrial fauna	
EPA objective	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
Policy and guidance	<i>Environmental Factor Guideline - Terrestrial Fauna</i> <i>Technical Guidance - Sampling methods for terrestrial vertebrate fauna</i> <i>Technical Guidance - Terrestrial fauna surveys</i> <i>Technical Guidance – Sampling of short range endemic fauna.</i> Policies and guidelines prior to 13 December 2016: - EPA Guidance Statement 20, <i>Sampling of Short-Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia</i> (EPA 2009) - EPA Guidance Statement 56, <i>Terrestrial Fauna Surveys for Environmental Impact Assessment in WA</i> (EPA 2004) - EPA Position Statement 3, <i>Terrestrial Biological Surveys as an element of Biodiversity Protection</i> (EPA 2002) - Technical Guide -<i>Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment</i> (EPA and DEC 2010)
Potential impacts	- the majority of clearing will occur in habitat of low or moderate conservation significance - clearing of approximately 0.12 ha Northern Quoll habitat - clearing for the Development Envelope may disrupt localised fauna linkages for Northern Quoll and other fauna - the process of clearing may result in the deaths of individual terrestrial fauna - vehicle movements during construction and operation could potentially lead to the fatality or injury of individual fauna - interaction of personnel with introduced feral predators has the potential to increase numbers of introduced feral predators which may increase the predation of native animals, particularly small mammals such as the Northern Quoll - light spill, noise emissions, dust and vibration could alter fauna behaviour through avoidance and disruption to behaviour.

Element	Description
Mitigation	Avoid:
	- the Proposal footprint will avoid drainage line habitat alongside Du Boulay creek - maintaining a buffer alongside the Du Boulay Creek to allow potential movement of fauna - preventing unauthorised access to Northern Quoll habitat - record Northern Quoll habitats to ensure baiting exclusion zones to reduce risk of secondary or accidental poisoning.
	Minimise:
	- informing the workforce of the fauna present and preventing direct and inadvertent feeding of feral animals - implementing and signposting speed limits for both mining equipment and light vehicles in the Development Envelope and on access roads - undertake baiting outside of Northern Quoll breeding season, outside of known habitat and bury baits to prevent non-target species locating the baits.
Outcomes	Rehabilitate:
	undertaking feral animal control.
	Residual Impact:
	- the majority of the disturbance (approximately 5100 ha of the 7366 ha Proposal) occurs in the Low conservation significance Stony Spinifex plain with or without low shrub and Hilltop/hill slopes/rocky outcrops habitat types - disturbance of habitats of Moderate or High local conservation significance occurs in habitats that have been degraded as a result of historical pastoral activities, such as drainage lines and cracking clay units; disturbance within other habitat types (i.e. dunes, samphire and mangrove) is limited - clearing of Northern Quoll habitat is limited to 0.12 ha and impact on Northern Quoll populations is unlikely as they were not found to utilise the potential habitat within the Proposal footprint during the reconnaissance and targeted surveys - the Proposal will not conflict with the WC Act as no fauna species will be made extinct or have its conservation status affected as the result of the implementation of the Proposal - no species listed as Endangered or Vulnerable under either the WC Act or EPBC Act will be affected by the Proposal.
	Offset:
	As the Proposal will meet EPA objective for Terrestrial fauna no offset is required.
Terrestrial environmental quality	
EPA objective	To maintain the quality of land and soils so that environmental values are protected.
Policy and guidance	<i>Environmental Factor Guideline – Terrestrial Environmental Quality</i> <i>Management of fibrous minerals in Western Australian mining operations – guideline (DMP 2015).</i>
Potential impacts	- mining activities have the potential to cause fibrous minerals to become airborne - inappropriate management of potential asbestiform material (including post-closure storage, and mine pit wall exposures) has the potential to cause fibrous minerals to become airborne.
Mitigation	Minimise:
	- mine planning that minimises the interaction with Dales Gorge material - disposing of potentially asbestiform containing material in designated encapsulated cell within WRDs - encapsulation and rehabilitation of TSF areas progressively when and where possible - a rigorous program of preventing or suppressing fibre/dust release (e.g. by water spraying, misting and fogging, application of binders and surfactants, installation of extraction ventilation, etc.). Prevention and/or suppression methods will be used for drilling and blasting, loading, transfer of ore and waste, crusher operations and conveyor transport of ore, processing operations including management of tailings, stockpile management and transfer of concentrate through to transfer onto export vessels - conducting workplace inspections and audits to ensure controls are maintained to a required standard.
	Rehabilitate:
	Disturbed areas (excluding the mine pit) will be rehabilitated to provide environmentally safe and stable landforms.

Element	Description
Outcomes	Residual Impact:
	the ongoing implementation of existing management measures (described above) will ensure the Proposal will not result in any significant impact to terrestrial environmental quality.
	Offset: As the Proposal will meet EPA objective for Terrestrial environmental quality no offset is required.

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1. Introduction

1.1 Purpose and scope

CITIC Limited (formerly named CITIC Pacific Limited) is the ultimate owner of Sino Iron Pty Limited (Sino Iron) and Korean Steel Pty Limited (Korean Steel). Sino Iron and Korean Steel were acquired from Mineralogy Pty Ltd (Mineralogy) and are both parties to the agreement scheduled to the *Iron Ore Processing (Mineralogy Pty. Ltd.) Agreement Act 2002* (as amended) (IOPAA).

Sino Iron and Korean Steel each hold mining rights and subleases authorising the extraction of a combined two billion tonnes (Bt) of magnetite ore, from an orebody known as the George Palmer deposit, located in the West Pilbara region of Western Australia, and contained entirely within Mining Leases M08/123, M08/124 and M08/125.

In 2006, CITIC Limited established CITIC Pacific Mining Management Pty Ltd (CPM) to manage development and ongoing operation of its iron ore mine and export facilities at Cape Preston collectively referred to as the Sino Iron Project. CPM conducts those activities on behalf of Sino Iron and Korean Steel in accordance with requirements within Statement 635 (which was granted by the Minister for the Environment under Part IV of the *Environmental Protection Act 1986* (EP Act) in 2003.

The existing Sino Iron Project (the existing project), is located at Cape Preston 80 km south west of Karratha within the Pilbara Region of WA (Figure 1-1).

The existing project involves the open cut mining, processing and export of magnetite ore and includes the following:

- mining and crushing of ore and associated groundwater drawdown and waste rock disposal
- ore processing facilities that include pellet plants (yet to be constructed), concentrators, and tailings disposal areas
- infrastructure including power station, desalination plant, workforce accommodation, roads, conveyors, pipelines, site drainage structures, flood protection and waste disposal facilities, workshops and administration facilities
- port terminal infrastructure including; product stockyards; conveyors; barge loading and transshipment facility; rock causeway and breakwater structure; trestle jetty and dredge berth (yet to be constructed).

The Sino Iron Mine Continuation Proposal (the Proposal) is an expansion of the existing project required to accommodate 2 Bt of mine operations. The Proposal does not seek to alter existing mining, processing and tailings production rates or increase throughput of the desalinisation plant. The Proposal is limited to addressing constraints which are contained within the existing project approvals. The Proposal will ensure continuous operation of the existing project by expanding current facilities that include tailings storage areas (TSF); waste rock landforms; mine pit area and depth; product stockyard capacity; and other supporting infrastructure. The Proposal will increase discharge of mine dewater discharge into the Fortescue River mouth from 2 gegalitres per annum (GLpa) to up to 8 GLpa.

The Proposal will use the existing processing and operating infrastructure, administration facilities and continue to apply current management practices approved under Statement 635.

1.2 Proponent

The Proponents for the Proposal are Sino Iron Pty Limited and Korean Steel Pty Limited (the proponents for the Sino Iron Project authorised by Statement 635).

Proponent details:

Sino Iron Pty Ltd – ACN 058 429 708
Korean Steel Pty Ltd – ACN 058 429 600
GPO Box 2732
Perth WA 6001

Key contact:

Mr Bruce Watson
Manager Sustainability and Environment
CITIC Pacific Mining Management Pty Ltd
T: 9226 8316
Bruce.watson@citicpacificmining.com

1.3 Environmental impact assessment process

This Environmental Review has been prepared in accordance with Environmental Protection Authority (EPA) *Instructions on how to prepare an Environmental Review Document* (EPA 2016a) to support referral of the Proposal under s 38 of the EP Act.

In accordance with s 2.3.1 of the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016*, this Environmental Review aims to provide sufficient information for the EPA to assess the Proposal at the referral stage. Specifically, this Environmental Review has been prepared to a standard consistent with that of similar Environmental Reviews for mines in Western Australia and provides a comprehensive review of environmental factors relevant to the Proposal.

The Proposal will continue to be managed in accordance with the existing project's approved practices. The Proponents have demonstrated a high standard of environmental performance and compliance in the existing project. In addition, the Proponents has undertaken substantial consultation for the Proposal with government agencies (referred to as Decision-Making Authorities (DMAs)). The existing project has in place appropriate licences and secondary approvals and well-established relationships with relevant DMAs. Consultation with DMAs has included describing the Proposal as well as determining steps to progress appropriate licences and secondary approvals to support the Proposal, subsequent to approval under Part IV of the EP Act.

The Proponents has undertaken consultation with the Australian Government Department of Environment and Energy (DEE). The Proposal was referred to the Minister under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 19 January 2017. The referral (2017/7862) was advertised on 27 January 2017 and will available for comment until 10 February 2017. Whether the Proposal is a 'controlled action' under the EPBC Act has not yet been determined.

The Proposal will be submitted to the Minister for State Development for approval in accordance with the IOPAA in due course.

1.4 Other approvals and legislation

The Proposal is located within the Mardie Station Pastoral Lease (approximately 225 000 ha), which is operated by Pastoral Management Pty Ltd (PMPL) (also a subsidiary company of CITIC Limited) as a cattle station outside the approved mining areas.

With the exception of L08/126 (held by PMPL), the Proposal is located within 'Area A' under the IOPAA (Sino Iron and Korean Steel are parties to the IOPAA and will implement the Proposal in accordance with proposals approved under that State Agreement). Tenements located within 'Area A' are described within Figure 2-6.

The Proponents have appropriate licences and secondary approvals for the existing project as identified in Table 1-1.

Table 1-1: Other approvals and regulation

State and Local Government approvals			
Is rezoning of any land required before the proposal can be implemented? If yes, please provide details.			No
If this proposal has been referred by a decision-making authority, what approval(s) are required from you?			N/A
Proposal activities	Land tenure/access	Type of approval	Legislation regulating the activity
Clearing of native vegetation	IOPAA <i>Mining Act 1979</i>	Part IV assessment	EP Act – <i>Part IV</i>
Abstraction / Dewatering	IOPAA <i>Mining Act 1979</i>	Section 5C Licence to take groundwater Section 26D Licence to construct wells Part IV assessment Part V assessment	<i>Rights in Water and Irrigation Act 1914</i> (RiWI Act) EP Act – <i>Part IV</i> EP Act – <i>Part V</i>
Mining and processing	IOPAA <i>Mining Act 1979</i>	Approval of additional Project Proposals Part IV assessment Part V assessment	IOPAA EP Act – <i>Part IV</i> EP Act – <i>Part V</i>
Disturbance of Aboriginal Heritage sites	IOPAA <i>Mining Act 1979</i>	Section 18 consents	<i>Aboriginal Heritage Act 1972</i>



CITIC PACIFIC MINING
中信泰富矿业

Mine Continuation Proposal

Figure 1 - 1

Regional location

0 10 20
Kilometres

1:600,000

Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 20/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MB, Strategen Internal Reference 4397_01_2017_APP

Legend

- Development Envelope
- Conceptual Footprint
- Statement 635 approval (MS635)
- Populated Place
- Airport
- Eramurra Village
- Homesteads
- Railway
- Principal Road
- Mardie Station

2. The Proposal

2.1 Background

2.1.1 Existing project regulatory history

The existing project was assessed by the EPA under Part IV of the EP Act at a Public Environmental Review (PER) level (referred to in this document as the Austeel PER). This assessment processes also included completion of a Supplementary Environmental Review (SER). Following assessment by the EPA (Bulletin 1056), the existing project was approved by the Minister for the Environment through Statement 635 in October 2003. Subsequent to this approval there have been five s 45c applications to amend the existing project resulting in the following attachments to Statement 635:

- Attachment 1 - Increase in mining rate to approximately 67.4 Mtpa, increase in concentrator rate to approximately 19.6 Mtpa, and increase in production rate of tailings to approximately 47.8 Mtpa (approved 8 September 2004)
- Attachment 2 - Changes in the project layout and increases in infrastructure footprint, including relocation of accommodation village and construction camps, desalination plant, services corridor route, gas pipeline route, waste dumps, TSF, port stockpiles, and expansion of the services corridor and use of a buried slurry pipeline in place of conveyor (approved 13 February 2009)
- Attachment 3 - Relocation of proposed pellet plant from original location near mine site to the project's port at Cape Preston (approved 18 March 2009)
- Attachment 4 - Increases in footprint of mine pit, waste dumps, and tailings storage facility, and increases in mining rate to 95 Mtpa and processing rates (approved 3 July 2009)
- Attachment 5 - Increase to disturbance area (for roads, infrastructure associated with the TSF and for a dewater discharge pipeline from mine to a proposed discharge location near the mouth of the Fortescue River) and discharge of dewatered groundwater from mine site to a location near the mouth of the Fortescue River (approved 31 August 2016).

Statement 822 was issued on 23 December 2009 following a s 46 application to amend the approval conditions in Statement 635. Statement 822 removed Condition 7-1 (5) and Conditions 8-1 to 8-4 of Statement 635 and replaced them with Conditions 8-1 to 8-8. The conditions removed from Statement 635 related to the requirement to conduct further investigations into seawater quality and the location of the marine outfall and replaced them with conditions related to Ecological Protection Areas.

2.1.2 Balmoral South Iron Ore Project – on hold

The Balmoral South Iron Ore Project was proposed by Mineralogy to the south of the existing Sino Iron Project. The Balmoral South Iron Ore Project was assessed by the EPA at the level of PER and recommended for approval with conditions in October 2009 (Report 1340) with Statement 823 issued in December 2009. However, the Balmoral South Project has not progressed in line with condition three of Ministerial Statement 823 (which imposes a 5 year commencement period on the approval) and the Proponents are not aware of any plan by Mineralogy to progress that project.

2.1.3 Mineralogy Expansion Proposal (MEP) – on hold

In 2009 Mineralogy prepared a PER for the Cape Preston Iron Ore Project (the Mineralogy Expansion Proposal (MEP)) (Figure 2-1). The MEP was also referred to as Stages 3-5 of the Mineralogy Cape Preston Iron Ore Project (with the existing Sino Iron Project referred to as Stage 1 and the Balmoral South Iron Ore Project referred to as Stage 2).

Stages 3, 4 and 5 of the MEP were for three different proponents. Stage 3 represented an expansion of the Sino Iron Project, with Stage 4 and 5 comprising development of the proposed Mineralogy Iron Ore Project and the Austeel Steel Project on adjacent tenements. The MEP proposed an increase in the overall disturbance footprint of approximately 20 000 ha in addition to the cumulative 7000 ha already approved for the existing project and the adjacent Balmoral South Project (discussed above).

Stage 3 of the MEP was almost identical to this Proposal and therefore this Environmental Review references information from the MEP for context (Figure 2-2).

The environmental assessment for the MEP was not concluded and has been placed on hold by the EPA. However, prior to being placed on hold the PER for the MEP had been prepared in accordance with EPA approved Environmental Scoping Document and approved for release for a six week public comment period (5 October 2009 to 16 December 2009). During the preparation of the PER and public comment period substantial consultation was undertaken with government agencies and non-government organisations. The consultation involved 26 groups including:

- key government Ministers, agencies and regional branches
- the Shire of Roebourne (Local Government Authority) (now the City of Karratha)
- non-government organisations that represent indigenous interests, conservation and recreation groups and industry bodies
- community groups
- local business groups.

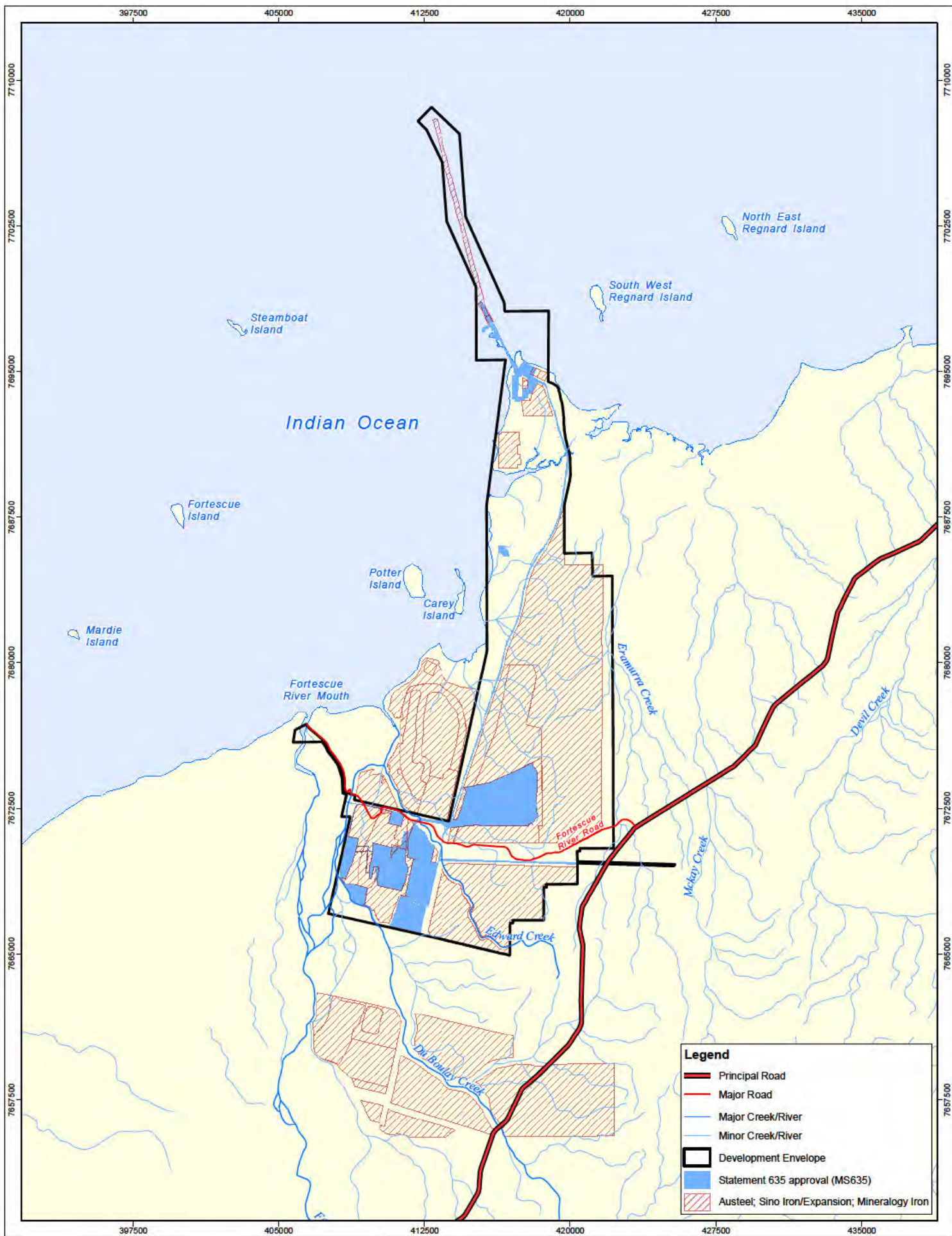
During the preparation of the PER the main issues raised by stakeholders related to:

- effects on vegetation and flora and fauna (including subterranean fauna and short-range endemics and faunal linkages)
- impacts on surface water and groundwater quality and quantity
- effects on the marine environment including water quality and marine fauna
- air emissions (including dust)
- health issues related to water supply and use and wastewater treatment
- Aboriginal heritage.

During the public comment period the submissions received mainly related to requirements for secondary approvals by DMAs. A total of 11 submissions were received including eight from government agencies with two non-government organisation and private submissions. This demonstrates that the MEP received very limited public interest.

The main issues raised by stakeholders were:

- provision of additional technical detail on the design of waste rock dumps (WRD) and TSF to DMP
- provision of information concerning groundwater dewatering operations to DoW
- ongoing consultation regarding Aboriginal heritage values.



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Mine Continuation Proposal

Figure 2 - 1

Mineralogy Expansion Proposal

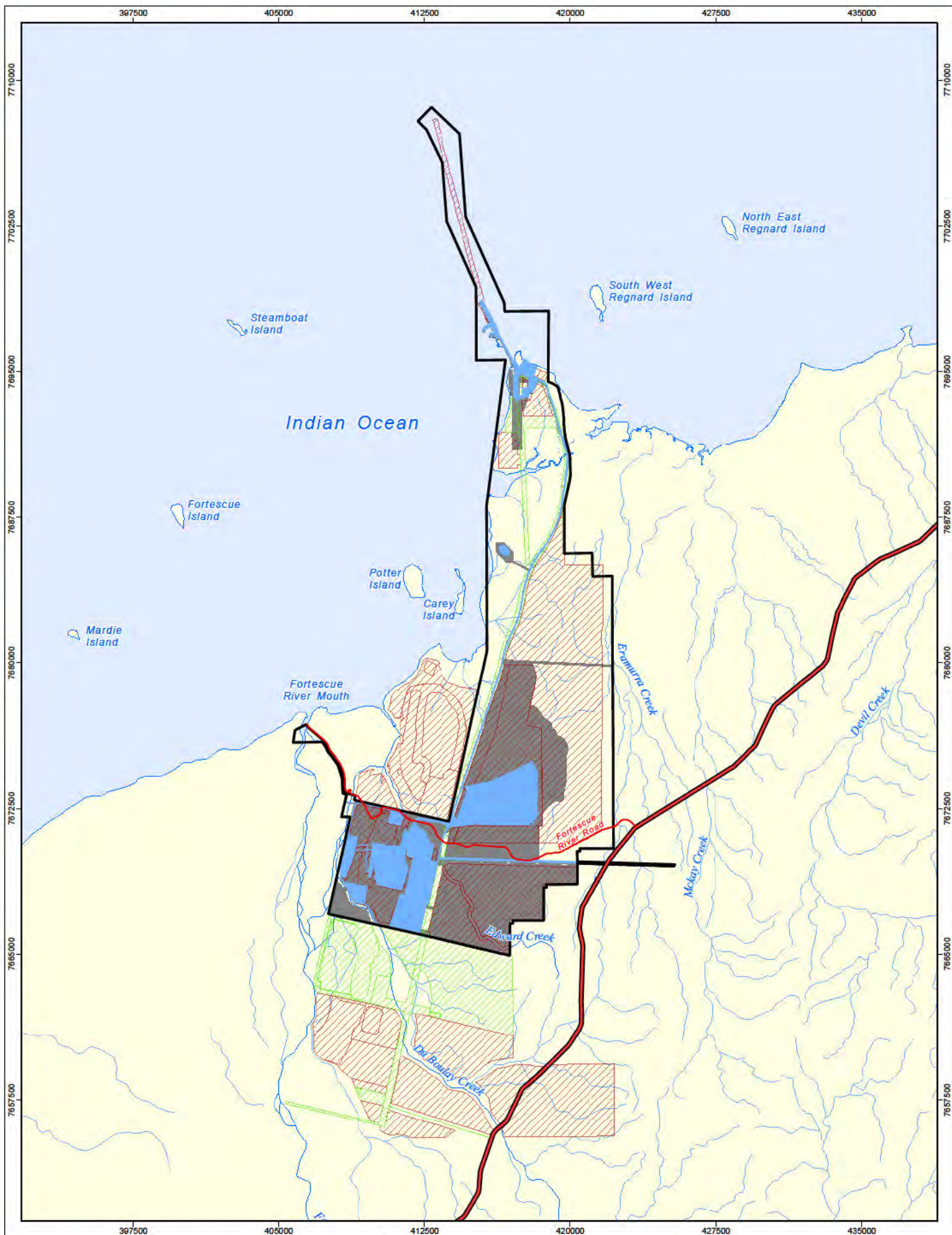
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Department: ENV Date: 20/01/2017

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Mine Continuation Proposal

Figure 2 - 2

Comparison of Mineralogy
Expansion Proposal with
Mine Continuation Proposal

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Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 20/01/2017

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Legend

- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Conceptual Footprint
- Development Envelope
- Statement 635 approval (MS635)
- Mineralogy Expansion Project Footprint
- Austeel; Mineralogy Iron; Sino Iron/Expansion;
- Balmoral South Project

2.2 Justification

The Proponents have commercial agreements in place with Mineralogy authorising the extraction of a combined two billion tonnes of magnetite ore from the George Palmer Orebody. The existing project was designed to allow for construction of infrastructure required for mining and processing for an initial five years of operations in line with the approved Project Proposals under the IOPAA. The Austeel PER identified that the George Palmer Orebody had an estimated reserve of 4 BT and that mining rights to the George Palmer Orebody are held by Mineralogy.

Given that more than five years has now elapsed, to avoid impacts to current operations and to support continuation of the existing project the mine pit and waste rock landforms and the existing TSF capacity need to be extended. An expansion of the port stockyard capacity is also required to provide additional buffering capacity between production inflows and export outflows, to prevent shutdown of upstream operations in the event of prolonged weather delays or unplanned maintenance at the port.

No alternative locations are available within the existing approval footprint for implementation of the Proposal. Similarly in order to maintain continuation of existing operations there are no alternative staging or timing options.

2.3 Description of Proposal

The Proposal includes establishing a Development Envelope to encompass the existing project mine and port areas, which are separated by approximately 10 km (shown in Figure 2-3). The Proposal involves an extension of existing activities at both the mine and port areas (shown in detail in Figure 2-4 and Figure 2-5, respectively). The nature of the extension of activities in each area is described in Section 2.3.1 and 2.3.2.

The Proposal will increase the approved disturbance area by 7366 ha, from 2734 ha to no more than 10 100ha.

2.3.1 Mine

In the mine area the Proposal involves increasing the area of the mine pit, WRD, TSF and associated infrastructure (Figure 2-4). The majority of the increase in the footprint for the Proposal is located in the mine area. The Proposal will not alter approved mining rates; however, the discharge of mine dewater into the Fortescue River mouth will be increased from 2 GLpa to up to 8 GLpa.

Mine pit

The proposed mine pit expansion involves increasing the mine pit depth from approximately 220 m to approximately 400 m and extending the mine pit to the west. The authorised extent of disturbance for the mine pit pursuant to Statement 635 is 360 ha. As part of the Proposal, the mine pit will be extended beyond this limit (this increased disturbance is included in the total proposed additional disturbance area of 7366 ha for the Proposal).

To ensure continuous operations, preparation of the west pit requires earthworks to commence in mid 2017. To coincide with this date approval is required for increased topsoil and subsoil storage capacity within Mining Leases M08/123, M08/124 and M08/125. Approval for removal of overburden from the pit will also be required in mid-2017 to allow commencement of the two year construction period that is required to develop the additional TSF capacity.

In addition to the pit expansion, associated mine infrastructure will be expanded to support continuation of mine operations. This infrastructure may include: temporary workshops; access tracks; flood protection bunds; safety bunds; haulage and light vehicle roads; power lines; water pipelines; mine dewater pumps and pipelines; turkey nests and other water storage facilities; mobile power facilities; environmental monitoring infrastructure, etc.

All disturbances associated with this infrastructure are included in the total proposed additional disturbance area of 7366 ha for the Proposal.

Tailings storage facilities

The authorised extent of the approved TSF pursuant to Statement 635 is 987 ha.

Waste from the concentrator plant is disposed of to the TSF. The approved TSF, which was designed to cater for the first five years of operation, has become severely constrained. The rate for tailings disposal is approximately 46 mtpa of dry tailings, which had been assumed to settle to a bulk density of around 1.45 t/m³. However, the bulk densities achieved to date have been as low as 1.3 t/m³. Consequently, a proportionally larger TSF will be required to contain the expected tailings volumes for continued processing operations.

The constructed TSF is located approximately six kilometres north-east of the concentrator plant within Mining Leases M08/264, M08/265 and M08/266. The TSF consists of a conventional paddock type dam, high density thickeners, thickener reagents plant and a sand filtration plant.

The Stage 1 TSF capacity is expected to be fully utilised by early 2017. In alignment with the existing project, the Stage 2 TSF development is being constructed on top of the Stage 1 TSF and is expected to meet the needs for (at most) a further two years of production. The combined Stage 1 and Stage 2 TSF is expected to provide for a total of 147 Mm³ of storage capacity.

To ensure continuous operations, the TSF will be extended beyond the approved limit of 987 ha as part of this Proposal (this increased disturbance is included in the total proposed additional disturbance area of 7366 ha for the Proposal).

Conceptual designs for the TSFs required to support continued mine operations propose additional locations to the north and south of the approved TSF on G08/53 (to the north) and G08/63 (to the south) respectively. These additional TSFs will require a two year construction period ahead of their operation. To ensure that these additional facilities are available for use when the Stage 2 TSF capacity is exhausted construction is required to commence in mid 2017.

Furthermore, to improve slope rehabilitation and acceptably manage rainwater runoff on the eastern side of the currently approved TSF, the northern TSF is proposed to be built up to the west side of the adjacent ridge located within G08/74.

Waste dumps

The authorised extent of approved waste dumps pursuant to Statement 635 is 600 ha. To ensure continuous operations, the WRDs will be extended beyond the approved limit of 600 ha as part of this Proposal (this increased disturbance is included in the total proposed additional disturbance area of 7366 ha for the Proposal).

The economics of the Proposal's scale of waste rock management demand that overburden and interburden (waste rock) be disposed of as waste rock landforms that are located as close as possible to the mine pit and that avoid significant vertical lifts in order to reduce costs. An exception to this rule would be where waste rock material is identified as being suitable for construction of tailings impoundment retaining walls.

Due to its location at distance from the mine, construction of WRDs and TSF may require installation of a conveyor for the purpose of economically transporting large volumes of mine waste rock required to construct these facilities.

Amongst other considerations, the location of the waste rock landforms has been chosen to minimise encroachment into the 100 year average recurrence interval (ARI) flood levels. The combined capacities of these areas will accommodate the projected waste rock that will be extracted.

The main objectives in determination of the final profile of the waste rock landforms are geotechnical and erosional stability. The final profile including maximum height of each individual waste rock landform will take on a vertical concave design and be sympathetic to the surrounding landscape.

A bund will be constructed around the western and south-western waste rock landforms to provide protection in case of 100 year ARI flood event of the Fortescue River and to control sediment from waste rock landforms and surrounding areas.

Dewatering

The Proposal involves an increase to the rate of groundwater discharge (from mine dewatering) from 2 GLpa. Detailed analysis (RPS APASA 2017) was conducted to determine if an increase in the discharge would be appropriate for the receiving environment. The analysis identified that the receiving environment could receive a discharge of up to 8 GLpa without environmental values being significantly affected. Based on this analysis it is proposed to increase the discharge up to 8 GLpa as part of the Proposal.

The location of the discharge will continue to be into the mouth of the Fortescue River.

Creek diversion

To accommodate infrastructure, the south branch of Edwards Creek will be realigned in two places (Figure 2-4). The two realignments will enable the disturbance area of the infrastructure to be minimised.

Diversion 1 is being proposed to allow expansion of an existing smaller waste dump in M08/123 adjacent to the mine. Diversion 1 involves realigning the southern branch of Edwards Creek along the eastern boundary of M08/123. The alignment requires construction of a 1.4 km channel and will result in the south branch feeding into the middle branch approximately 3 km upstream of the current location. The channel will be designed to be consistent with dimensions of the existing channel.

Diversion 2 is being proposed to accommodate construction of the TSF in mining tenement G08/63. The southern branch of Edwards Creek will be diverted around the TSF. This diversion would run west along the southern boundary of G08/63 and then north to rejoin the creek. The channel will be designed to be consistent with dimensions of the existing channel.

2.3.2 Port

In the port area the Proposal consists of increasing the area of the product stockpile as well as the port infrastructure (Figure 2-5). The increase in footprint at the port is included in the total proposed additional disturbance area of 7366 ha for the Proposal.

The Project differs from other iron ore projects in the Pilbara in that magnetite ore requires significant processing prior to being saleable. After ore is mined it is crushed and ground through a milling process, then mixed with water to form slurry which is passed through a magnetic separator to produce ore concentrate. Once completed the ore concentrate is stored at the port for shipment.

The existing ore concentrate stockpile at the port has a total capacity of approximately one million tonnes, which is equivalent to approximately ten days of shipping capacity (from empty); however, to mitigate operational impacts due to planned or unplanned disruptions to shipping or processing the stockpile must be maintained with a minimum volume of 500,000 tonnes of concentrate. This reduces the available shipping capacity to approximately 500,000 tonnes or the equivalent of only five days shipping capacity.

If there are delays to transport shipping schedules or transshipping associated with weather (e.g. cyclones) the existing approved capacity with the operational constraints is inadequate. Due to the size of the current stockpiles, if there are any prolonged weather delays or unplanned maintenance it will result in a forced suspension of all upstream processing activities.

Expansion of the stockyard (to approximately 3 Mt) at the port is proposed, to provide additional buffering capacity between production inflows and export outflows and thus prevent unplanned shutdowns of upstream operations.

2.3.3 Additional infrastructure corridors

The Proposal includes the construction of two new infrastructure corridors:

- one of which will extend from the north-south road across tenements G08/53 and G08/74 to the airstrip for the purposes of providing transport, power and water supply infrastructure to the airstrip
- the other of which will extend from M08/123 and/or M08/124 across G08/63 (broadly adjacent to L08/20), to connect power and water supplies to mine facilities.

All disturbances associated with these corridors is included in the total proposed additional disturbance area of 7366 ha for the Proposal.

2.3.4 Proposed approval

A key element of the Proposal is modernising the approval for the existing project. This Environmental Review includes:

- revising the key characteristics table and proposing a Development Envelope with a total disturbance footprint within that envelope
- updating the previous Operational Environmental Management Plan (OEMP) (Appendix 3)
- modernisation of the existing Statements (635 and 822) (Appendix 4).

The aim of modernising the approval is to maintain requirements of the existing approved management practices.

This environmental review document assesses impacts of the Proposal in the context of the original approval, although this does not include consideration of impacts from the existing project. Importantly, the Proposal does not introduce any new project elements or impacts that have not been previously assessed.

2.3.5 Key proposal characteristics

The key characteristics provided in Table 2-1 are proposed to replace the key characteristics identified in Statement 635 and 822 and incorporates both the Proposal and the existing project.

Table 2-1: Key Proposal characteristics

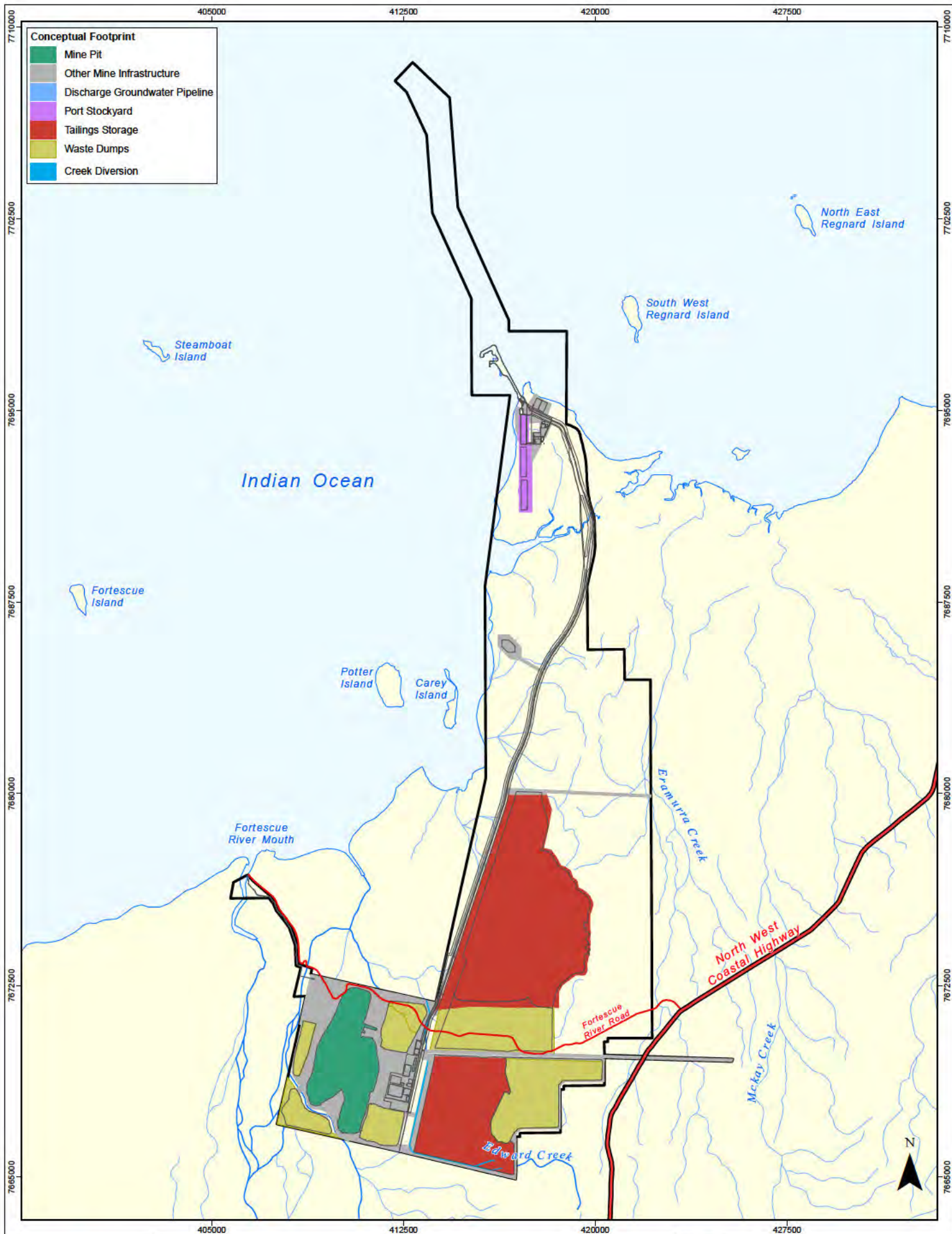
Proposal title	Sino Iron Mine Continuation Proposal			
Proponents name	Sino Iron Pty Ltd and Korean Steel Pty Ltd.			
Short description	The proposal will expand an existing iron ore mine, processing and export facility at Cape Preston.			
Element	Location	Approved extent (existing project under Statement 635)	Proposed change (this Proposal)	Proposed extent (revised Proposal)
<i>Physical elements</i>				
Mine and associated infrastructure	Mine area	• 360 ha • 600 ha • 987 ha • 48 ha • 739 ha • total	Increase in disturbance of 7366 ha	No more than 10 100 ha within a Development Envelope of 22 737 ha.

Element	Location	Approved extent (existing project under Statement 635)	Proposed change (this Proposal)	Proposed extent (revised Proposal)
<i>Operational elements</i>				
Depth of Pit	Figure 1	Up to 220 m	Additional 180 m	Approximately 400 m.
Rate of mining (Ore)		Up to 95 Mtpa	No change	Up to 95 Mtpa.
<i>Process plant</i>				
Concentrator Rate		Up to 27.6 Mtpa	No change	Up to 27.6 Mtpa.
Produced waste to tailings storage		Up to 67.4 Mtpa	No change	Up to 67.4 Mtpa.
Pellet production		Up to 13.8 Mtpa	No change	Up to 13.8 Mtpa.
Direct reduced/hot briquetted iron	Figure 1	Up to 4.7 Mtpa	No change	Up to 4.7 Mtpa.
<i>Infrastructure</i>				
Power Station capacity; gas usage		640MW	No change (Note: only 450 MW constructed to date)	640 MW.
Product conveyor/ haul road Mine to Port Service corridor	Figure 1	25 km from mine site to port at Cape Preston – average width 55 m, 81 m at crossing from mainland to Cape Preston Road Buried slurry pipeline replaces conveyor Dewatering plant at the port Additional buried pipelines Power transmission lines	No change	25 km from mine site to port at Cape Preston – average width 55 m, 81 m at crossing from mainland to Cape Preston Road. Buried slurry pipeline replaces conveyor. Dewatering plant at the port. Additional buried pipelines. Power transmission lines.
Groundwater bore field		Amount to be determined by relevant decision making authority	No change	Amount to be determined by relevant decision making authority.
Pit dewatering		In accordance with DoW Licence	No change	In accordance with DoW Licence.
Dewater discharge	Mouth of the Fortescue River	2 GLpa	Increase in discharge by up to 6 GLpa	Up to 8 GLpa.

Element	Location	Approved extent (existing project under Statement 635)	Proposed change (this Proposal)	Proposed extent (revised Proposal)
Desalinated seawater	Figure 1	Up to 44 GL per annum	No change	Up to 44GL per annum.
Brine disposal	Figure 1	Up to 57.8 GL per annum	No change	Up to 57.8GL per annum.
Accommodation Village	Figure 1	Accommodation village: One permanent village – located on mainland north of the mine, opposite Carey Island (up to 970 people). Village also used as construction camp Two construction camps located onsite, on ML08/123 and at permanent village sites	No change (Note: only M08/123 construction camp implemented to date)	Accommodation village: One permanent village – located on mainland north of the mine, opposite Carey Island (up to 970 people). Village also used as construction camp. Two construction camps located onsite, on ML08/123 and at permanent village sites.

Port

Product stockyard capacity		Approximately 1 Mt	Approximately 2 Mt	Approximately 3 Mt.
Bridging structures or rock causeway to Preston Island	Figure 1	Approximately 1.1km, bridging structures or rock causeway to island, then trestle jetty	No change	Approximately 1.1km, bridging structures or rock causeway to island, then trestle jetty.
Dredging		Up to 4.5 million metres cubed (Mm3) disposed offshore	No change (Note: berth pocket, shipping channel and direct ship loading jetty yet to be constructed)	Up to 4.5 million metres cubed (Mm3) disposed offshore.



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Mine Continuation Proposal

Figure 2 - 3

Development Envelope
and Conceptual Proposal layout

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Projection: MGA Zone 50

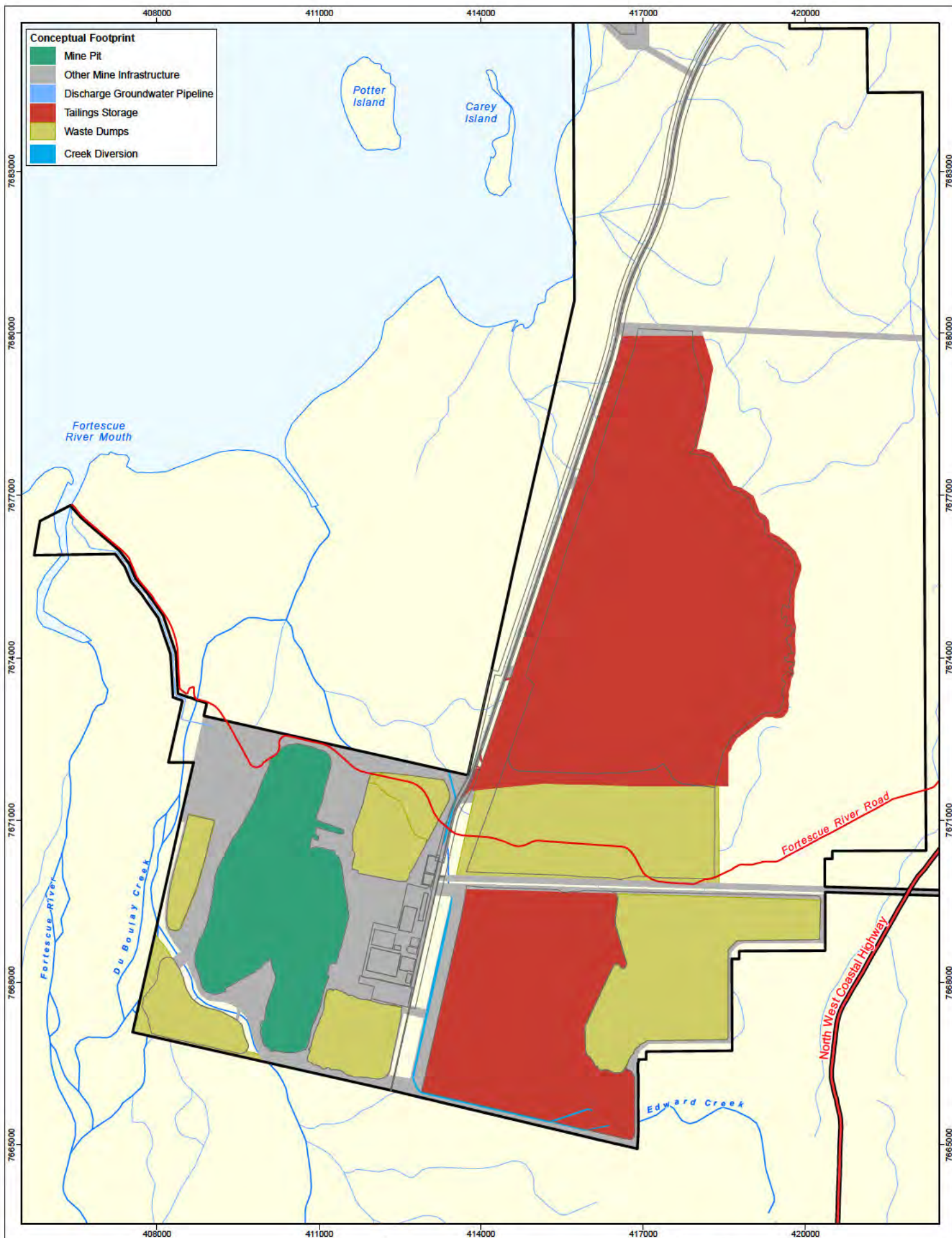
Department: ENV Date: 24/01/2017

Sheet Size: A4 Status: Final

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Legend

- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Conceptual Layout
- Development Envelope



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Mine Continuation Proposal

Figure 2 - 4

Indicative layout of Mine Area

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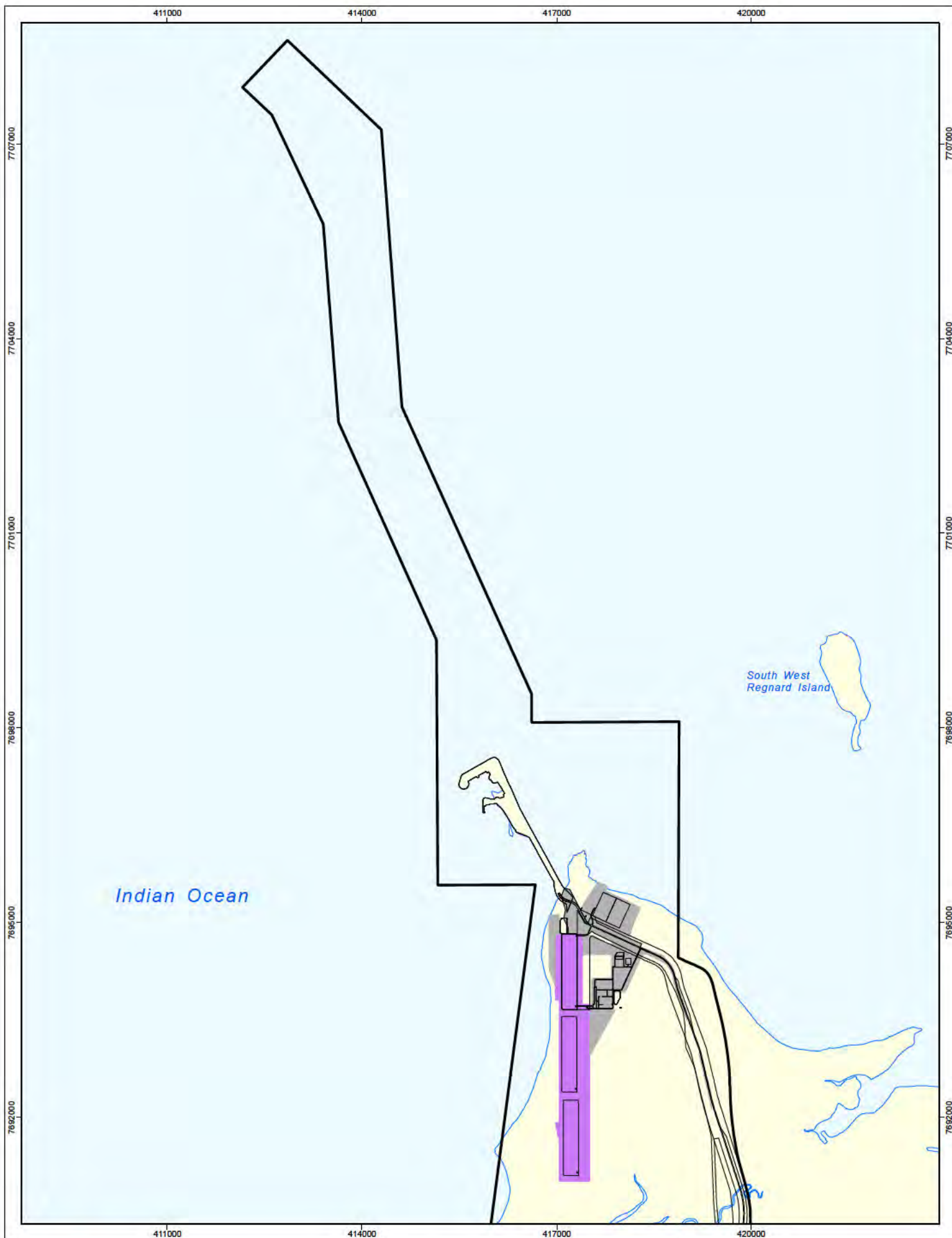
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Legend

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- Minor Creek/River
- Conceptual Layout
- Development Envelope

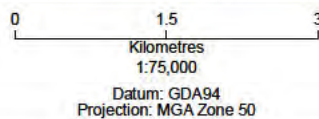


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Mine Continuation Proposal

Figure 2 - 5

Indicative layout of Port Area



Department: ENV Date: 20/01/2017

Sheet Size: A4 Status: Final

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Legend

- Conceptual Layout
- Development Envelope
- Conceptual Footprint**
- Other Mine Infrastructure
- Port Stockyard

2.4 Local and regional context

2.4.1 Physical environment

Cape Preston is 80 km south-west of Karratha in the Pilbara Region of Western Australia which has an arid tropical climate with two distinct seasons: a summer wet season and a winter dry season (Gentili 1972). The region experiences very low annual rainfall of 250 mm to 300 mm, high evaporation and high daytime temperatures. Rainfall is characterised by frequent, low-intensity events related to localised thunderstorms and tropical upper air disturbances, as well as occasional high-intensity events associated with tropical cyclones, which can lead to large-scale sheet flooding and considerable erosion.

The majority of watercourses in the Pilbara are ephemeral and generally flow after heavy rainfall events (Ruprecht and Ivanescu 2000). The Development Envelope is located adjacent to the lower reaches of the Fortescue River, extending from the coast to about 25 km inland. Edwards Creek and Du Boulay Creek are minor tributaries of the Fortescue River, flowing through the Development Envelope in a north-west direction before discharging into the Fortescue River (Aquaterra 2008a).

During large flood events the channels of the Fortescue River, Edwards Creek and Du Boulay Creek breach and the flood flows extend over the adjacent floodplains (URS 2009). Along the portion of the Fortescue River adjacent to the southern section of the Development Envelope, there is a significant 'break-out' area to the west of the main channel, which redirects high level flood flows away from the main channel in a north-westerly direction towards the coast and away from the Development Envelope (URS 2009). For further information on surface hydrology refer to Section 5.3.1.

The hydrogeology of the Development Envelope is mostly influenced by Hamersley Group Lower Proterozoic fractures rock system on the east and the Lower Fortescue Alluvial aquifer on the west. The major aquifers in the region are the gravels of the Fortescue River alluvium and to a lesser extent the Yarraloola Cretaceous Conglomerate and fractures and weathering within the Proterozoic rock (CloudGMS 2017, included in Appendix 1).

Groundwater flow tends to be in a north-westerly direction towards the coast. The Fortescue River alluvium aquifer and deeper sediments on the main floodplain are mostly recharged by the infiltration of river flow, although there is some minor direct infiltration of rainfall and some throughflow from flanking basement rock aquifers (URS 2009).

The general surface geology of the area is characterised by two series of north-north-easterly trending ridges of outcropping Lower Proterozoic aged rocks of the Mount Bruce Supergroup, which are part of the Hamersley Basin (URS 2009). These rocks dip steeply to the west-north-west and become generally younger from east to west, although there are numerous minor faults in the area that have resulted in some repeats of stratigraphic horizons (URS 2009).

A geological fault line runs in a south to north direction, east of the Development Envelope. West of the fault line, the area is characterised by ridges of Brockman Iron Formation that contains the orebody, Mt. McRae Shale and Mt. Sylvia formation and further west the area is dominated by residual clays, sands, gravel and Fortescue River Alluvium. East and parallel to the fault line, a higher series of ridges are formed by the Kylena and Maddina Volcanics which comprise of basalts and tuffs (URS 2009).

2.4.2 Terrestrial ecology

The Development Envelope is within the Roebourne sub-region of the Pilbara bioregion as per the Interim Biogeographic Regionalisation of Australia. The vegetation found within the Roebourne sub-region is broadly described into four separate categories based on setting (Kendrick and Stanley 2001):

- coastal plains consist of a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*
- uplands are dominated with *Triodia* hummock grasslands
- ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands
- marine alluvial flats and river deltas support samphire, *Sporobolus* and mangrove communities.

Several vegetation and flora surveys have been undertaken within the Cape Preston region and a total of 639 flora species from 73 families have been recorded. This total includes 614 (96%) native species and 25 (4%) introduced (weed) or non-endemic species. Families with the highest representation were Poaceae (Grass family – 81 native taxa, 5 introduced taxa), Papilionaceae (Pea family – 57 native taxa), and the Malvaceae (Mallow Family – 59 native taxa, 2 introduced taxa). The condition of the vegetation has been largely affected by pastoral grazing, and weeds are present in the area.

No species listed as Declared Rare Flora under State legislation or threatened flora under Federal legislation has been recorded within the project area during site surveys. For further information on flora and vegetation refer to Section 8.

The Cape Preston area contains seven broad terrestrial habitat types (Ecoscape 2016a). The majority of habitat within the Development Envelope is low open shrubland over low spinifex on flat plains, which are of low conservation significance. The highest conservation value terrestrial fauna habitats within the Development Envelope are associated with drainage lines.

Desktop fauna surveys of the project area identified 238 fauna species that could potentially occur or have been previously recorded in the project area. On ground surveys conducted by Phoenix (2009a; 2009b) recorded 132 bird, 84 reptile, 24 native mammal and 3 amphibian species. Of those species recorded, 32 are listed either under the *Wildlife Conservation Act 1950* (WC Act) and/or EPBC Act. The *Biodiversity Conservation Act 2016* (BC Act) was introduced in late 2016; however, the WC Act is still current it has been referred to in the document rather than the BC Act.

Twenty-five potential SRE species were also recorded in the project areas. For further information on fauna species (including potential SRE species) and habitats refer to Section 9.



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Mine Continuation Proposal

Figure 2 - 6

Tenure

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Projection: MGA Zone 50

Department: ENV Date: 2/02/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MB, Strategen Internal Reference 4403_01_2017_APP

Legend

- Tenements
- Development Envelope

3. Stakeholder consultation

CPM has an ongoing consultation program with relevant stakeholders. As the Proposal largely overlaps with Stage 3 of the MEP, substantial consultation on the impacts of the Proposal was undertaken with DMAs in 2009 prior to the release of the PER and following the public comment period for the MEP. This consultation involved detailed discussion on the findings of specialist reports and investigations relating to environmental factors.

As operator of the existing project, the Proponents have had an ongoing role in consultation with stakeholders. Additional stakeholder consultation for the Proposal was undertaken from the early planning stages of the Proposal. The focus of the additional consultation has been to inform stakeholders of relevant differences between the previous MEP and the Proposal. Based on the changes (relative to the MEP) the following consultation was undertaken:

State Government agencies:

- Department of Aboriginal Affairs (DAA)
- Department of Environment Regulation (DER)
- Department of Mines and Petroleum (DMP) - Environment Division
- Department of Mines and Petroleum (DMP) - Resource Safety Division
- Department of Water (DoW)
- Department of Parks and Wildlife (Parks and Wildlife)
- Western Australian Office of the Environmental Protection Authority (OEPA).

Australian Government agencies:

- Department of Environment and Energy (DEE).

Other relevant stakeholders:

- Pastoral Management Pty Ltd (PMPL)
- Mineralogy.

Comments and advice received from government agencies and other relevant stakeholders were incorporated into the design of the Proposal. A summary of stakeholder consultation undertaken to date is summarised below in Table 3-1.

Table 3-1: Stakeholder consultation table

Stakeholder	Date	Topic/issue raised	Proponent response/outcome
State Government agencies			
Department of Aboriginal Affairs (DAA)	Briefing 18/01/2017	CPM gave an overview of the Mine Continuation Proposal outlining key characteristics for the proposal and how key issues, including heritage, are to be managed. DAA queries: • do CPM have indigenous land use agreements (ILUA) in place with traditional land owners who have claims over the area • have CPM commenced heritage surveys associated with the Proposal.	Agreements are in place, the Yaburara and Mardidhunera People (YM) ILUA is registered with National Native Title Tribunal. YM claim area covers the Proposal, the Kuruma Marthudunera (KM) claim area is only along the south of Mardie Station. Survey on mining tenure (M08/123, M08/124, M08/125) had commenced and a S18 submission to DAA will be made in the coming months. Heritage survey programs for the remaining areas of the Proposal will commence following submission of this s18.

Stakeholder	Date	Topic/issue raised	Proponent response/outcome
Department of Environment Regulation (DER)	Briefing 30/11/2016	DER identified: - stockpile expansion will necessitate an amendment to L8758/2013/1 - ambient dust risk assessment and monitoring locations will need to be reviewed to factor in the revised stockpile orientation - increased pit dewatering discharge rate to the Fortescue River Mouth will necessitate an amendment to L8308/2008/2 - future TSF will necessitate an amendment to L8308/2008/2 premise boundary and identify new monitoring bore locations.	CPM has commenced preparing necessary amendments to identified licences. Work to identify additional monitoring points is also being undertaken. A revised monitoring program will accompany CPM's application to amend its existing operating licences
Department of Mines and Petroleum (DMP) (Environment Division)	Briefing 12/10/2016 Briefing 24/11/2016 Site visit 07/12/2016	Updates to TSF and Waste Rock Management Plans DMP provided the following comments/questions: - review of 2016 AER noted CPM has almost exhausted the approved disturbance under MS635. - proposal will necessitate diversion of Edwards Creek. Will this be a permanent diversion? - what are the existing statutory controls re Mesquite Management? - it is considered likely the OEPA will require a revised closure and rehabilitation plan as a component of the Proposal submission.	- This Proposal includes additional area of terrestrial disturbance. - The Proposal includes a permanent diversion of Edwards Creek. External consultant was engaged and surface water modelling completed. Refer to Section 5.5.3. - In accordance with Commitment 5 of Statement 635, CPM is an active member of the Pilbara Mesquite Management Committee. CPM has committed to contributing ~\$3,000,000 over 10 years to the control of mesquite on Mardie Station. Refer to Section 8.5.2. - A review of the 2006 OEPA approved preliminary decommissioning and closure plan and the 2011 internal CPM closure plan has been completed and forms a component of this submission. Refer to Appendix 3.
Department of Mines and Petroleum (DMP) - Resource Safety Division (letter and e-mail correspondence associated with meetings)	Correspondence dates: 19/09/2014 27/10/2014 3/12/2014 19/01/2015 24/05/2016	Management of fibrous minerals.	CPM has provided comprehensive management information and the results of ongoing monitoring and investigation with respect to this matter. Since providing this information DMP has not raised any further concerns. Management of fibrous minerals is addressed within Section 10. The Fibrous Minerals Management Plan submitted to DMP in 2016 is included within Appendix 3. DMP has not raised any further concerns since this Plan was submitted in May 2016.
Department of Water (DoW)	Meeting 17/11/2016	Scope of groundwater model.	Groundwater model updated to include cumulative impacts of proposed adjacent mines. Refer to Section 5.5.1 and Appendix 1.
Department of Parks and Wildlife (Parks and Wildlife)	Telephone call 1/12/2016	Description of project and offer of project briefing.	Parks and Wildlife advised that OEPA officers are able assess project and no need to consult Parks and Wildlife further.

Stakeholder	Date	Topic/issue raised	Proponent response/outcome
Western Australian Office of the Environmental Protection Authority (OEPA)	Meeting 18/11/2016 Meeting 14/12/2016	Initial high level briefing for OEPA. Discussion of marine modelling approach.	
Australian Government agencies			
Department of Environment and Energy (DEE)	Briefing 10/01/2017	Briefing on the historical approvals. DEE comments: - information that addresses how historic survey data was considered and the basis for work to update the previous survey data or reasons for not doing further survey work - likelihood of the Proposed Action affecting Denning habitat for Northern Quolls.	Terrestrial fauna and Flora and vegetation survey work has been reviewed to consider currency of survey work in terms of guidance and species. Flora and Fauna consultants have confirmed that historic surveys meet required standards and that further survey effort is unlikely to identify further species of conservation significance (Refer Sections 8.3 and 9.3). No Northern Quoll denning habitat likely to be affected by the Proposal (Ecoscape 2016).
Other relevant stakeholders			
Pastoral Management Pty Ltd (PMPL)	Ongoing liaison	PMPL is a subsidiary company of CITIC Limited and manages the cattle station outside the approved mining areas.	No outcomes identified.
Mineralogy	Letter 9/12/2016	Letter from CPM requesting Mineralogy's cooperation in securing approvals.	CPM has ongoing consultation working with Mineralogy as parties to the IOPAA.

4. Assessment of preliminary key environmental factors

4.1 Principles

The EP Act identifies a series of principles for environmental management. The environmental principles are the highest level goals that a proposal or scheme must meet in order to be found environmentally acceptable by the EPA. CPM has considered these principles in relation to the development and implementation of the Proposal. Table 4-1 outlines how the principles relate to the Proposal.

Table 4-1: EP Act principles

Principle	How it will be address by the Proposal
<u>Precautionary principle</u> Where there are threats of serious irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by: 1. careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and 2. an assessment of the risk-weighted consequences of various options.	The Proposal has used existing environmental data during design and has supplemented it with additional studies or peer reviews of previous material. CPM has maintained close correspondence with relevant government agencies to minimise any uncertainty surrounding the environmental impact of the Proposal. Detailed design plans, environmental management plans and closure plans will avoid or minimise impacts on identified environmental values.
<u>Intergenerational equity</u> The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The Proposal can be designed and implemented without significant impacts on the health, diversity or productivity of the environment.
<u>Conservation of biological diversity and ecological integrity</u> Conservation of biological diversity and ecological integration should be a fundamental consideration.	Survey work has been used to identify and confirm the range and condition of the environmental factors within and surrounding the Proposal development boundary. The Proposal will not substantially reduce the extent of any vegetation type or habitat within the Cape Preston area. The findings indicate that with appropriate design, management plans and progressive rehabilitation that no likely significant biodiversity or ecological impacts will result from the proposed development at local or regional scales.
<u>Improved valuation, pricing and incentive mechanisms</u> 1. Environmental factors should be included in the valuation of assets and services. 2. The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. 3. The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. 4. Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which benefit and/or minimise costs to develop their own solutions and responses to environmental problems.	Environmental constraint avoidance and management costs have been considered in the design of the Proposal.
<u>Waste minimisation</u> All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Waste will be minimised by adopting the hierarchy of waste controls; avoid, minimise, reuse, recycle and safe disposal.

4.2 Preliminary key environmental factors identified

Table 4-2 identifies the relevant preliminary key environmental factors for the Proposal and summarises the associated environmental aspects of the Proposal (e.g. dewatering, clearing) and potential impacts of the environmental aspects. The table also presents the work completed to undertake the environmental assessment. The potential impacts identified for each key environmental factor are assessed in detail within Sections 5 to 10 of this document.

Potential impacts, their mitigation and management, and the proposed regulatory mechanisms for ensuring mitigation are presented using relevant studies to demonstrate the Proposal meets the EPA objective for each preliminary key environmental factor (Table 4-2).

Environmental factors determined not to be key environmental factors are discussed in Section 12.

Table 4-2: Preliminary key environmental factors

Factor	Location	Environmental aspect	Potential impact	Work completed
Hydrological Processes	Mine Edwards and Du Boulay Creeks Fortescue River	- Dewatering and discharge - Construction of infrastructure.	- Groundwater drawdown from dewatering has potential to modify groundwater and surface water flows (Section 5.5.1). - Discharge of groundwater has potential to modify surface water flows in the Fortescue River (Section 5.5.2). - Diversion of Edwards Creek will modify surface water flows (Section 5.5.3). - Construction of physical elements will alter surface water flows (Section 5.5.4).	- Prepared a peer-reviewed groundwater model to predict changes in groundwater flows. Peer-reviewed groundwater model included: - the cumulative impacts of other mining projects in the area. - prediction of pit lake upon closure. - Prepared a review to predict the changes in flow volumes for surface water courses as a result of the Proposal.
Inland Waters Environmental Quality	Mine Fortescue River Edwards Creek	- Runoff from mine area - Groundwater discharge - Formation of pit lake post-closure.	- Diversion of Edwards Creek has the potential to increase stream velocity, which may affect water quality (Section 6.5.1). - Physical development of the site and use of infrastructure will generate runoff which has potential to affect surface water quality (Section 6.5.2). - Following the formation of a pit lake after closure, evaporation and groundwater flow into the pit has the potential to affect water quality within the pit lake and surrounding environmental values (Section 6.5.3).	- Prepared a review to predict the changes in flow volumes for surface water courses as a result of the Proposal. - Identified the location and design parameters of groundwater discharge infrastructure. - Peer-reviewed groundwater model includes prediction of the likelihood of the formation of a pit lake after closure as well as a risk assessment of the water quality of the pit lake and likelihood significantly affecting surrounding regional water quality values.
Marine environmental quality	Mine Fortescue River	Groundwater discharge.	Discharge of groundwater has potential to affect the water quality of the Fortescue River estuary (Section 7.5.1).	Prepared a peer-reviewed hydrodynamic marine model to assess changes to marine water quality as a result of the discharge of groundwater.
Flora and Vegetation	Mine Port	- Clearing - Dewatering.	- Clearing of native vegetation has potential to affect regional representation of vegetation communities and flora species (Section 8.5.1). - Clearing has potential to introduce/spread weeds (Section 8.5.2). - Groundwater drawdown from dewatering has potential to affect groundwater dependent ecosystems (Section 8.5.3).	- Prepared a review of completed botanical assessments to summarise and confirm the currency of previous surveys undertaken at Cape Preston. - Updated species lists and identified changes in status of conservation significant flora species and vegetation communities.
Terrestrial fauna	Mine Port	- Clearing - Dewatering.	- Clearing has potential to reduce extent of fauna habitat (Section 9.5.1). - Clearing has potential to disrupt localised fauna linkages for native fauna (Section 9.5.2). - Clearing of Northern Quoll habitat has potential to affect habitat availability for this species (Section 9.5.3). - Development has potential to introduce/attract feral animals (Section 9.5.4). - Mine operations have potential to reduce habitat quality or result in the death or injury of terrestrial fauna (Section 9.5.5).	- Prepared a review of completed terrestrial fauna assessments to summarise and confirm the currency of previous surveys undertaken at Cape Preston. - For Endangered Northern Quoll undertook an assessment in accordance with the DEE guidelines for surveying, including conducting both a reconnaissance and targeted survey.

Factor	Location	Environmental aspect	Potential impact	Work completed
Terrestrial environmental quality	Mine Port	• Mining and operational activities • Post-closure.	1. Mining activities have the potential to cause fibrous minerals to become airborne. 2. Inappropriate management of potential asbestiform material (including post-closure storage, and mine pit wall exposures) has the potential to cause fibrous minerals to become airborne.	1. Summarise the results of fibrous minerals investigations and monitoring as well as the implementation of the existing Fibrous Minerals Management Plan.

5. Hydrological processes

5.1 EPA objective

To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

5.2 Policy and guidance

The relevant policy for Hydrological processes is:

- *Environmental Factor Guideline - Hydrological Processes* (EPA 2016b).

5.3 Receiving environment

A summary of work completed to describe the receiving environment with respect to Hydrological processes is presented in Table 5-1.

Table 5-1: Summary of environmental studies and survey effort

Author/ date	Survey/ investigations name	Study area, type and timing	Study standard/guidance and limitations
Recently completed work			
<i>Cloud GMS 2017</i>	<i>Sino Iron Expansion Proposal Groundwater Modelling Study</i>	Hydrogeological assessments of the effect of the Project during life of mine and post closure.	Peer reviewed model. ANZECC/ARMCANZ Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000). Water Quality Protection Guidelines (No. 1-11) (DoW & DoIR, 2000). State Water Quality Management Strategy (ANZECC and ARMCANZ, 2001). Barnett, B et al. 2012 Australian Groundwater Modelling Guidelines.
<i>RPS 2017</i>	<i>Edwards Creek Diversions and Southwest Waste Dump</i>	Surface water assessment of engineering designs.	
<i>RPS APASA 2017</i>	<i>Discharge Modelling Assessment Fortescue River Outfall</i>	Delft3D-FLOW hydrodynamic model.	Peer reviewed model. Model adheres to the International Association for Hydro-Environment Engineering and Research guidelines for documenting the validity of computational modelling software, closely replicating an array of analytical, laboratory, schematic and real-world data.
Previously completed work			
<i>Aquaterra 2009a</i>	<i>Mineralogy Expansion Projects (Stage 3-5) Surface Water Management</i>	Surface water assessment (including 1 in 100 year ARI flood assessment) of the Fortescue River and Du Boulay Creek floodplain adjacent to the Sino Iron Project for the Stages 3-5 Mineralogy Expansion Proposal conducted in 2009.	ANZECC/ARMCANZ Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000). Water Quality Protection Guidelines (No. 1-11) (DoW & DoIR, 2000). State Water Quality Management Strategy (ANZECC and ARMCANZ, 2001).

Author/ date	Survey/ investigations name	Study area, type and timing	Study standard/guidance and limitations
Aquaterra 2009b	<i>Mineralogy Expansion Projects (Stages 3-5) – Hydrogeological assessment</i>	Hydrogeological assessments (prediction of groundwater inflows and drawdown) of Stages 3-5 Mineralogy Expansion Proposal conducted in 2009.	ANZECC/ARMCANZ Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000). Water Quality Protection Guidelines (No. 1-11) (DoW & DoIR, 2000). State Water Quality Management Strategy (ANZECC and ARMCANZ, 2001).
Aquaterra 2001	<i>Austeel Iron Ore Project Prediction of Groundwater Level Drawdown</i>	Groundwater model of existing Project.	

5.3.1 Surface water

The Development Envelope is adjacent to the Fortescue River; the major watercourse in the vicinity of the Proposal with an effective catchment area of 20 000 km² (Aquaterra 2009a). The Development Envelope is drained by Edward Creek and Du Boulay Creek, which are minor tributaries to the Fortescue River (Figure 5-1). Near the Development Envelope the Fortescue River is braided and comprises several channels that follow a primary floodplain (approximately 2.5 km wide).

The lower Fortescue River estuary is tidal dominated and experiences strong tidal influence (spring tidal range at approximately 3.6 m) that extends approximately 4 km inland. At the mouth of the Fortescue River, the river channel is in excess of 200 m wide forming an estuarine setting of salt marsh and intertidal flats. Upstream of the estuary the Fortescue River has a well-defined main flow channel, typically 4 m to 6 m deep and about 100 m wide. The combination of a wide well defined channel and high tidal range provides high velocities in the river mouth and the current speed in the Fortescue River frequently exceeds 0.1 m/s (RPS APASA 2017) (Figure 5-2). The strong tidal influence means the estuary has a low sediment trapping efficiency; naturally high turbidity and well mixed waters (RPS APASA 2017).

In addition to the strong tidal flows, the river mouth also experiences a very high rate of flushing from the discharge of water during the wet season. At the DoW Bilanoo gauging station (approximately 35 km upstream) the long-term mean annual discharge of the river is 305 GLpa and on average more than 90% occurs during the wet season from January to April (DoW 2015a). As there are other creeklines that enter the Fortescue River downstream of the gauging station (including Edward and Du Boulay creeks) it is likely that the discharge at the river mouth will be substantially higher. As shown in Figure 5-3, the long-term average monthly streamflow corresponds with rainfall patterns.

An assessment of the permanency of river pools was determined on the basis of an analysis of satellite imagery (CloudGMS 2017). The assessment determined that there are two permanent pools (Mungajee and Tom Bull), five semi-permanent pools (Bilanoo, Stewart, Chuerdoo, Jilan Jilan and one unnamed) and two unnamed intermittent pools.

Tom Bull Pool (the furthest pool downstream) is tidally influenced. The remainder of the pools occur after river flow events, during which groundwater is recharged from the surface water and the watertable rises (CloudGMS 2017).

Edwards and Du Boulay Creeks drain ridges to the east and southeast of the Development Envelope and flow in a north-westerly direction through the Development Envelope into the Fortescue River. The creeks typically have main flow channels with 5 m to 10 m wide gravel beds and trees along the banks.

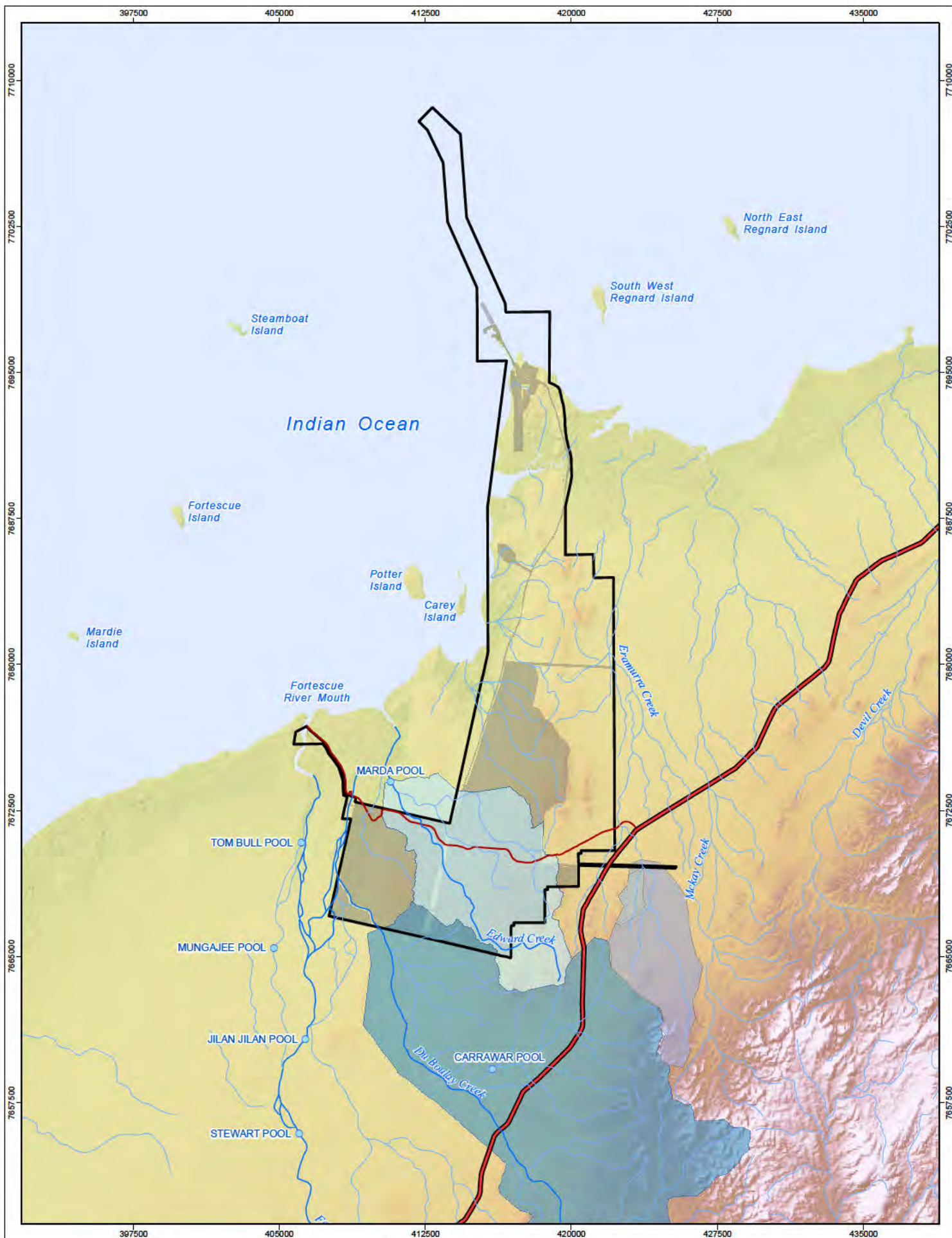
Floodplains adjacent to the creeks typically comprise open grassed areas with scattered trees. Edwards Creek has three main branches, with a total catchment of about 50 km² where the creek enters the Fortescue floodplain. The southern branch comprises approximately 29 km² and the middle and northern branch together comprise approximately 21 km². Edwards Creek (southern branch) runs northwest diagonally through mining tenement M08/63, from the south east edge of the mining tenement to the north-west corner, where there is a set of large culverts under the North-South Road. The creek then enters mining tenement M08/123.

The catchment area of Du Boulay Creek is about 200 km² where it meets the Fortescue River floodplain. The Du Boulay Creek flows at an extremely flat grade on the Fortescue floodplain towards an anabranch of the Fortescue River. Flood flows spread out across the Fortescue floodplain and flood depths are shallow.

Estimates of flood flows for Edwards Creek and Du Boulay Creek were undertaken by RPS (2017). As shown in Table 5-2 the flood estimates of Du Boulay are substantially higher than the south branch of Edwards Creek.

Table 5-2: Flood estimate of Edwards and Du Boulay creeks

ARI flood estimate	Edwards Creek (south branch) (m ³ /s)	Du Boulay Creek (m ³ /s)
10 year	25	262
20 year	41	426
100 year	97	616



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Figure 5 - 1

Topography and surface hydrology

0 5 10
Kilometres
1:250,000
Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 25/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MB, Strategen Internal Reference 4404_01_2017_APP

Legend

- Major Creek/River
 - Minor Creek/River
 - Development Envelope
 - Conceptual Footprint
- Catchment Boundaries**
- Du Boulay Creek
 - Edward Creek
 - Eramurra East
 - Eramurra West

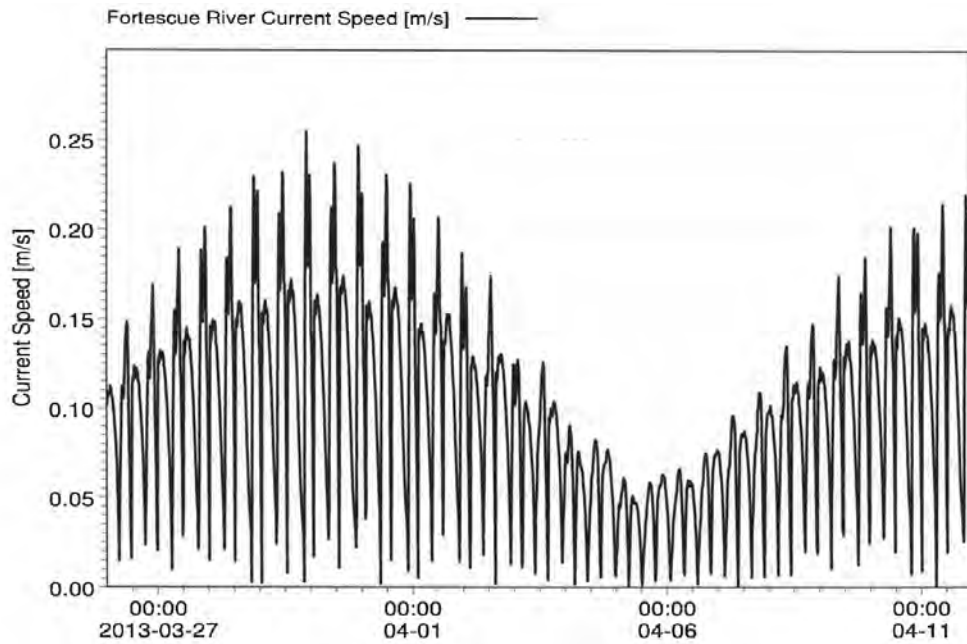


Figure 5-2: Fortescue River current speed

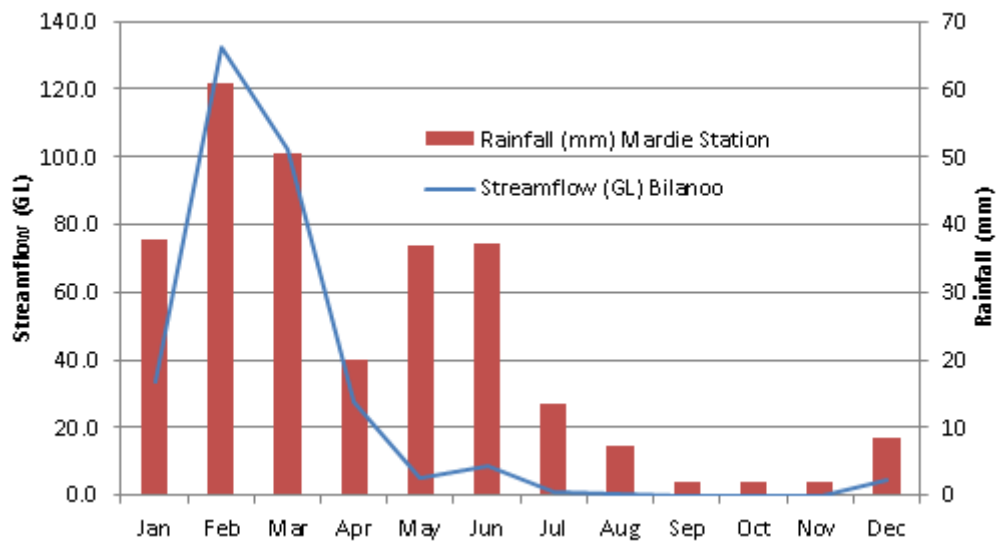


Figure 5-3: Comparison of long-term rainfall (at Mardie Station) and average streamflow of the Fortescue River (at Bilanoo gauging station approximately 35 km upstream)

5.3.2 Groundwater

The George Palmer Orebody is within Proterozoic basement rocks. In order to access the ore the western pit will intersect the edge of the Quaternary Fortescue River floodplain alluvium. The older basement rocks (including the Brockman Iron Formation and the Orebody) lie to the south east of the younger alluvium, which is associated with the historical location of the Fortescue River floodplain. These two geological types have very different hydrogeological properties.

The Fortescue River floodplain alluvium is continuous over an area in excess of 200 km² and has a saturated thickness of up to 20 m (Aquaterra 2008c). The Fortescue alluvium is highly permeable and contains a freshwater aquifer. In comparison, there are only minor secondary aquifers in the Proterozoic basement rocks, including the Orebody banded iron formation, generally associated with fracturing.

Groundwater flow in the region is generally to the northwest towards the ocean, with local groundwater flows being influenced by topography, creeklines and underlying geology. The interface between the permeable alluvium and the low permeability basement rocks influences the groundwater levels and flows in the Development Envelope (CloudGMS 2017). The watertable is higher in the basement rocks than the alluvium as the alluvium is permeable which allows water to move through it and discharge (Figure 5-4).

The Proterozoic basement rock aquifers are recharged by infiltration of rainfall and local runoff in areas of outcrop and via leakage from overlying soils and sediments in areas of subcrop. These aquifers discharge to the Fortescue River alluvium and coastal sediments. As such, groundwater flow in the basement rock aquifers is generally from topographic highs towards the Fortescue River and the coast.

The Fortescue River floodplain alluvium is mostly recharged by infiltration of river flow, although there is also direct infiltration of rainfall and some throughflow from flanking basement rock aquifers. These aquifers discharge via base flow to the Fortescue River during periods when the watertable is above the riverbed and river water levels, and by evapotranspiration (CloudGMS 2017).

There are a number of pastoral bores within the Fortescue River floodplain alluvium and the Proterozoic basement rocks associated with the Mardie Station. Mardie Station is owned and operated by PMPL as a cattle station outside the approved mining areas.

Approved extent of groundwater drawdown

The existing project includes dewatering to allow mining to a depth of 220 m. The SER for the existing project included a prediction of groundwater drawdown based on a groundwater model by Aquaterra (2001). The 2001 groundwater model identified that drawdown of 0.5 m would extend 3.5 km to the west, 5 km to the east and 15 km to the north and south of the George Palmer Orebody. Section 3.1 of EPA Bulletin 1056 summarises that the total area covered by the 2001 drawdown zone is about 14 900 ha. The extent is shown in Figure 5-5. As the spatial information for the 2001 groundwater modelling described within Bulletin 1056 was not available, the drawdown contours described in this Bulletin's figures were digitised. Consequently, there is a discrepancy between the area identified in the Bulletin (14 900 ha) and the digitised extents (15 730 ha). Table 5-3 shows the difference between the digitised areas from Bulletin 1056 compared to the more recent CloudGMS (2017) modelling completed for the Proposal. The CloudGMS (2017) model incorporates substantial additional monitoring data since the initial 2001 model was prepared. However, the new model did not re-validate the predicted drawdown from the approved existing project.

The impact of the existing project on the drawdown on groundwater dependent ecosystems (GDEs) is described in Section 8.3.4.

As the existing project does not intersect the Fortescue River floodplain alluvium the extent of drawdown predicted extends in the direction of the mine pit (i.e. northeast to southwest). The predicted extent of the drawdown at 0.5 m, 1.0 m and 5.0 m contours for the existing project (Aquaterra 2009b) is shown in Figure 5-5.

Aquaterra (2001) concluded that water levels would not recover above the base of the final pit. On this basis the existing project was predicted to result in a dry pit void.

Dewatering of groundwater has been conducted to support the existing project and is subject to a licence issued by the DoW under the RiWI Act that specifies the maximum dewatering rate and includes conditions for monitoring. As part of the licensing process an Operating Strategy is required by DoW detailing the volumes that are available for dewatering and the monitoring requirements. The Operating Strategy has been prepared and approved by DoW and regular contact has been maintained with the DoW, including annual reporting of dewatering.

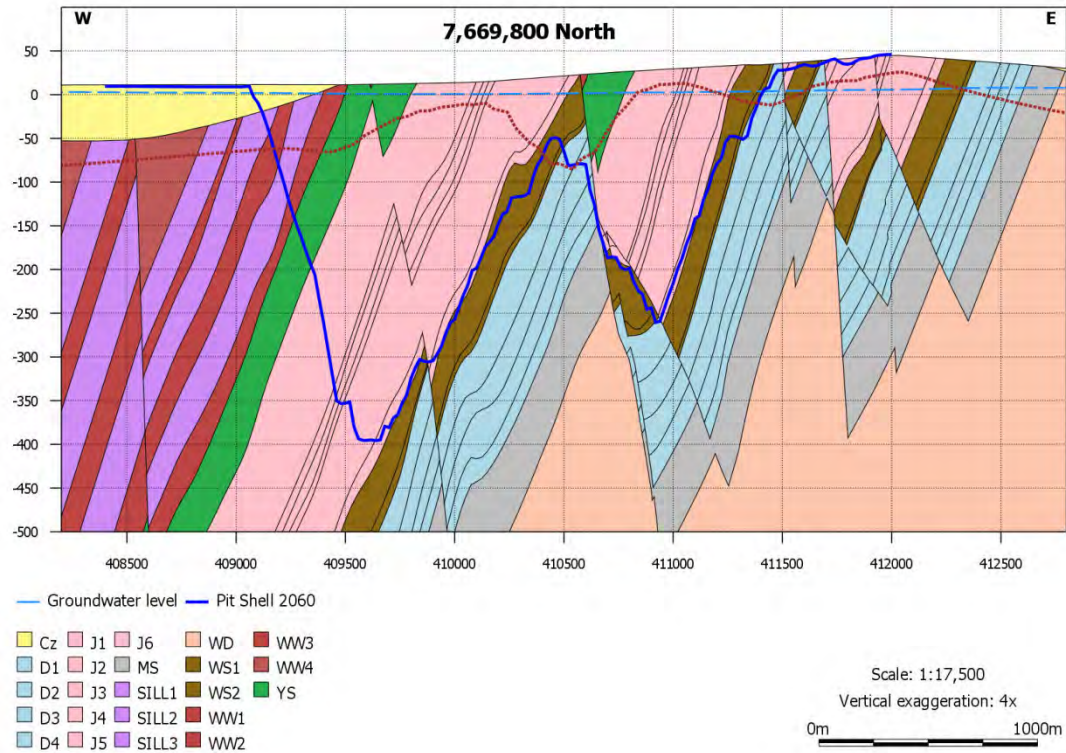
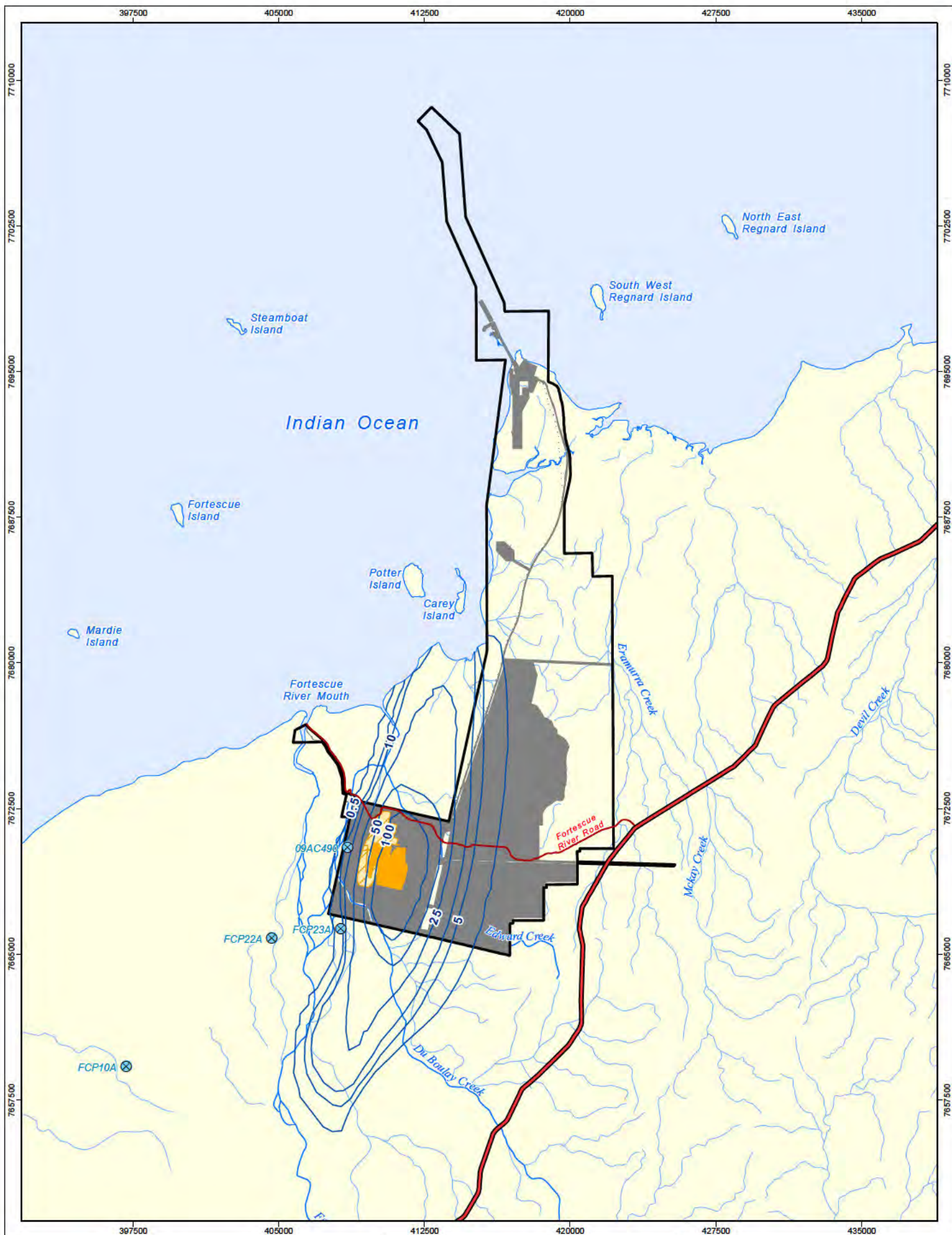


Figure 5-4: Schematic geographic cross section



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Figure 5 - 5

Approved extent of
groundwater drawdown

0 5 10

Kilometres

1:250,000

Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 27/01/2017

Sheet Size: A4 Status: Final

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DS

Requested by
MB, Strategen

Internal Reference
4408_01_2017_APP



Monitoring bore



20 Year Drawdown Approved Extent



Major Creek/River



Minor Creek/River



Conceptual Footprint



Development Envelope



Stage 1 - Sino Iron Approved Mine Pit



Stage 3 - Sino Iron Extension Mine Pit

Mineralogy Expansion Proposal modelling

Modelling of the extent of drawdown from the MEP was conducted by Aquaterra (2009b). The modelling for the MEP occurred after the approval process for the Balmoral South (i.e. Stage 2) commenced. In consideration of the potential Stage 2 mine the MEP modelling included the combined extent of drawdown from Stages 1 to 2 and then Stages 1 to 5 to determine the relative increase from Stages 3 to 5.

Stages 1 and 2 combined had a predicted extent of drawdown of 22 550 ha, which represents 7650 ha above the 14 900 ha predicted from Stage 1 by Aquaterra (2001). With the addition of Stages 3 to 5 the cumulative extent of drawdown (i.e. for Stages 1 to 5) was predicted to be 26 601 ha, representing 4051 ha above the drawdown predicted for Stages 1 and 2. As shown in Figure 5-6, the predicted extent of drawdown from Stages 1 to 5 is approximately 25 km north-south and approximately 15 km east-west, which represents an increase of around 2 km to the east and 2 to 5 km to the north compared to Stages 1 and 2 only (Aquaterra 2009b).

While modelling for Stages 3 to 5 identified that the mine pit would not intersect the Fortescue River alluvium (and therefore limit drawdown within the alluvium) a subsequent review of the geological model identified that it would be unlikely that the mine pit would have been able to avoid intercepting the Fortescue Alluvials. On this basis, it is likely that the extent of drawdown and outflow of water from the alluvium would have been greater than that predicted in modelling for the MEP.

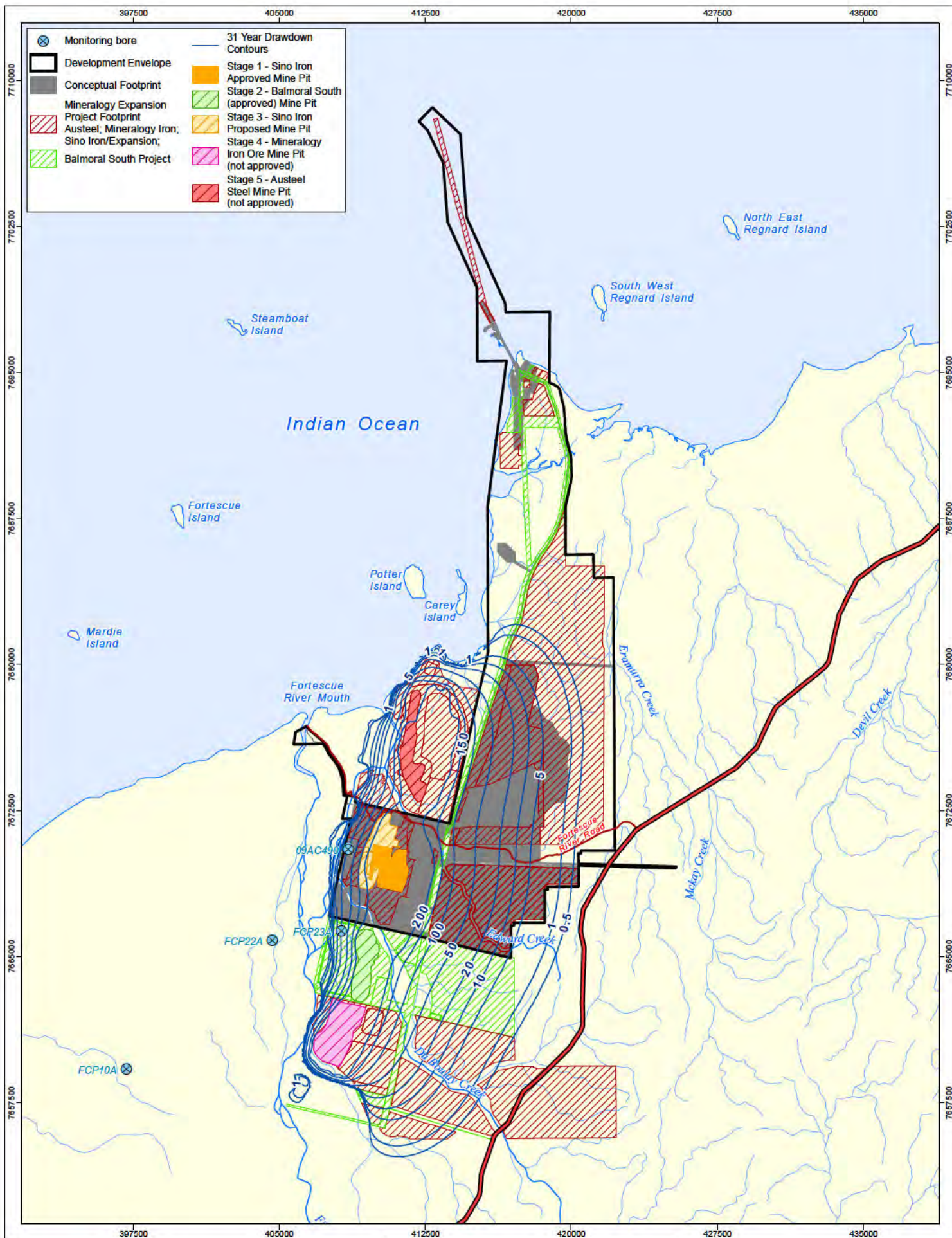
Aquaterra (2009b) predicted the groundwater outflow (i.e. from the alluvium to the pit) to be 172 kL/d to 314 kL/d or approximately 0.1 GLpa from the cumulative effects of Stages 1 to 5 (depending on the stage of development and the modelled recharge conditions). The 2009 model predicted that outflows from the alluvium would be small and may contribute between 4 and 13% of the total dewatering discharge from the mine pit, with the balance contributed from the Proterozoic basement rock aquifer/s.

The groundwater throughflow in the main aquifer (gravels) in the alluvium has been estimated (Commander 1993) at between 2.3 GLpa and 9.2 GLpa, with calculations undertaken by Aquaterra (2009b) give a throughflow estimate of around 5 GLpa under average conditions. Therefore the leakage 0.1 GLpa due to Stages 1 to 5 represents between 1.5 to 2.3% of the total throughflow of the aquifer. Aquaterra (2009b) concluded that although the drawdown within the basement material reaches the eastern edge of the alluvial aquifer in some areas, the magnitude of drawdown in the Fortescue River alluvium would be negligible.

Based on the Aquaterra (2009a) groundwater modeling the MEP PER concluded that the addition of Stages 3 to 5 would result in:

- a relatively minor increase in the extent of drawdown
- a negligible impact on the hydrological regime of the Fortescue River.

During the public comment period DoW recommended that additional work be undertaken to better describe the interactions between dewatering and the alluvium, groundwater dependent vegetation and saline inflows into the pits. These matters are addressed within the next section.



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Figure 5 - 6

Modelled extent of
Mineralogy Expansion Proposal
Stages 3 – 5 modelling drawdown

0 5 10

Kilometres

1:250,000

Datum: GDA94

Projection: MGA Zone 50

Department: ENV Date: 27/01/2017

Sheet Size: A4 Status: Final

Drawn by
CF

Requested by
MB, Strategen

Internal Reference
4407_01_2017_APP

Modelling undertaken for the Proposal

Groundwater modelling for the Proposal was undertaken by CloudGMS (2017) to further refine the modelling undertaken for the existing project as part of DoW groundwater abstraction and dewatering requirements and the MEP in 2009. The scope of the groundwater modelling study was to:

- outline regional and local hydrogeology with reference to recent investigations and present amended cross-sections showing the relationship between alluvial and basement rock aquifers
- predict annual groundwater inflows to the pit
- predict groundwater level drawdowns in response to dewatering
- assess potential impacts of mining/dewatering on groundwater quality and quantity
- predict final pit void water levels, groundwater flows and quality
- assess potential long-term impacts of mining/dewatering on other groundwater users and GDEs.

In the response to the MEP PER the DoW identified several areas of concern relating to the uncertainty of the hydraulic properties of the rocks and hydraulic connection between the alluvial sediments and the pit. Specifically, these responses included:

- representation of the spatial relationship between the alluvial sediments, pit void and basement rocks as depicted in cross-sections of the mine site
- consideration of additional flows via secondary porosity – mining at depth has potential to open up flow paths in fractures and shears in the basement rock, which would change the hydrogeological characteristics of the aquifer
- uncertainty in the hydraulic connection between alluviums associated with the Fortescue River (and Du Boulay Creek) and the pit and the impacts on GDV associated with Du Boulay Creek
- mine closure connection between the Fortescue River alluvium and the pit through secondary porosity / permeability with a worst case scenario of the pit filling to groundwater level of the alluvial aquifer.

The scope of the CloudGMS (2017) groundwater model included addressing DoW comments on previous modelling. To ensure that DoW comments were adequately addressed, the scope of the groundwater modelling was provided to DoW and a meeting held with DoW on 17 November 2016 to discuss the issues. At this meeting DoW also requested that the cumulative impacts of all mines in the Cape Preston (i.e. all mines identified in the MEP) be modelled.

The key difference with the CloudGMS (2017) model and the previous models developed for the mine is the enhanced understanding of the local geology to develop a more accurate conceptual model. Based on the conceptual model the model domain has 15 vertical layers:

- three layers representing the superficial layers
- two layers representing weathered & fractured basement rocks
- 10 layers representing the unweathered basement rocks.

In addition, the Cloud GMS (2017) model has incorporated additional local and regional data, including:

- groundwater level hydrographs from 38 DoW regional observation bores
- groundwater levels from 205 standpipe observation bores (174 of these sites were within the existing model domain and used to inform the model development and calibration)
- monthly average values of pore pressure from 109 sensors deployed across 16 bores (sensors were located at depths between -15 mAHD and -300 mAHD)
- monthly abstraction totals from 17 production bores and in-pit sumps at the existing project
- eight cross-section transects to investigate the extent and thickness of alluvial sediment to be intersected by the west mine pit.

The model extent covers the whole of the Lower Fortescue River catchment downstream of Bilanoo gauging station. The boundary conditions are:

1. Northwest boundary along the Indian Ocean is a constant head boundary and groundwater level is set at the mean seawater level.
2. Eastern boundary approximately aligns with a mapped thrust fault between the Fortescue Group to the east and is assumed as a no-flow boundary given the low conductivity and limited recharge for the weathered Hamersley Group.
3. Southern boundary located along the upstream limit of the alluvial and Yarraloola aquifers is approximately treated as a no-flow boundary as it is perpendicular to groundwater flow and given the low conductivity of the weathered Hamersley Group and only a very small part of the cross-section being alluvial sediments.

5.3.3 Diversion of Edwards Creek

The southern branch of Edwards Creek will be realigned in two sections (Figure 5-7). The two realignments will enable the disturbance area of the infrastructure to be minimised.

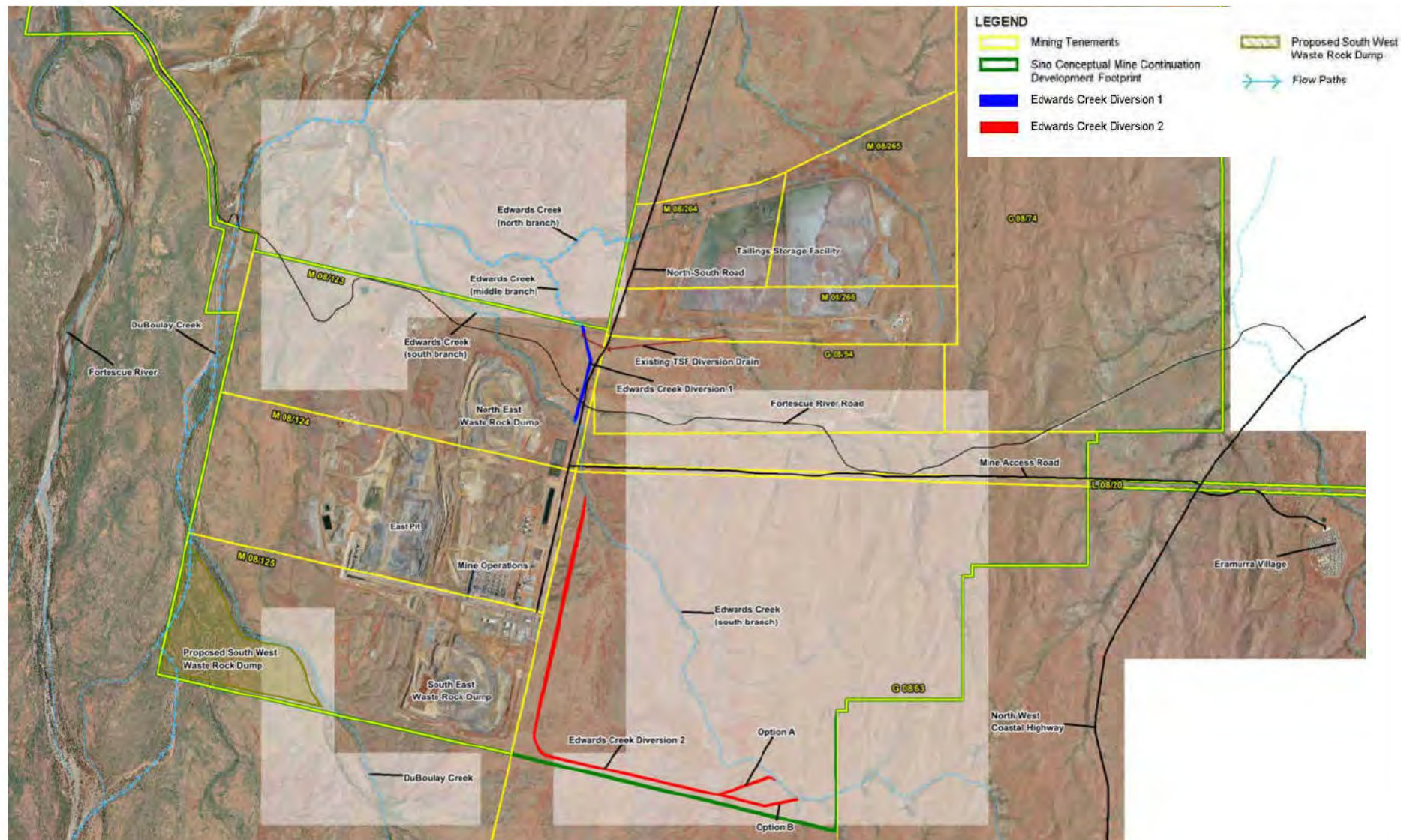
Diversion 1 is proposed to allow expansion of an existing smaller waste dump in Mining Tenement M08/123 adjacent to the mine. Diversion 1 involves realigning the southern branch of Edwards Creek along the eastern boundary of mining tenement M08/123. The alignment requires the construction of a 1.4 km channel and will result in the south branch feeding into the middle branch approximately 3 km upstream of the current location. The channel will be designed to be consistent with the dimensions of the existing channel of Edwards Creek.

Diversion 2 is proposed to accommodate the construction of the TSF in Mining Tenement G08/63 and involves diverting the southern branch of Edwards Creek around the TSF. This diversion will be 7.0 km and run west along the southern boundary of Mining Tenement G08/63 boundary and then north to rejoin the creek. The channel will be designed to be consistent with the dimensions of the existing channel of Edwards Creek.

The drainage design criteria for areas that may acceptably be subject to occasional flooding is typically set at the 1 in 5 to 10 year ARI flood level (RPS 2017). This level of flood protection may be provided by drainage channels that approximate the natural dimensions of the creeks, with a bed width of approximately 8 to 10 m (RPS 2017). Where the consequences of flooding are high (i.e. flooding of a pit) a much greater flood protection (such as a 1 in 100 year ARI) is provided. However, the associated drainage channels required to convey 1 in 100 year ARI flood flows require substantially more clearing and earthworks and are not considered warranted based on consequences.

The two diversions have been designed to accommodate the 1 in 5 to 10 year ARI flood flow. This is equivalent to the level of current flooding risk from the creeks impacting the Development Envelope, and existing drainage provisions (open channels, culverts, etc) in the Development Envelope. Once the design capacity of the open channel is exceeded, such as during cyclonic events, then flooding will occur around the mine site in general, as would occur naturally without the Proposal.

DoW (2015b) advice on future climate projections identifies that global climate change models for the Pilbara are unclear and indicate that both drier or wetter climates are possible. On this basis current rainfall values have been used in the calculation of future ARI flood flows.



Source: RPS 2017

Figure 5-7: Proposed diversion of Edwards Creek

5.4 Potential impacts

The following potential impacts have been identified:

- groundwater drawdown from dewatering has potential to modify groundwater and surface water flows
- discharge of groundwater has potential to modify surface water flows in the Fortescue River
- diversion of Edwards Creek will modify surface water flows
- construction of physical elements will alter surface water flows.

While Section 5.5.1 predicts the extent of groundwater drawdown, the effects of groundwater drawdown on GDEs are considered in Section 8.5.3. Section 5.5.2 assesses only the effect of the discharge of groundwater on hydrological process, with the effect on the water quality of the Fortescue River estuary described Section 7.5.1.

5.5 Assessment of impacts

5.5.1 Groundwater drawdown

Increase in the extent of the drawdown from the Proposal

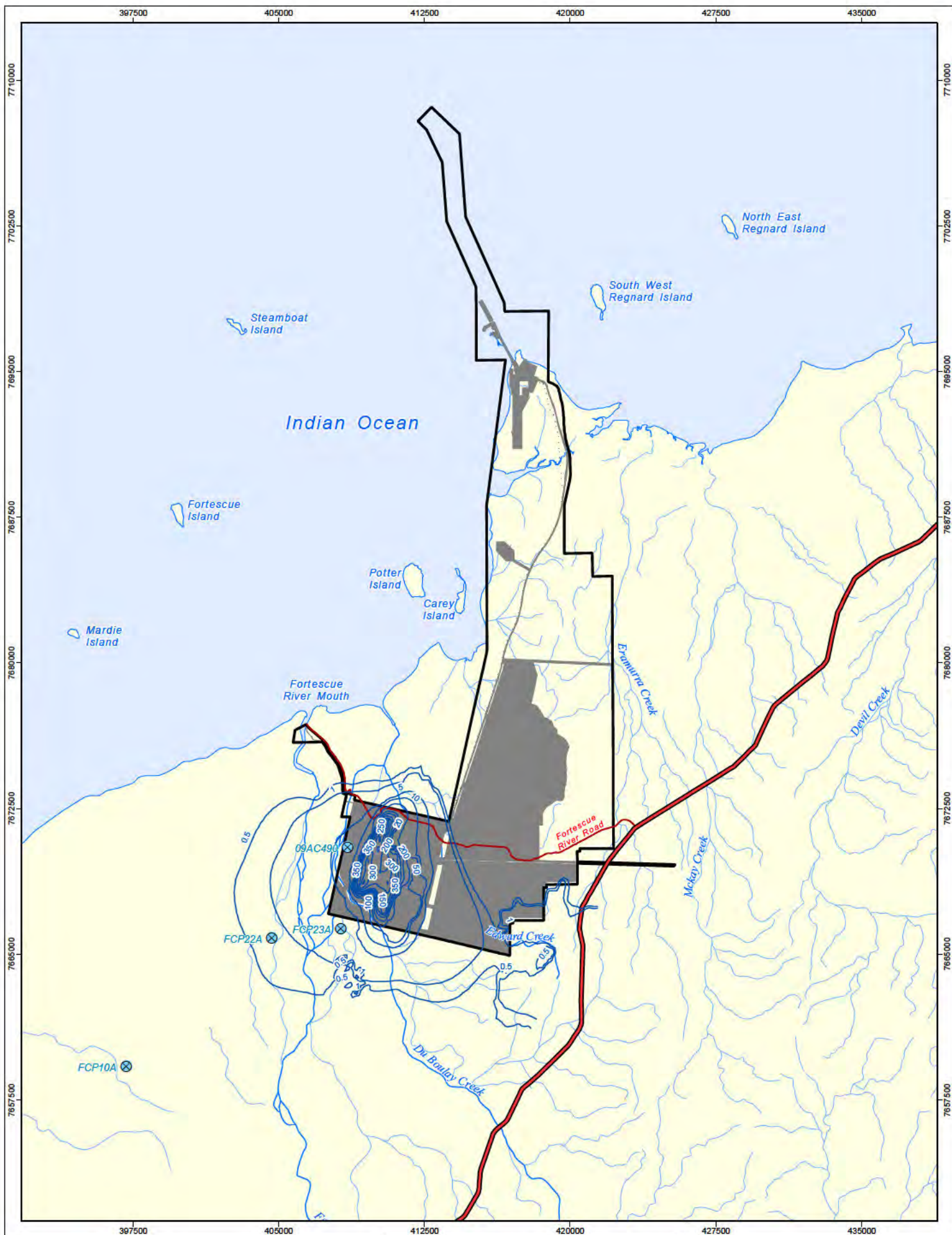
The predicted extent of drawdown from the Proposal at the end of mining is shown on Figure 5-8 (CloudGMS 2017). The extent of drawdown at 5 m, 1 m and 0.5 m contours is at approximately 2 km, 5 km and 7 km respectively from the mine pit, although at a smaller drawdown the distance is more variable. The 5.0 m drawdown contour is almost entirely within the Proposal disturbance footprint.

In comparison with the existing project (Figure 5-9) the extent of drawdown is less elongated (i.e. 'rounder'). While the extent of the 0.1 m drawdown contour for the Proposal will extend an additional 5 km to the west, it extends 5.0 km less to both the north and the south than the existing project. The 5.0 m drawdown for the Proposal is almost entirely within the 5.0 m contour of the existing project. The 10.0 m drawdown contour is entirely within the 10.0 m contour for the existing project.

As shown in shown in Table 5-3 predicted drawdown associated with the Proposal represents an overall decrease in the extent of the 0.5 m, 5.0 m and 10.0 m drawdown contours in comparison to the existing project.

Table 5-3: Comparison of extent of drawdown

Depth of drawdown(m)	Extent of existing project (ha)	Extent of Proposal (ha)	Difference (ha)
0.5	15 730.7	14 399.1	-1331.6
5.0	11 840.5	3192.2	-8648.3
10.0	9940.7	2144.4	-7796.3



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Figure 5 - 8

Extent of groundwater
drawdown

0 5 10

Kilometres

1:250,000

Datum: GDA94
Projection: MGA Zone 50

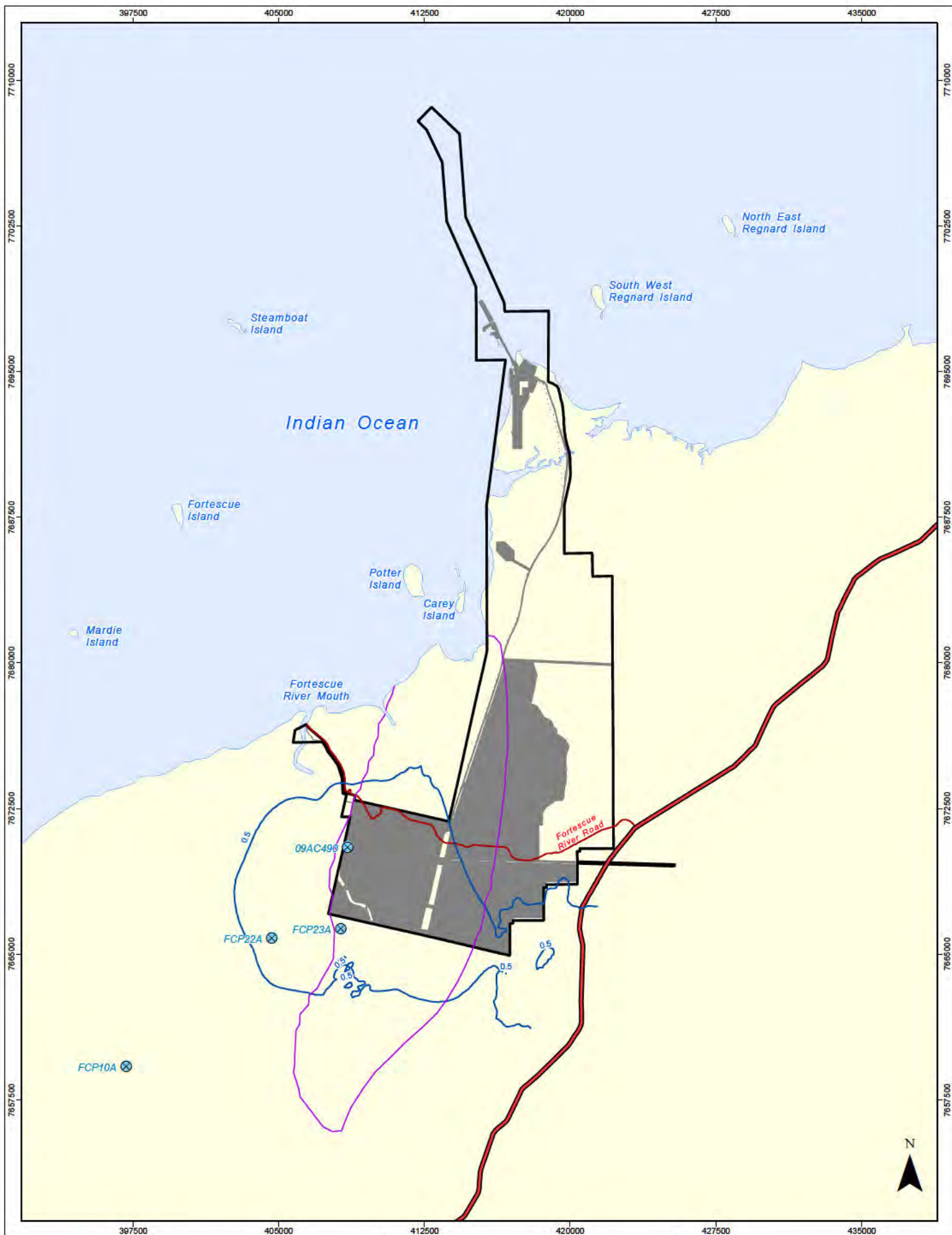
Department: ENV Date: 27/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MB, Strategen Internal Reference 4408_01_2017_APP

Legend

- Monitoring bore
- Groundwater Drawdown
- Mine Continuation Proposal
- Major Creek/River
- Minor Creek/River
- Development Envelope
- Conceptual Footprint

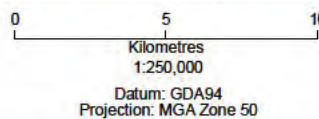


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Figure 5 - 9A

Comparison of extent of
drawdown (0.5m) with approved extent



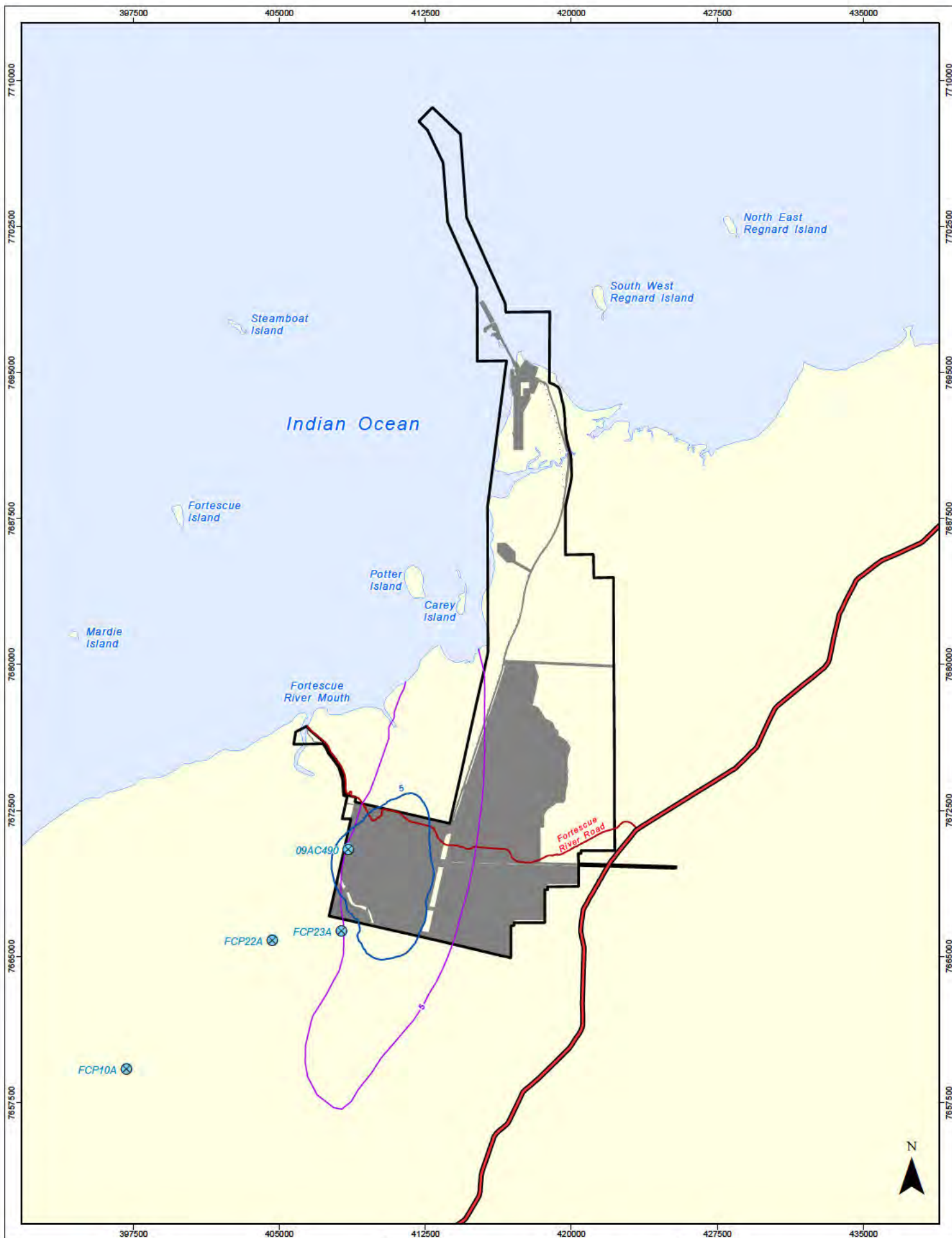
Department: ENV Date: 27/01/2017

Sheet Size: A4 Status: Final

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Legend

- Monitoring bore
- Groundwater Drawdown
- Mine Continuation Proposal
- 20 Year Drawdown Approved Extent
- Development Envelope
- Conceptual Footprint



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Mine Continuation Proposal

Figure 5 - 9B

Comparison of extent of
drawdown (5m) with approved extent

0 5 10
Kilometres
1:250,000
Datum: GDA94
Projection: MGA Zone 50

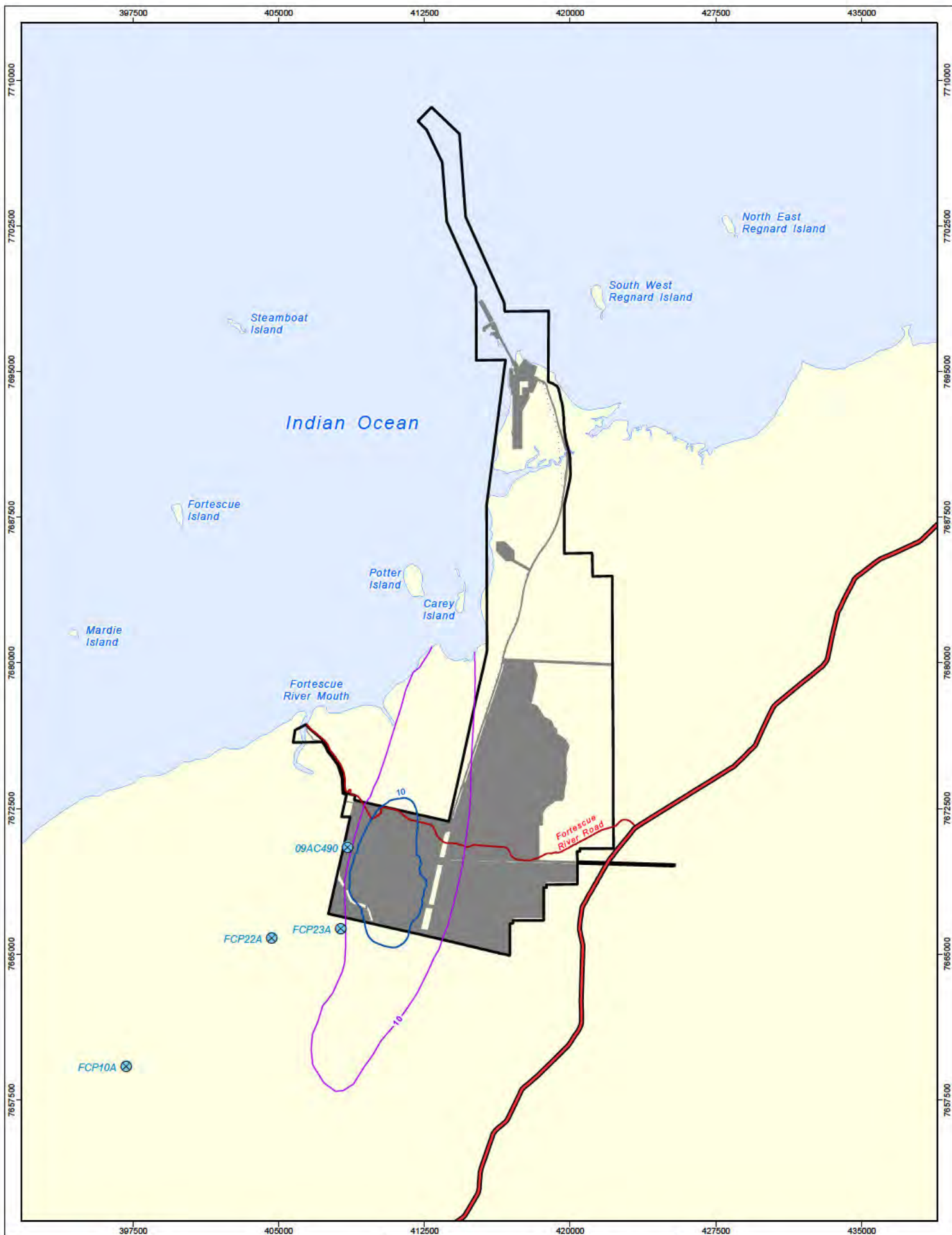
Department: ENV Date: 27/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MB, Strategen Internal Reference 4451_00_2017_APP

Legend

- Groundwater Drawdown
- Mine Continuation Proposal
- 20 Year Drawdown Approved Extent
- Development Envelope
- Conceptual Footprint

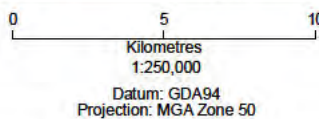


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Mine Continuation Proposal

Figure 5 - 9C

Comparison of extent of
drawdown (10m) with approved extent



Legend

- ⊗ Monitoring bore
- Groundwater Drawdown
- Mine Continuation Proposal
- 20 Year Drawdown Approved Extent
- Development Envelope
- Conceptual Footprint

Department: ENV Date: 27/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MB, Strategen Internal Reference 4452_00_2017_APP

As shown in Figure 5-10 the potential impacts of a drawdown of less than 1.0 m during the life of mine is expected to be difficult to observe. While the groundwater model is capable of predicting a drawdown of 0.5 m or less, the highly variable groundwater levels within the Fortescue River flood plain is expected to make it difficult to detect a groundwater drawdown of 0.5 m in the field. Modelled groundwater level hydrographs (shown in Figure 5-10) are provided for regional reference monitoring sites to demonstrate the variability and rate of change in groundwater levels within each drawdown contour:

1. FCP10A located approximately 15 km SW of the mine pit is predicted to have a drawdown of less than 0.5 m. This hydrograph shows minimal change in groundwater levels over the 144 year period modelled.
2. FCP22A located at approximately 5 km SW of the mine pit is predicted to have a drawdown of between 0.5 and 1.0 m. The high degree of variability in the hydrograph is a result of the proximity of the bore to the Fortescue River (approximately 1 km) and in response to rainfall and river flows. Groundwater levels will continue to vary seasonally in response to rainfall and river flow by approximately 2.0 m. This hydrograph shows a subtle decline in groundwater levels.
3. FCP23A located approximately 2 km SW of the mine pit is predicted to have a drawdown of between 1.0 and 5.0 m. The groundwater levels at FCP23A shows a gradual decline of approximately 3 to 4 metres during mining and appears to reach dynamic equilibrium at this level soon after the completion of mining.
4. 09AC490 located 1 km West of the mine pit is predicted to have a drawdown of between 5.0 and 10 m. This hydrograph shows a steady decline over the life of mining of approximately 8 m at 40 years (i.e. on average 1 m every five years) and then stabilises at the completion of mining. However, this location is within the Proposal development footprint.

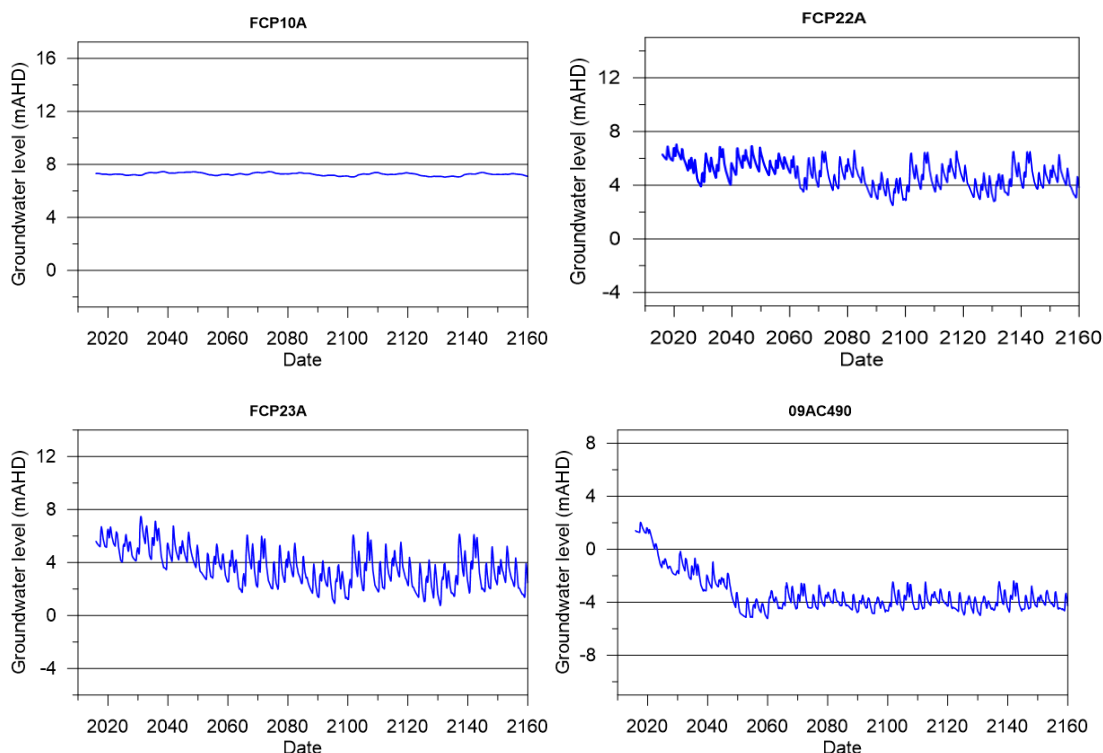


Figure 5-10: Changes to groundwater levels

Effect on surface water pools

As identified in Section 5.3.1, there are two permanent and five temporary groundwater pools on the Fortescue River floodplain. The pools are all river flow fed, although the furthest pool downstream, Tom Bull Pool, is also tidally inundated (CloudGMS 2017). Only Mungajee Pool was identified as a permanent freshwater pool. Mungajee Pool is located at approximately 7 km SW of the mine pit.

As shown in Figure 5-11, groundwater levels at Mungajee Pool are predicted to have a drawdown of less than 1.0 m over more than 100 years. As the groundwater levels vary seasonally by approximately 2.0 m this demonstrates that water in the pool will be present long enough to contribute to the regional groundwater. On this basis, it is unlikely that there will be a significant change in the hydrological values of any surface water pools.

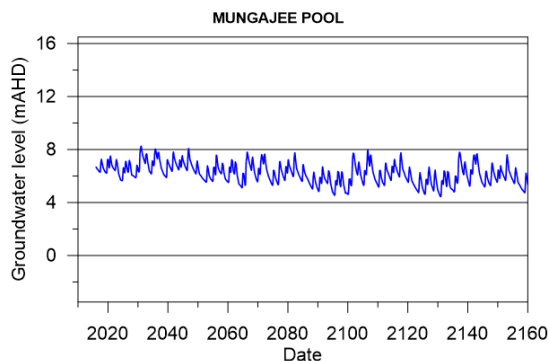


Figure 5-11: Mungajee Pool hydrograph

Recovery of groundwater level after closure

At the completion of mining the vertical profile of the groundwater drawdown will change from a steep-sided deep profile to a shallower profile. While this means that the extent of deeper drawdown levels (i.e. more than 10 m) will contract closer to the mine pit it will result in a minor increase in the extent of the shallower 1.0 m contour. The post closure groundwater levels are shown in Figure 5-12.

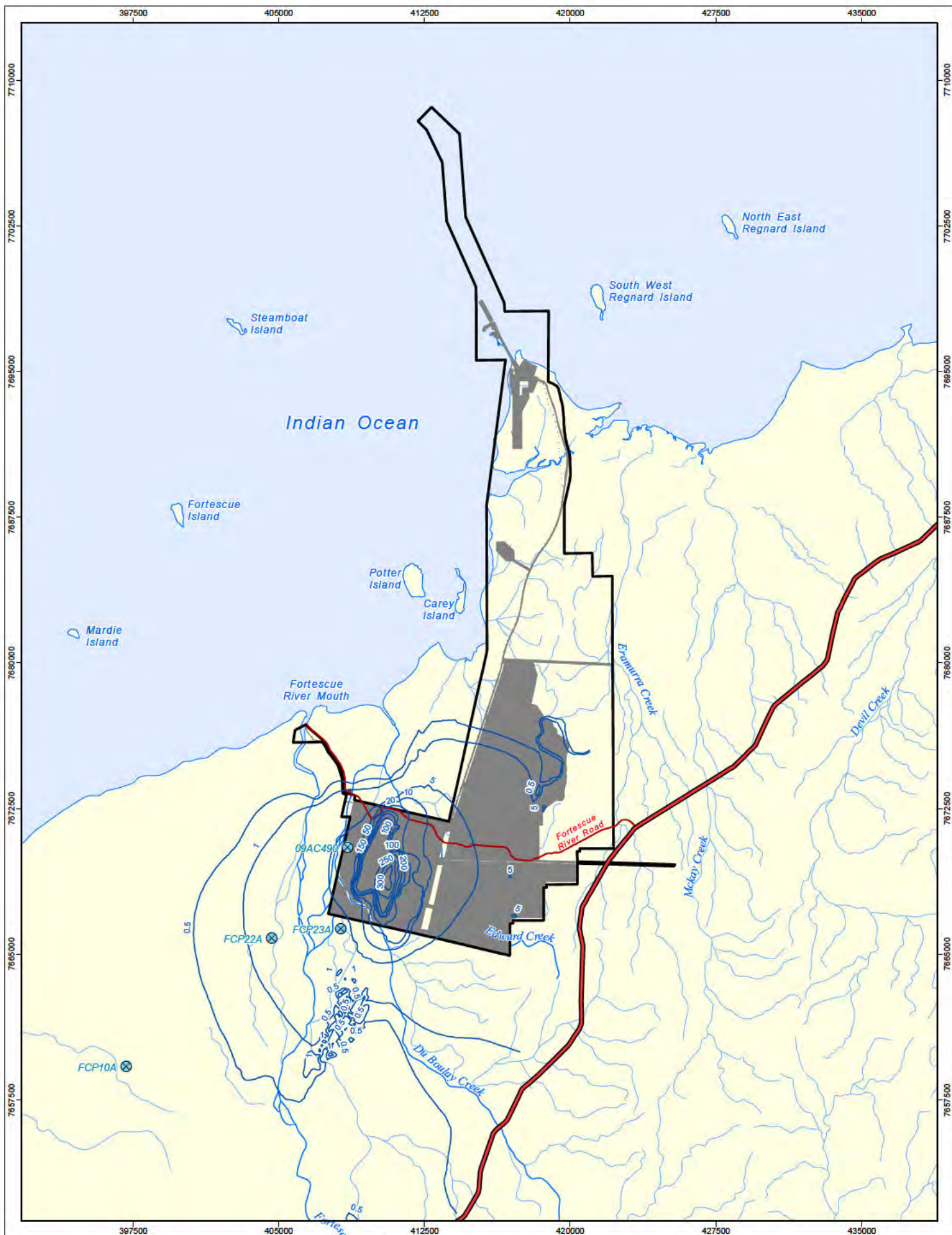
The recovery of groundwater levels will result in the flow of groundwater into the pit. The West Pit is predicted to fill relatively rapidly due to groundwater inflows from the weathered material along the western margin of the pit.

After 100 years the water level in the West Pit is expected to reach a level of approximately -160 to -170 mAHD (i.e. more than 230 m deep) with the East Pit recovering to a water level of approximately -300 to -310 mAHD (i.e. 50 m deep) (Figure 5-13).

Regional context of groundwater changes

In addition to the magnitude of the change in groundwater levels the relative change in groundwater levels is also important. Figure 5-14 to Figure 5-16 show changes to depth to water as a result of the Proposal. As shown in Figure 5-14 currently the depth to the groundwater in proximity to the mine pit is 10 m. The depth to groundwater for the majority of the Fortescue River floodplain is between 20 and 5 m, closer to the coastline the depth to the groundwater decreases. With the exception of the mine pit, at the end of mining the depth to groundwater is not predicted to be substantially different throughout the extent of the model. The dewatering will increase the extent of the area that has a groundwater depth between 10 – 20 m; however, this approximately follows the existing boundaries and distribution of groundwater depths.

At 80 years after the completion of mining (Figure 5-16) the depth to groundwater throughout the modelled area will again be very similar to levels at the start of the modelling period. On this basis, groundwater levels are not expected to substantially change in the regional area.



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Figure 5 - 12

Post closure groundwater levels

0 5 10
Kilometres

1:250,000

Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 27/01/2017

Sheet Size: A4 Status: Final

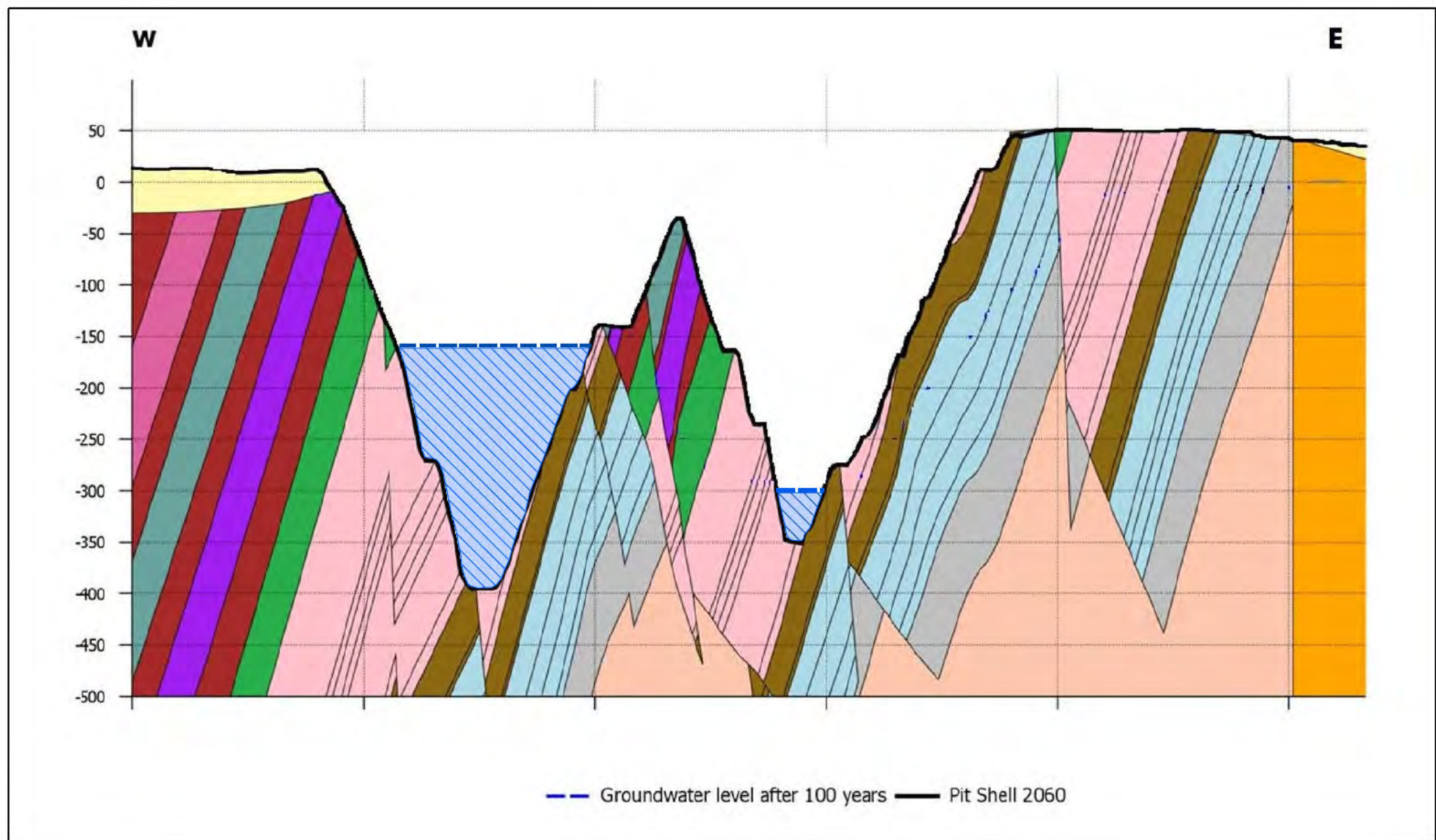
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DS

Requested by
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Internal Reference
4458_01_2017_APP

Legend

- Monitoring bore
- Post closure groundwater levels
- Major Creek/River
- Minor Creek/River
- Development Envelope
- Conceptual Footprint



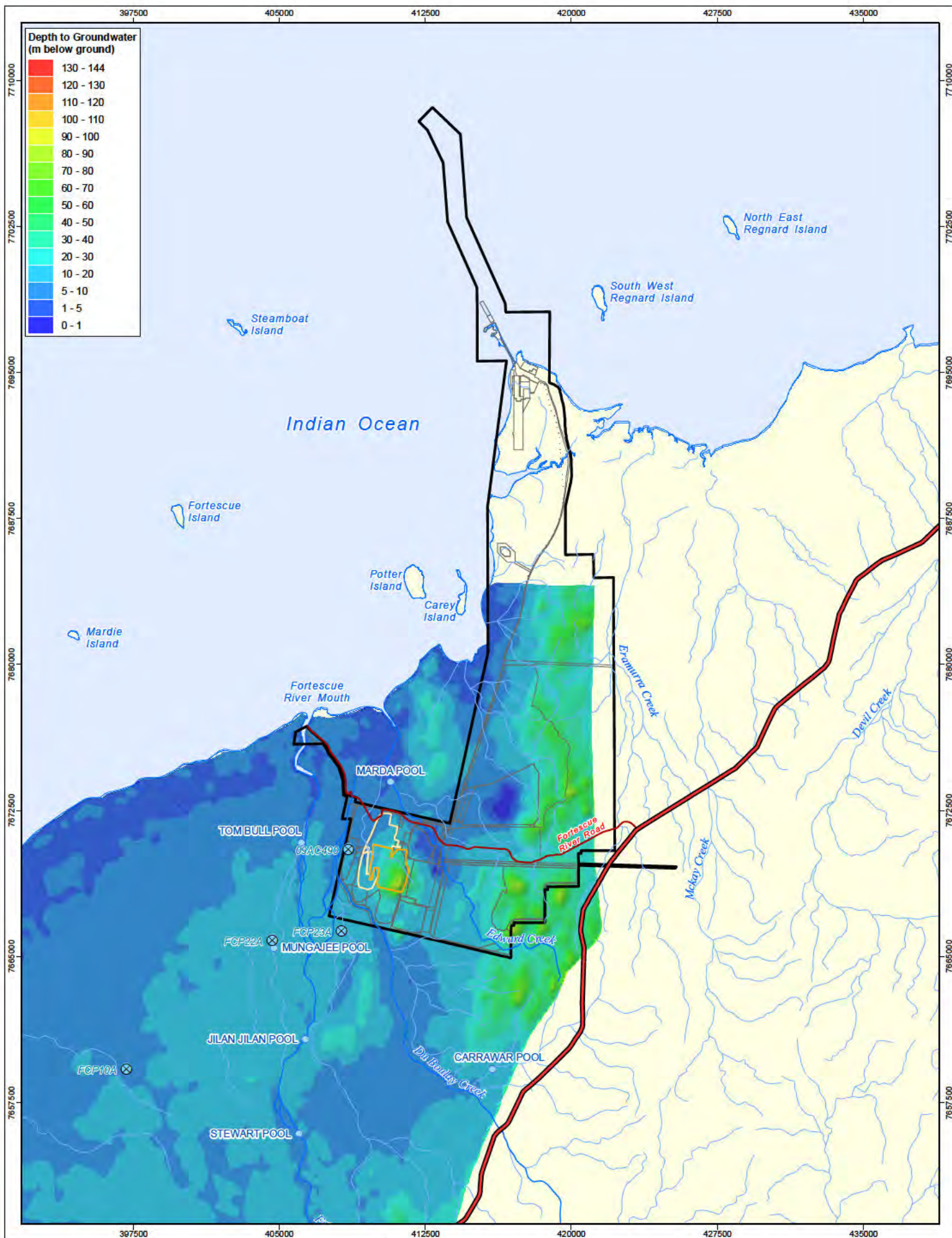
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Mine Continuation Proposal

Figure 5-13

Conceptual Mine Pit Closure Section

Department:	ENV	Date:	1/02/2017
Sheet Size:	A4	Status:	Final
Drawn by DS	Requested by MB, Strategen	Internal Reference 4461_00_2017_APP	



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Mine Continuation Proposal

Figure 5 - 14

Current regional dept
to groundwater

0 5 10
Kilometres

1:250,000

Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 27/01/2017

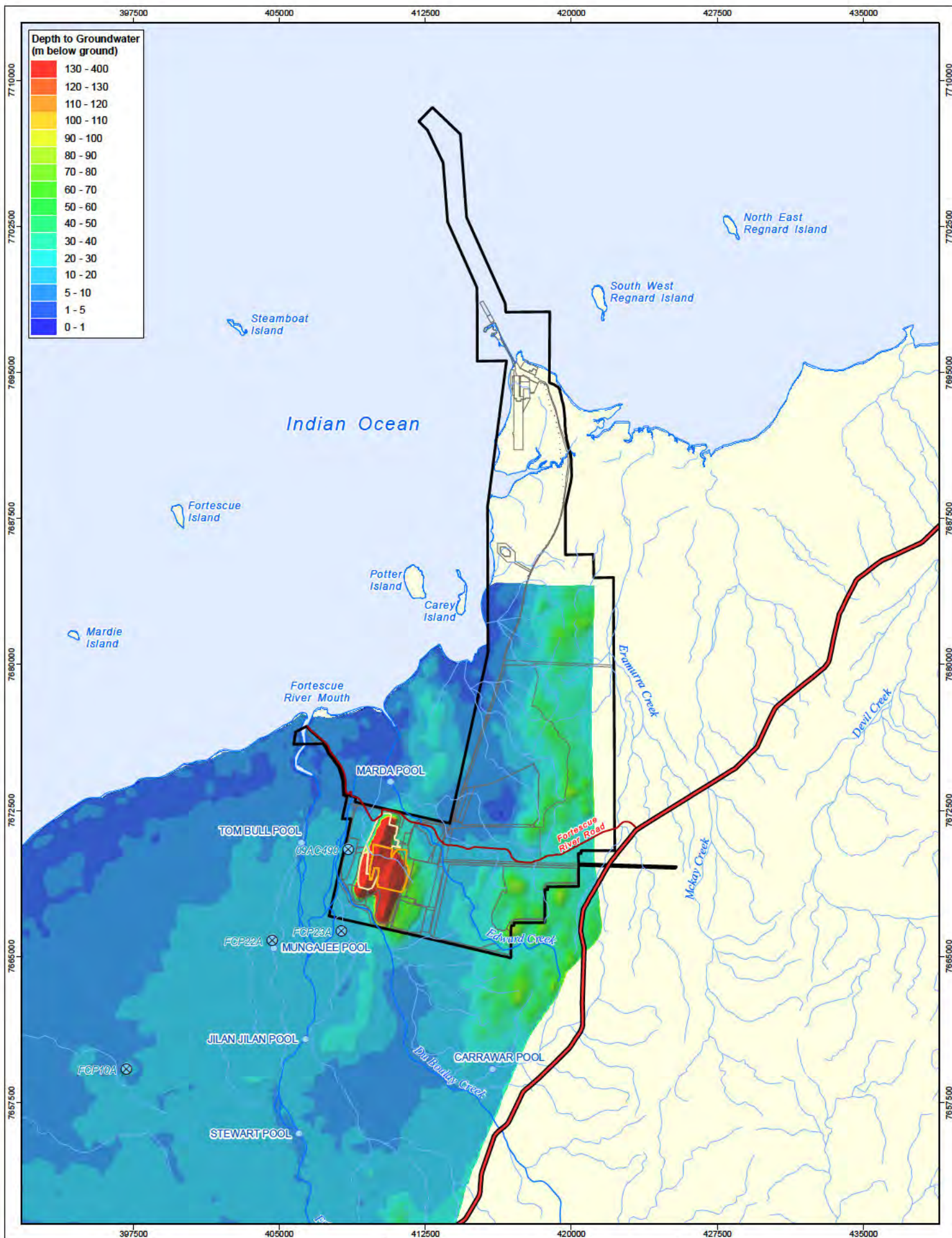
Sheet Size: A4 Status: Final

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Internal Reference
4433_00_2017_APP

- ⊗ Monitoring bore
- Pool
- Major Creek/River
- Minor Creek/River
- Conceptual Footprint
- ▭ Development Envelope
- ▭ Stage 1 - Sino Iron Approved Mine Pit
- ▭ Stage 3 - Sino Iron Extension Mine Pit



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Mine Continuation Proposal

Figure 5 - 15

Depth to regional groundwater
at end of mining

0 5 10
Kilometres

1:250,000

Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 27/01/2017

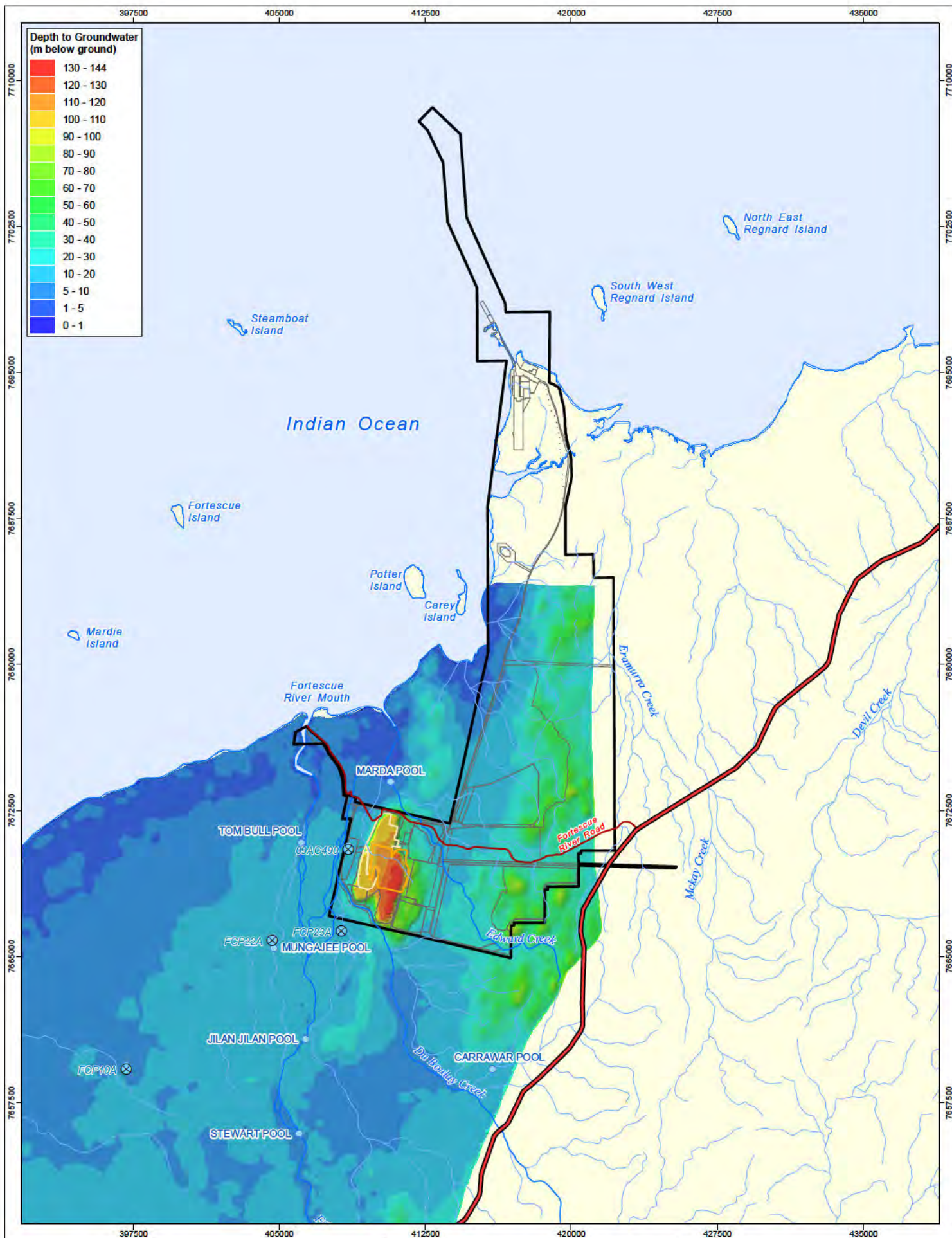
Sheet Size: A4 Status: Final

Drawn by
CF

Requested by
MB, Strategen

Internal Reference
4434_00_2017_APP

- Monitoring bore
- Pool
- Major Creek/River
- Minor Creek/River
- Conceptual Footprint
- Development Envelope
- Stage 1 - Sino Iron Approved Mine Pit
- Stage 3 - Sino Iron Extension Mine Pit



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Figure 5 - 16

Depth to regional groundwater
80 years after end of mining

0 5 10

Kilometres

1:250,000

Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 27/01/2017

Sheet Size: A4 Status: Final

Drawn by: CF Requested by: MB, Strategen Internal Reference: 4435_00_2017_APP

- Monitoring bore
- Pool
- Major Creek/River
- Minor Creek/River
- Conceptual Footprint
- Development Envelope
- Stage 1 - Sino Iron Approved Mine Pit
- Stage 3 - Sino Iron Extension Mine Pit

Consideration of cumulative impacts

In accordance with feedback received from DoW CloudGMS (2017) undertook a model run that included the full development of all mines in the Cape Preston area (as identified in the MEP). The consideration of impacts included an estimate of possible mining and dewatering requirements; however, it has not been possible to verify these assumptions with the other proponents and it is considered unlikely that any of these mines will be developed. Thus these cumulative impacts are highly unlikely to materialise and represent a best estimate 'worst' case.

The cumulative impact model assumed that the mines were similar to that proposed in the MEP, which specify similar pit depths to this Proposal for the other mine pits. In addition to the consideration of other mines pits the Balmoral South (i.e. Stage 2) proposal included the establishment of a borefield to produce water for operational requirements. The Balmoral South borefield includes 20 production bores within the Fortescue River floodplain alluvium to the southwest of the Proposal that are designed to generate 6 GLpa (Figure 5-17).

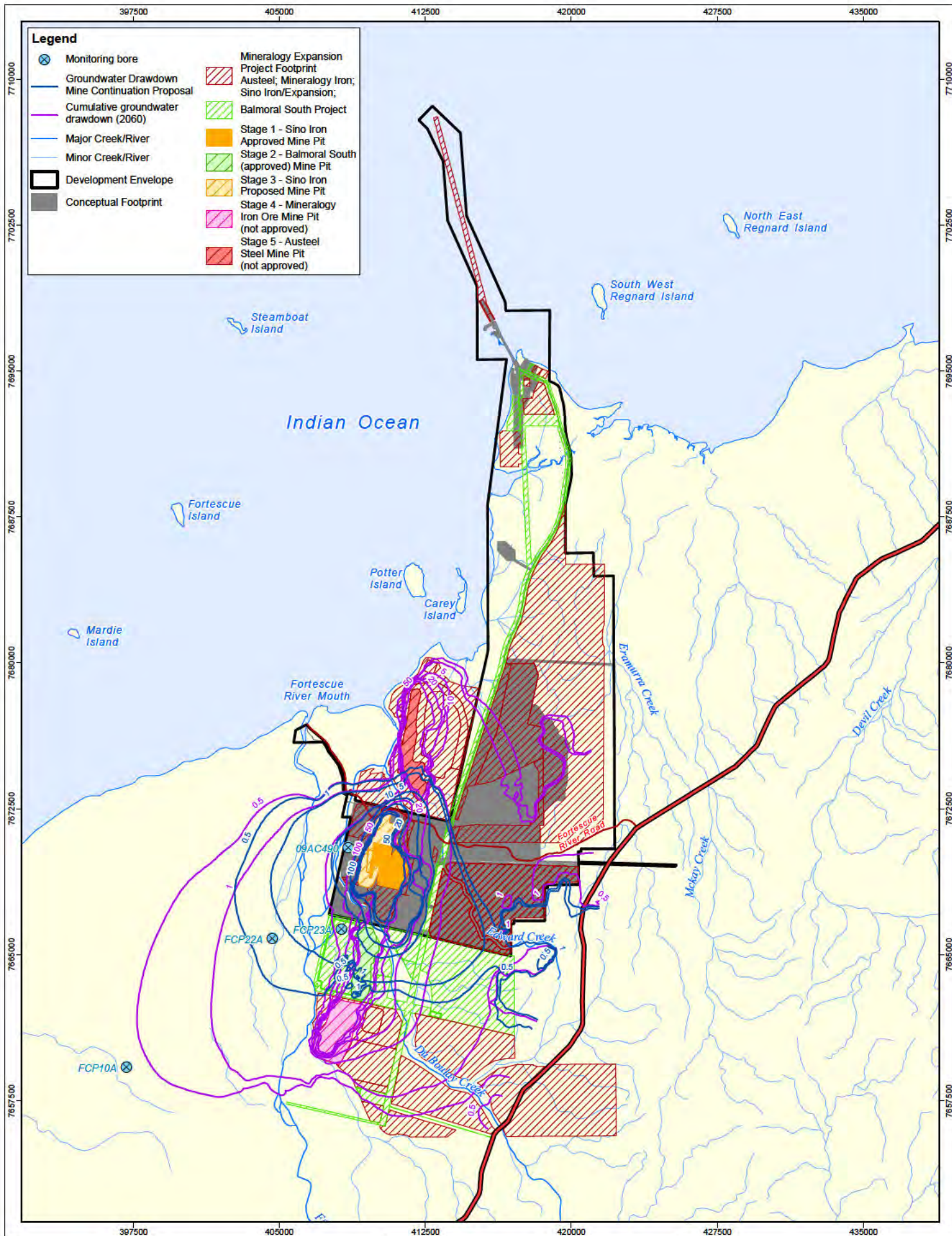
Extent of drawdown from inclusion of additional mine pits generally follows that of the Proposal, i.e. drawdowns of 5 m are generally confined to within 2 km of the mine pits. However, the inclusion of the production bores throughout the superficial aquifer located in the Fortescue River floodplain substantially expand the extent of the 1.0 m and 0.5 m drawdown contours.

As shown in Table 5-4 the extent of the cumulative 0.5 m drawdown contour is substantially larger than either the existing project or the Proposal (approximately twice as large). However, both the 5.0 m and 10.0 m drawdown contours are much smaller than the existing project and not substantially greater than those forecast for the Proposal. This indicates that higher drawdown contours are primarily limited to the immediate vicinity of the mine pits.

Although the development of the other mines pits is considered unlikely by the Proponent, outside the implementation of the production bores, the additional mine pits do not substantially increase the extent of groundwater drawdown.

Table 5-4: Comparison of extent of cumulative drawdown of all mines

Depth of drawdown(m)	Extent of existing project (ha)	Extent of Proposal (ha)	Cumulative drawdown of all Cape Preston mines (ha)
0.5	15 730.7	14 399.1	30 069.6
5.0	11 840.5	3192.2	4972.6
10.0	9940.7	2144.4	2319.0



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Mine Continuation Proposal

Figure 5 - 17

Extent of cumulative
groundwater drawdown

0 5 10
Kilometres

1:250,000

Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 27/01/2017

Sheet Size: A4 Status: Final

Drawn by
DS

Requested by
MB, Strategen

Internal Reference
4450_00_2017_APP

5.5.2 Discharge of groundwater

Figure 5-18 presents the total modelled pit inflows over the life of the mine. The predicted inflows show a steady increase to approximately 5 GLpa in 2025. This steady increase coincides with the mining in the West Pit. The median final pit inflows are approximately 7.5 GLpa at around 2035.

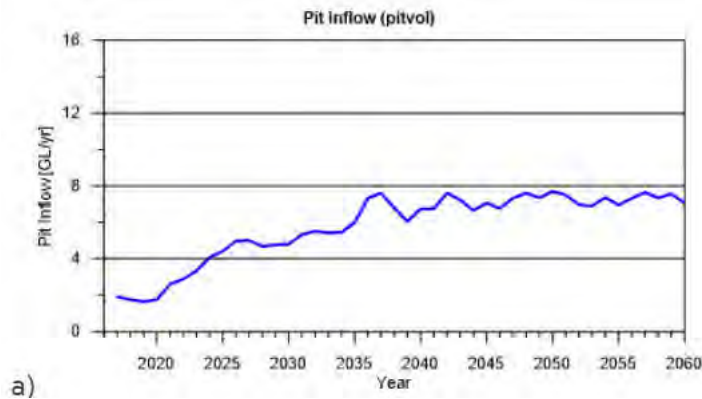


Figure 5-18: Total pit inflows

Based on a median pit inflow of 7.5 GLpa (as identified in Figure 5-18) the Proposal includes increasing the discharge from 2 GLpa to up to 8.0 GLpa. The discharge of 8.0 GLpa will accommodate years where pit inflows are above predicted median inflow. The Proposal will increase the groundwater discharge into the lower Fortescue River estuary. The hydrological regime at the mouth of the Fortescue River is not expected to be significantly affected by the addition of the groundwater as the natural flows are large (Fortescue River discharge is greater than 305 GLpa), highly variable and have a strong tidal influence.

RPS APASA (2017) determined that the peak downstream river flow rates ranged from 40 m³/s during neap tide to 200 m³/s during the spring tide. In comparison flow rates from the release of 8 GLpa was 0.24 m³/s. On this basis, the change to any hydrological processes from the discharge of groundwater would be negligible.

5.5.3 Diversion of Edwards Creek

The southern branch of Edwards Creek will be realigned in two sections (Figure 5-7). As described in Section 5.3.3, the two realignments will enable the disturbance area of the infrastructure to be minimised.

Both diversions have been designed to reflect the existing channel with a bed width of 8 to 10 m and able to accommodate a 5 to 10 year ARI flood event. The intent of the design for the proposed diversions is to perform in a similar manner during runoff events to the existing channel, and be stable in the long term with similar hydraulic and geomorphic characteristics. To achieve the design intent the proposed alignment maintains the length of the original creek so as not to increase the gradient of the creek bed. On this basis, the channel is not expected to significantly alter either the flow or velocity of the creek.

As the velocity of the creek is proposed to be maintained the diversions are unlikely to substantially modify the surface flow properties of Edwards Creek.

5.5.4 Alteration of surface flows

The Proposal will involve placing an additional waste rock stockpile in the south-west corner of tenement M08/125, within the 1 in 100 year ARI flood extent of both the Fortescue River and Du Boulay Creek floodplain. The 1 in 100 year ARI floodplain for Du Boulay Creek is approximately 1400 m wide (on average), while the riparian zone appears to vary from 300 to 600 m and up to 1 km wide.

Encroachment of the waste dump onto the flood plain will restrict flow (in significant flood events), resulting in increased flood height and velocity. During a 1 in 100 year ARI flood the flood height is forecast to rise by 0.75 m with an average increase in velocity of 0.2 m/s (to a total velocity of 2.0 m/s).

The increase in flood height and velocity are not expected to produce a measureable change in the sediment load of the creek during 100 year ARI flood events. The Proposal will maintain vegetation buffer between the Proposal footprint and floodplain channels to limit increases in flood levels and velocities, and minimise erosion. On this basis the Proposal is therefore unlikely to significantly affect stream flow characteristics of any water course.

5.6 Mitigation

The overall objective for the mitigation of impacts to hydrological processes is to ensure that the impacts on hydrological regimes as a result of implementation of the Proposal will be minimised so as to meet the EPA's objective. The Proposal will continue to apply management measures outlined in the DoW operating licence required under the RiWI Act. An application to update the licence will be submitted to DoW that will continue to apply existing measures.

The mitigation measures proposed include:

Avoidance:

- incorporate flood modelling data and surface flow data into the design of the Proposal to avoid significant impacts to hydrological processes.

Minimisation:

- discharging groundwater to the Fortescue River on outgoing tides to minimise changes to hydrological processes
- a naturally vegetated buffer will be maintained between the bunds around the Proposal elements and floodplain channels to limit increases in flood levels and velocities, and minimise erosion
- monitoring will be undertaken to continue to assess potential impacts to nearby creeklines
- an Operating Strategy shall detail the monitoring and adaptive management measures for of the groundwater drawdown aspects
- realignment of the southern branch of Edwards Creek into two sections to enable the minimisation of the disturbance area of the infrastructure.

5.7 Predicted outcome

When the mitigation and management measures have been implemented, it is expected that the Proposal will result in the following outcomes in relation to the Hydrological processes factor:

- the areal extent of the 0.5 m, 5.0 m and 10.0 m drawdown contours will decrease relative to the existing project
- the recovery of groundwater is expected to result in a pit lake of approximately 250 m deep in the west pit and 20 m deep in the east pit
- the regional groundwater levels are not expected to be significantly affected
- no permanent pools will be significantly affected
- the cumulative development of all mines on Cape Preston would not substantially increase the areal extent of groundwater drawdown
- although highly unlikely to occur the inclusion of additional mines to assess cumulative impacts to hydrological processes do not significantly affect groundwater levels; however, Balmoral South borefield will increase the extent of the 1.0 m drawdown contour
- during mining the predicted mine pit inflows that will need to be dewatered are 8.0 GLpa
- the discharge of 8.0 GLpa will not substantially affect flows or values of the Fortescue River
- the development of a Waste Dump adjacent to Du Boulay Creek is not expected to affect volumes or surface water significantly increase flow velocities.

Based on the predicted residual impacts, the objective for Hydrological processes can be met.

6. Inland waters environmental quality

6.1 EPA objective

To maintain the quality of groundwater and surface water so that environmental values are protected.

6.2 Policy and guidance

The relevant policy for Inland waters environmental quality is:

- *Environmental Factor Guideline - Inland Waters Environmental Quality* (EPA 2016c).

6.3 Receiving environment

A summary of work completed to describe the receiving environment regarding Inland waters environmental quality is included in Table 6-1.

Table 6-1: Summary of environmental studies and survey effort

Author/ date	Survey/ investigations name	Study area, type and timing	Study standard/guidance and limitations
Recently completed work			
RPS 2017	<i>Edwards Creek Diversions and Southwest Waste Dump</i>	A surface water assessment of engineering designs.	
RPS APASA 2017	<i>Discharge Modelling Assessment Fortescue River Outfall</i>	Delft3D-FLOW hydrodynamic model.	Peer reviewed model. Model adheres to the International Association for Hydro-Environment Engineering and Research guidelines for documenting the validity of computational modelling software, closely replicating an array of analytical, laboratory, schematic and real-world data.
RPS APASA 2016	<i>Cape Preston Pit Water River Discharge Assessment</i>	Nearfield dilution assessment for the discharge of 2 GLpa.	
Aquaterra 2009a	<i>Mineralogy Expansion Projects (Stage 3-5) Surface Water Management</i>	Surface water assessment (including 1 in 100 year ARI flood assessment) of the Fortescue River and Du Boulay Creek floodplain adjacent to the Sino Iron Project for the Stages 3-5 Mineralogy Expansion Proposal conducted in 2009.	ANZECC/ARMCANZ Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000). Water Quality Protection Guidelines (No. 1-11) (DoW & DoIR, 2000). State Water Quality Management Strategy (ANZECC and ARMCANZ, 2001).

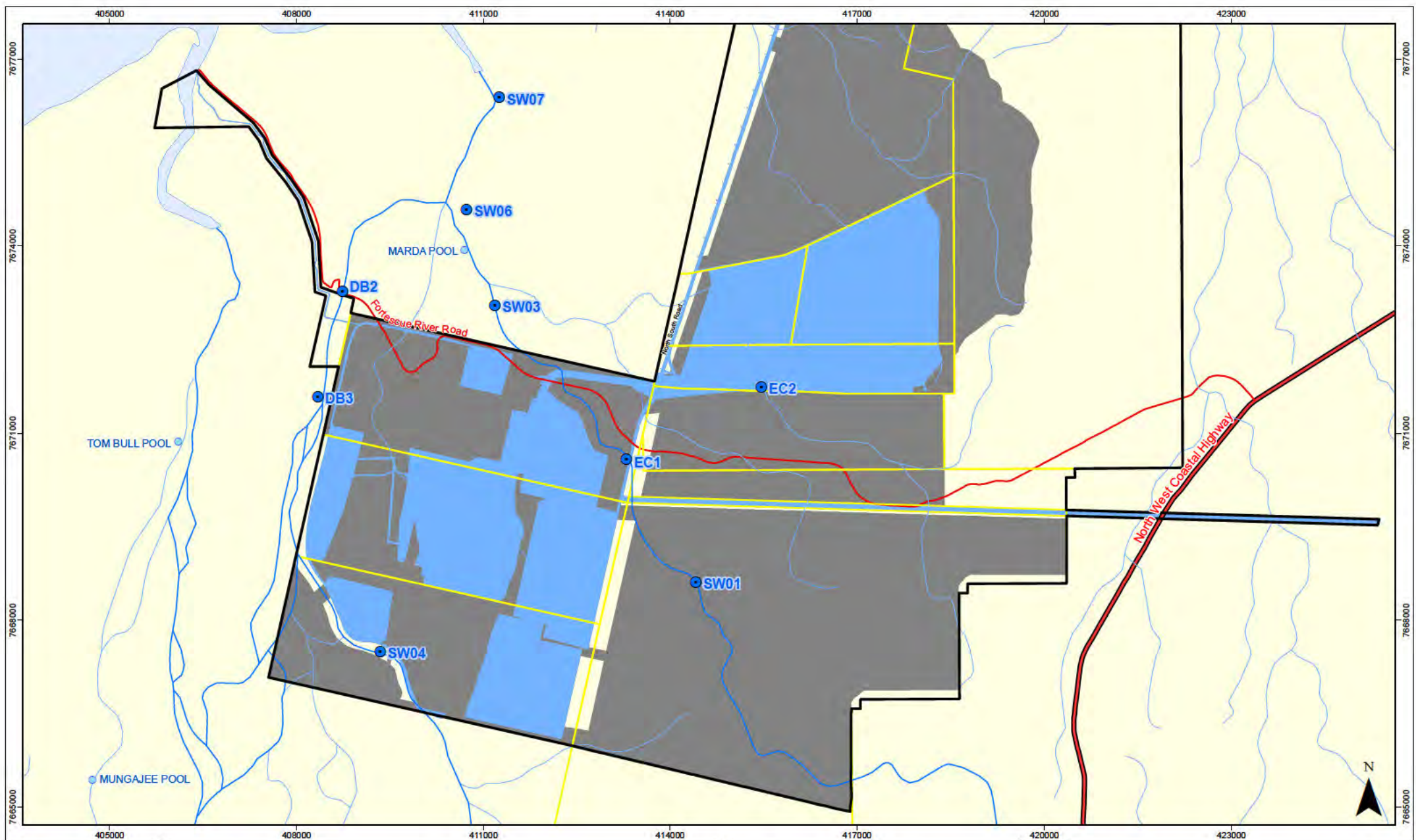
6.3.1 Water quality of the Fortescue River

As described in Section 5.3.1, at the mouth of the Fortescue River, the river channel is in excess of 200 m wide forming an estuarine setting of salt marsh and intertidal flats (Aquaterra 2009a). The combination of a wide well defined channel and high tidal range provides high velocities in the river mouth and the current speed in the Fortescue River frequently exceeds 0.1 m/s (Aquaterra 2009a). The strong tidal influence means the estuary has a low sediment trapping efficiency; naturally high turbidity and well mixed waters. In addition to the strong tidal flows, the river mouth also experiences a very high rate of flushing from the discharge of water during the wet season.

Salinity (TDS) of the lower tidal reaches of the Fortescue River has been recorded between 39 000 to 41 000 mg/L over the dry season, with typical concentrations of 37 000 mg/L which exceeds the typical concentration of seawater salinity (around 35 000 mg/L TDS) due to concentration by evaporation of salts within the river estuary and tidal reaches (RPS APASA 2017). However, the system is expected to be highly dynamic and at periods of high flow (i.e. the wet season) the salinity is expected to be lower, reflecting the greater relative volume of freshwater.

The tidal influence extends approximately 4 km inland.

The Proponents have an ongoing surface water monitoring across the Development Envelope to detect any changes to the water quality in the watercourses (Figure 6-1).



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Figure 6 - 1

Location of surface water quality sampling sites

0 1.5 3
Kilometres
1:80,000

Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 20/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MC, Strategen Internal Reference 4411_01_2017_APP

Legend

- Baseline Surface Water Monitoring Site
- Pool
- Major Creek/River
- Minor Creek/River
- Principal Road
- Major Road
- Development Envelope
- Statement 635 approval (MS635)
- Conceptual Footprint

6.3.2 Design of surface water diversion

The southern branch of Edwards Creek will be realigned in two sections (Figure 5-7). As described in Section 5.3.3, the two diversions will enable the disturbance area of the infrastructure to be minimised.

The two diversions have been designed to accommodate the 5 - 10 year ARI flood flow. This is equivalent to the level of current flooding risk from the creeks impacting the site, and existing drainage provisions (open channels, culverts, etc) on the site. Once the design capacity of the open channel is exceeded, during cyclonic events for example, then flooding will occur around the mine site in general, as would occur naturally without the development.

By maintaining the natural design of the creek the design is not expected to change the hydrological properties of the creek.

6.3.3 Formation of pit lake

As described in Section 5.5.2, during mining the rate of flow into the pit is approximately 8 GLpa. As groundwater levels recover, the numerical model estimates pit inflows to increase to approximately 7.1 GLpa. The rate of evaporative losses from the pit varies depending on the depth of the pit.

After 100 years the water level in the West Pit is expected to reach a level of approximately -160 to -170 mAHD (i.e. more than 230 m deep) with the East Pit recovering to a water level of –approximately -300 to -310 mAHD (i.e. 50 m deep) (Figure 5-13).

The quality of the groundwater flowing into the pit lake has been estimated using a backward streamlines analysis to determine the source of the water. As shown in Figure 6-2, the quality of the groundwater varies with the distance from the coast. The quality of inflows varies and includes both fresh and saline water (CloudGMS 2017).

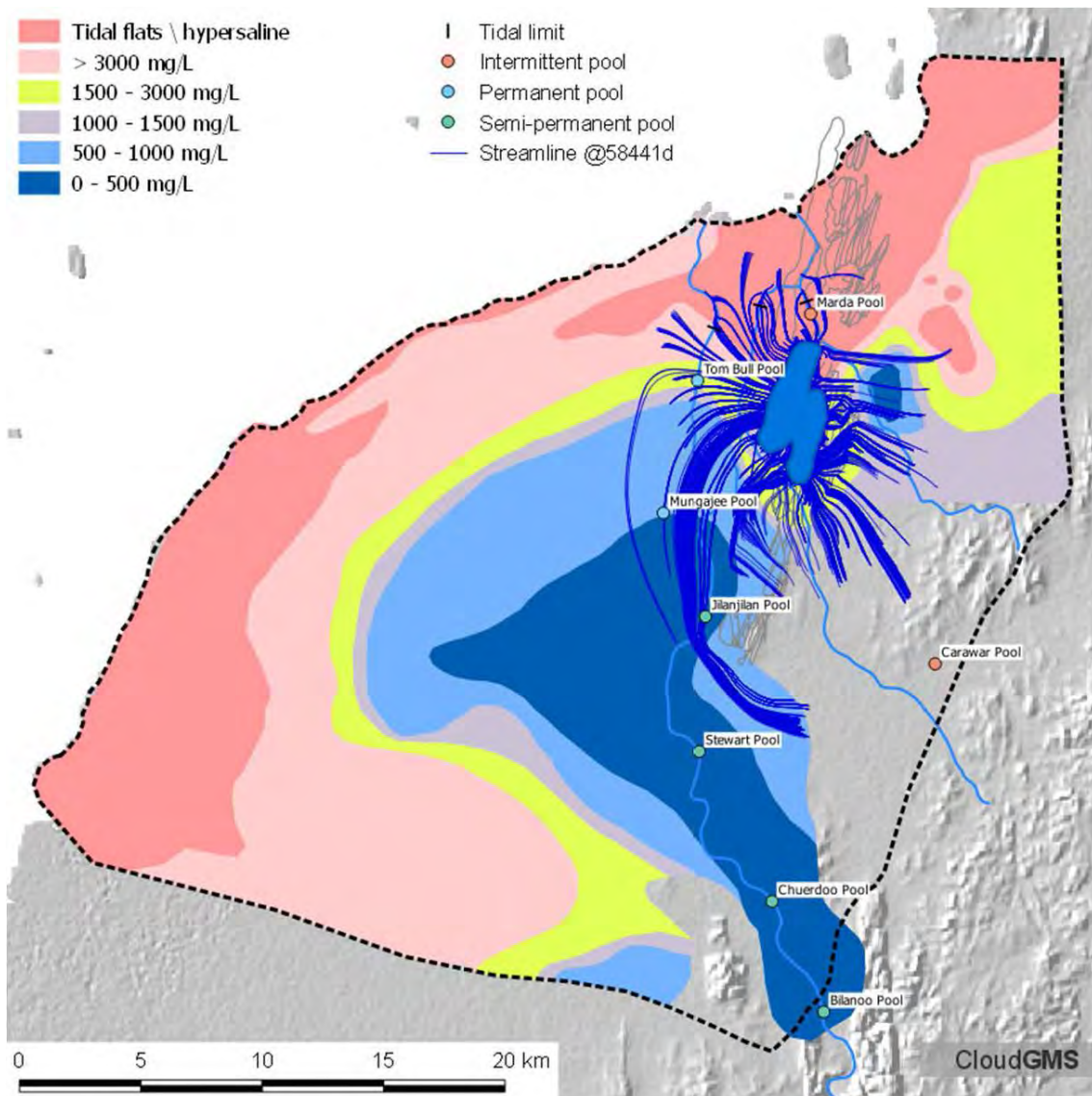


Figure 6-2: Groundwater quality of pit inflows

6.4 Potential impacts

The following potential impacts have been identified:

- diversion of Edwards Creek has the potential to increase stream velocity, which may affect water quality
- physical development of the site and use of infrastructure will generate runoff which has the potential to affect surface water quality
- following the formation of a pit lake after closure, evaporation and groundwater flow into the pit has the potential to affect water quality within the pit lake and surrounding environmental values.

The potential affect on water quality from the discharge of groundwater to the Fortescue River estuary is assessed in Section 7.5.1.

6.5 Assessment of impacts

6.5.1 Diversion of Edwards Creek

As described in Section 5.5.3, by maintaining the same length and natural design (i.e. the 8 – 10 m bed width) the diversions are not expected to substantially alter either the flow or velocity of the creek. The construction of the diversion will result in loose, erodible material within the creek bed to recreate the mobile bed and banks of the existing creeks. The sediment supply is not expected to be substantially affected by the diversion.

By maintaining the flow velocity and volume the creek is not expected to affect the water quality of either Edwards Creek or the Fortescue River downstream.

6.5.2 Alteration of surface flows

Surface water runoff from the Proposal is managed to prevent pollution entering watercourses in the Development Envelope. Proposal elements, such as the WRDs and TSFs that have the potential to generate runoff, are bunded to collect runoff. Collected surface water runoff is directed to sedimentation basins for treatment prior to discharge to the external environment.

The collection system would require a nominal 5 year ARI capacity peak inflow. The sizing (i.e. top surface area of the basin) is based on the rate of inflow, and size and percentage of particles to be removed. Water quality capture and treatment devices are not expected to treat all the flow, but rather focus on smaller, more frequent run-off events.

Collection of surface water runoff ensures that surface water quality is not affected.

At mine closure the WRDs would be rehabilitated, and eventually the dirty water collection bunds and sedimentation basin removed once rehabilitation objectives have been achieved.

6.5.3 Pit lake water quality

The primary influences on the water quality in the pit lake are the initial quality of the groundwater entering the pit and subsequent changes due to evaporation. Ongoing monitoring and testing of waste material encountered during mining has so far not identified material likely to affect pit water quality. This monitoring will be ongoing throughout the life of the mine and will be subject to further analysis as a requirement of the Conceptual Mine Closure Plan (Appendix 3).

As shown in Figure 6-2 the quality of the groundwater inflows will vary, with groundwater from all salinity categories (i.e. fresh to hyper saline) drawn into the final pit-lake (CloudGMS 2017). However, based on the project flow pathways there will be no flow of groundwater from a higher salinity area to a lower salinity area. This will mean that the distribution of groundwater salinities is not expected to be affected in the Fortescue River floodplain as a result of the Proposal.

As described in Section 5.5.1, at the completion of mining groundwater will continue to flow into the pit. Due to evaporation of water the pit will become a terminal pit lake. The flow of groundwater into the pit lake, and then evaporation, will result in an increase in concentration of solutes (i.e. salts and metals) that are in the groundwater (CloudGMS 2017). While the concentration of solutes in the mine pit will increase by operating as a terminal sink the pit lake will prevent any adverse effects to groundwater quality within the surrounding aquifer.

The major aquifer in the region that supports bores and GDEs is in the Fortescue River floodplain alluvium. The base of the mine pit will at approximately -400 mAH. The base of the aquifer within the Fortescue River floodplain alluvium is approximately -20 mADD. Based on the substantial vertical disconnection from the base of the mine pit and the aquifer, there is no potential for saline plume out of mine pit to affect any sensitive receptors.

It is likely that the quality of the pit lake will evolve to be saline or even hypersaline (i.e. more saline than the seawater).

6.6 Mitigation

The overall objective for the mitigation of impacts to inland water quality is to ensure that the impact on groundwater and surface water quality as a result of implementation of the Proposal will be minimised so as to meet the EPA objective. Implementation of the following measures will assist in mitigating impacts:

Avoidance:

- the design of the Edwards Creek diversion will maintain the same length and natural design (8 – 10 m bed width) as the natural watercourse

Minimisation:

- pass all runoff from disturbed areas through sediment traps prior to discharging downstream (during both construction and operation)
- collect seepage from the tailing dam and use it on the mine site for ore-processing, dust control purposes and road-making
- remove sediment from sediment basins prior to the wet season to the extent needed to maintain capacity. As required dispose of sediments to bio-remediation facility
- monitoring will be undertaken including visual inspection of water quality and quantity in major creeklines and Fortescue River pools in accordance with the OEMP (Appendix 3).

Rehabilitate:

- contain and cleanup any spill in accordance with DR017219 Hydrocarbons - Hazardous Materials Spill Response Procedure - Land.

6.7 Predicted outcome

When mitigation and management measures have been implemented, it is expected that the Proposal will result in the following outcomes in relation to Inland waters environmental quality:

- diversion of Edwards Creek will not significantly alter either flow or velocity within the creek and therefore is not expected to affect water quality of either Edwards Creek or Fortescue River downstream
- collection of surface runoff in sedimentation ponds will prevent surface water contamination
- pit lake will act as a terminal sink and likely become hypersaline over time although surrounding groundwater quality will not be adversely affected.

Based on the predicted residual impacts the Proposal will meet the EPA's objective for Inland waters environmental quality.

7. Marine environmental quality

7.1 EPA objective

To maintain the quality of water, sediment and biota so that environmental values are protected.

7.2 Policy and guidance

The relevant policies for Marine environmental quality are:

- *Environmental Factor Guideline - Marine Environmental Quality* (EPA 2016d)
- *Technical Guidance Protecting the Quality of Western Australia's Marine Environment* (EPA 2016e).

7.3 Receiving environment

A summary of work completed to describe the receiving environment regarding Marine environmental quality is included in Table 7-1.

Table 7-1: Summary of environmental studies and survey effort

Author	Survey/ investigations name	Study area, type and timing	Study standard/guidance and limitations
Recently completed work			
RPS APASA 2017	<i>Discharge Modelling Assessment Fortescue River Outfall</i>	Delft3D-FLOW hydrodynamic model.	Peer reviewed model. Model adheres to the International Association for Hydro-Environment Engineering and Research guidelines for documenting the validity of computational modelling software, closely replicating an array of analytical, laboratory, schematic and real-world data.
RPS APASA 2016	<i>Cape Preston Pit Water River Discharge Assessment</i>	Nearfield dilution assessment for the discharge of 2 GLpa.	

7.3.1 Fortescue River estuary water quality

The lower Fortescue River estuary experiences a strong tidal influence (with a spring tidal range of approximately 3.6 m) that extends approximately 4 km inland (DOW 2010). At the mouth of the Fortescue River, the river channel is in excess of 200 m wide forming an estuarine setting of salt marsh and intertidal flats (Aquaterra 2009a). The strong tidal influence of the estuary has a low sediment trapping efficiency, generating naturally high turbidity with well mixed circulation.

The area contains a well developed and structurally complex mangrove system that includes a total mapped area of approximately 35.5 ha of mangal community, with extensive cyanobacterial mats occurring on the tidal flats to the east of the tidal creek.

Salinity (TDS) of the lower tidal reaches of the Fortescue River has been recorded between 39 000 to 41 000 mg/L over the dry season, with typical concentrations of 37 000 mg/L which exceeds the typical concentration of seawater salinity (around 35 000 mg/L TDS) due to concentration by evaporation of salts within the river estuary and tidal reaches (RPS APASA 2017). However, the system is expected to be highly dynamic and at periods of high flow (i.e. the wet season) the salinity is expected to be lower, reflecting the greater relative volume of freshwater.

Background nutrient and chlorophyll-a concentrations in samples collected in 2002 were all found to be slightly above ANZECC & ARMCANZ indicative values for turbid macrotidal areas (DAL 2000, Maunsell 2002). As shown in Table 7-2 the waters around Cape Preston have elevated primary productivity compared to other areas, which may be a result of the occasional large contributions of sediment from Fortescue River and other nearby creek and tidal creek flows.

Table 7-2: Comparison of background water quality values with guideline levels

Parameter	Recorded values	ANZECC/ARMCANZ (2000) guideline values
chlorophyll-a (µg/L)	1.73	0.7-1.4
ortho-phosphorus (µg/L)	3	5
Nitrate + nitrite (µg/L)	38.5	2-8
Ammonium (µg/L)	19	1-10

7.3.2 Current groundwater discharge

In August 2016 the EPA approved the discharge of up to 2 GLpa of saline water from dewatering into the Fortescue River estuary. The groundwater discharge point is located approximately 1.25 km from the river mouth at a part of the river that is approximately 200 m wide (Figure 7-1). The discharge infrastructure consists of a linear diffuser structure placed perpendicular to the river bank extending for approximately 20 m. The diffuser structure is located approximately 10 m from the river bank.

Following approval from the EPA the project was also approved under Part V of the EP Act by DER with a discharge licence. The approved discharge licence requires the release on an outgoing tide to prevent plume migration upstream. The infrastructure has been installed and is currently undergoing commissioning.

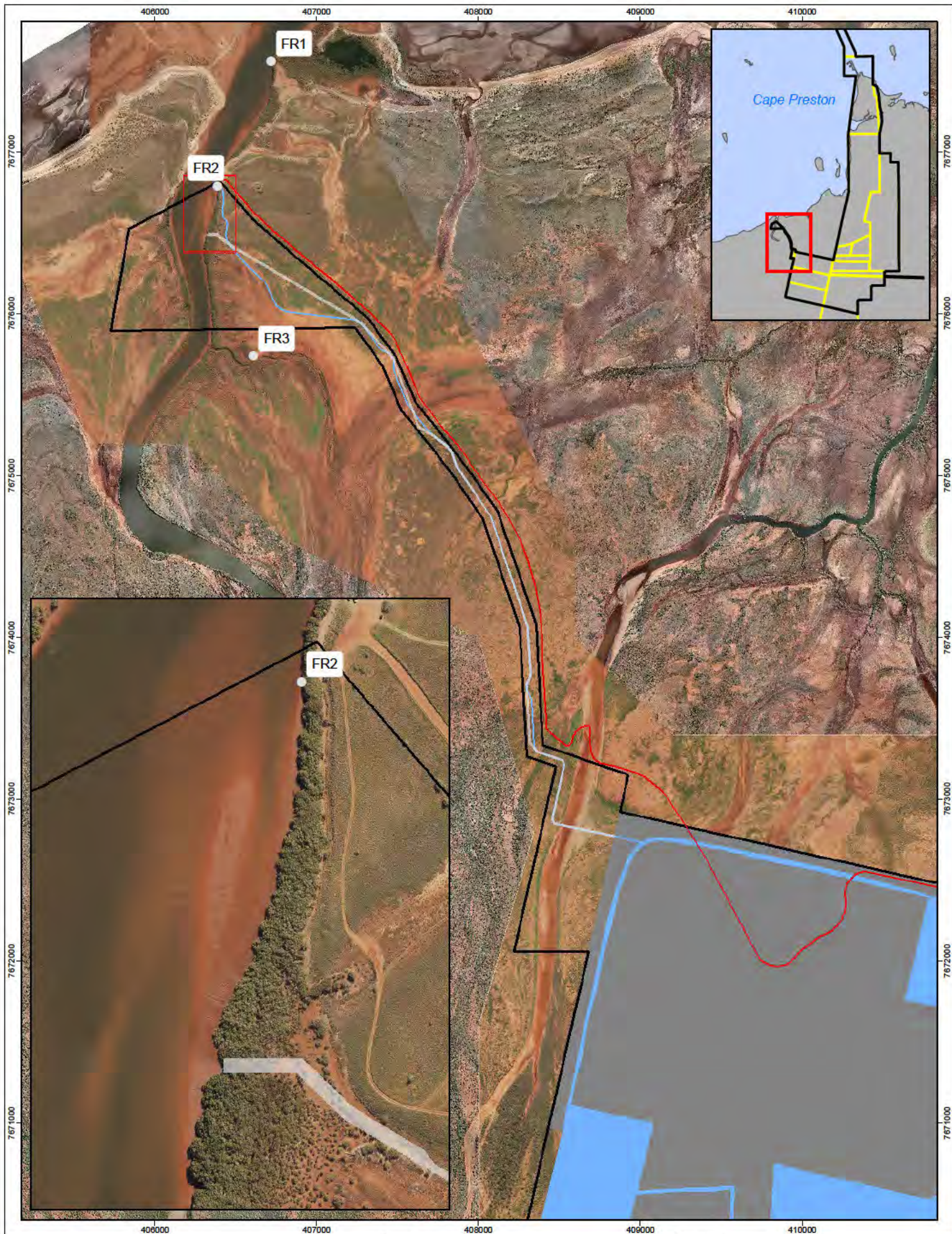
The assessment to support the application to discharge groundwater considered the following groundwater quality parameters: salinity (TDS), total suspended solids (TSS), pH, nutrients (ammonia, nitrate and total nitrogen) and metals (boron, copper, nickel and zinc). The quality of groundwater to be discharged was based on sampling from 2013 to 2015 and on sump volume flow weighted averages that were calculated in April 2013 and June 2015.

The discharge stream is hypersaline, potentially also containing elevated levels of nitrate and metals (boron, copper, nickel and zinc) (RPS APASA 2017). To account for the possibility that concentrations of nutrients and metals may change over time CPM have undertaken to the DER to sample nutrients and metals on a monthly basis (during active discharge) at the discharge site and at two additional sites 1 km further upstream and 1 km downstream.

Based on the expected concentrations of potential contaminants in the discharge and the relevant threshold concentrations for each contaminant, the initial water quality variables of most relevance were salinity, temperature and nitrate. The expected ranges for these variables identified that salinity was clearly the discharge contaminant that will require the highest dilution to achieve its concentration target (RPS APASA 2017). The salinity of the discharge stream will increase over the life of the mine due to the changing nature of the mining operations. The discharge stream is expected to eventually reach a maximum salinity concentration of approximately 70 000 mg/L. The regulatory salinity target is for median salinity concentration to be no more than 1200 mg/L above median ambient background at a suitable reference site. Based on the background salinity of 37 000 mg/L, this implies that a 27 times dilution is required.

The nearfield dilution assessment (RPS APASA 2016) for discharge rate of 2 GLpa determined the engineering design of a diffuser that would achieve the target of 27 times dilution for salinity. The assessment determined that this level of dilution would be achieved within 10 to 20 m of the discharge location.

For ammonia and phosphorus the groundwater nutrient concentration was at or below the ANZECC 99% marine protection level for Tropical Australia (ANZECC 2000). While the nitrate levels prior to dilution have the potential to exceed the ANZECC 80% species protection level, downstream of the discharge point the dominant habitat types are mangrove and algal mat zones. Mangrove and algal mat zones have been recognised as a nutrient sink and historically have been used in some locations as a natural filter for wastewater discharge, with algal mats typically comprised of nitrogen fixing blue-green bacteria (bluegreen algae). These organisms are not nitrogen limited, as they are able to fix nitrogen from the air. An increase in nitrogen concentrations in the water is therefore unlikely to significantly impact on their growth. It is noted that there would be no parallel increase in phosphorus concentrations. Thus, while the nitrate concentration at the discharge point is expected to be readily diluted by the combination of tidal and river flows, the impact on mangroves from increased nitrogen loads was considered to be readily manageable and of negligible significance.



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Figure 7 - 1

Location of mine dewater discharge infrastructure

0 0.5 1
Kilometres
1:30,000
Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 27/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MB, Strategen Internal Reference 4412_01_2017_APP

Legend

- Data
- Major Road
- Development Envelope
- Statement 635 approval (MS635)
- Conceptual Footprint

7.3.3 Environmental Quality Management Framework

In accordance with EPA (2016e) an Environmental Quality Management Framework (EQMF) has been developed to spatially define, assess and manage potential impacts of the Proposal on marine environmental quality. The EQMF has been used to define Environmental Values (EVs), Environmental Quality Objectives (EQOs) and, for the EQO 'maintenance of ecosystem integrity', Levels of Ecological Protection (LEPs).

Table 7-3 presents the five EVs and eight corresponding EQOs that apply throughout WA coastal waters. The maintenance of ecosystem integrity EQO (that corresponds with the ecosystem health EV) is considered to be a suitable proxy for the maintenance of cultural and spiritual, industrial water and aquaculture EQOs. On this basis, five EQOs were identified for the Proposal as necessary to protect the EVs. The other EVs and EQOs are still relevant to the assessment but are considered to be protected by default through the protection of the ecosystem health values.

Table 7-3: Summary of Environmental Values and Environmental Quality Objectives

Environmental values	Environmental Quality Objective	Relevant for the development of specific EQG
Ecosystem health	Maintenance of ecosystem integrity	Yes
Fishing and aquaculture	Maintenance of aquatic life for human consumption	Yes
	Maintenance of aquaculture	Protection of ecosystem health is an adequate proxy
Recreation and aesthetics	Maintenance of primary contact recreation values	Yes
	Maintenance of secondary recreational values	Yes
	Maintenance of aesthetic values	Yes
Cultural and spiritual	Maintenance of Cultural and spiritual values	Protection of ecosystem health is an adequate proxy
Industrial water supply	Maintenance of Industrial water supply values	Protection of ecosystem health is an adequate proxy

Consistent with EPA (2016e) the relevant LEP (within the maintenance of ecosystem integrity EQO) for the in the vicinity of the Proposal is a High LEP. The objective for a High LEP is to allow for small measurable changes in the quality of water, sediment and biota but not to a level that changes ecosystem processes, biodiversity or abundance and biomass of marine life beyond the limits of natural variation.

A Moderate LEP may be applied to relatively small areas, such as within inner ports, adjacent to heavy industrial premises and waste discharges. In areas assigned a Moderate LEP moderate changes in environmental quality may be acceptable provided there are only small changes in abundance and biomass of marine life and in the rates, but not types, of ecosystem processes. There should be no detectable and persistent changes in biodiversity due to waste discharges or contamination.

EPA (2016e) identifies that EQC should be determined on the basis of the risks to the environmental quality. The development of EQC should also be based on the scientific limits of acceptable change to a measureable environmental quality indicator important for the protection of the associated environmental value and that the EQC should be clear, readily measurable and auditable.

Section 7.3.4 assesses the risk to the environmental quality of the Fortescue River estuary from the discharge based on the comparison of quality of water in the Fortescue River estuary (as described in Section 7.3.1) and quality of groundwater (described in Section 7.3.2) to determine appropriate EQC.

7.3.4 Environmental quality criteria

As described in Section 7.3.3, the EPA (2016e) identify that EQC are developed on the basis of risk to the environmental values. As described in Section 7.3.2, prior to discharge the groundwater to be discharged is equivalent to that of the Fortescue River estuary for TSS, pH and metals (RPS APASA 2017). While the groundwater has naturally elevated nitrogen levels, the receiving environment has nitrogen-fixing algal mats and the low phosphorus levels in the groundwater means that the system is phosphorus limiting and unlikely to generate algal blooms. On this basis, the only key parameter that may affect the marine environmental quality is salinity (TDS).

For all five EQOs determined to be relevant in Section 7.3.3 (i.e. maintenance of ecosystem integrity, aquatic life for human consumption, primary contact recreation values, secondary recreational values and aesthetic values), the EQC for salinity has been adopted. Appendix 1 of EPA (2016e) identifies that salinity is a physico-chemical stressor and provides guideline values for defining High LEP and Moderate LEP as follows:

- High LEP: the 80th percentile of natural background $\leq$ predicted median concentration
- Moderate LEP: the 95th percentile of natural background $\leq$ predicted median concentration.

However, as described in Section 7.3.2 the regulatory salinity target is for median salinity concentration to be no more than 1200 mg/L (i.e. 1.2 ppt) above median ambient background at a suitable reference site. Based on the background salinity of 37 000 mg/L, this implies that a minimum of 27 times dilution is required (i.e. achieving more than a 27 is better than required). On this basis CPM are applying the same system as the current DER licence. The dilution requirement is considered to be a more conservative than the requirements identified in EPA (2016e).

Within the above context marine modelling (in Section 7.3.5) was therefore undertaken to determine the distribution of dilution levels of the discharge to achieve regulatory levels.

7.3.5 Marine modelling

To assess the dilution RPS APASA (2017) prepared a three-dimensional model with accurate representations of the bathymetry (from high-resolution multi-beam survey data), bottom roughness and spatially-varying wind stress for the region. The Delft3D-FLOW model is ideally suited for representing the hydrodynamics of complex coastal waters, including regions where the tidal range creates large intertidal zones and where buoyancy processes are important.

The new hydrodynamic model was run for a 15 to 30 day simulation period and was to be validated by comparison to 15 days of field measurements from an instrument deployed in the Fortescue River. The model was to be used to assess three potential discharge scenarios:

1. Intermittent discharge with a flow rate of 2 GL/yr. This case represents the flow rate and ebb tide discharge schedule that has been approved by the DER, that is, commencing 30 minutes after the turning of the tide and ceasing 1 hour prior to the next low tide. The outfall consists of one diffuser unit that is 21 m in length.
2. Intermittent discharge with a flow rate of 6 GL/yr. This case uses the same ebb tide discharge schedule. To manage the higher flow rate it is assumed that the outfall diffuser will be extended across the river by two additional 21 m diffuser units installed in serial, giving a total diffuser length of 63 m.
3. Intermittent discharge with a flow rate of 8 GL/yr. This case uses the same ebb tide discharge schedule. To manage the higher flow rate it is assumed that the outfall diffuser will be extended across the river by three additional 21 m diffuser units that will be installed in serial, giving a total diffuser length of 84 m.

The scope of the modelling assessment for each discharge scenario involved preparing salinity dilution maps for each scenario to demonstrate the potential zone of influence within the river, with a focus on the 27 times dilution threshold for salinity. Appendix 2 of EPA (2016e) specifically identifies the requirement to consider potential vertical variation of the potential contaminant plume. Based on the higher density of the more saline plume the model outputs considered at depth 0.5 m above the river bed. This depth was selected because it is consistent with a typical field sampling practices when dense plumes or intrusions are expected.

For all scenarios the median and 80th percentile dilution values were extracted from the model for the analysis depth to allow comparison to the relevant water quality criteria.

7.4 Potential impacts

The following potential impacts have been identified:

- discharge of groundwater has the potential to affect the water quality of the Fortescue River estuary.

Section 7.5 considers the impact to marine environmental quality, refer to Section 5.5.2 for consideration of changes to hydrological processes.

7.5 Assessment of impacts

7.5.1 Discharge of groundwater

The assessment of discharge scenarios is presented in Table 7-4. The assessment considers the modelled extent of dilution level within each cell at both a median and 80th percentile assessment. In addition the assessment provides time series data at the discharge location.

The modelling identifies that the 2 GLpa scenario provides a high level of dilution throughout the model domain. For both the 6 GLpa and 8 GLpa scenarios the dilution results at the discharge point were similar (RPA APASA 2017). For both these scenarios the incidence and duration of the minimum 27 times dilution threshold exceedance at the discharge location was very similar and limited to an hour. On this basis throughout the entire domain no cells were less than the minimum 27 times dilution target for either the median or 80th percentile (as shown in Figure 7-2 for the 80th percentile for the 8 GLpa discharge).

As the 8 GLpa discharge is above the minimum target dilution level for all cells and the time series indicates that this would not be met at the discharge location for only an hour (under certain tides). On this basis the discharge would still meet the requirements of a High LEP. Therefore, an 8 GLpa discharge is not considered to significantly affect any environmental values associated with marine environmental quality.

Table 7-4: Assessment of discharge scenarios

Discharge scenario	Median graphs	80 th percentile graph	Time series graphs at discharge location
2 GLpa	The dilution is greater than 50 times dilution everywhere throughout the domain.	The dilution is greater than 50 times throughout most of the domain except for a localised area at the diffuser outlet where dilution was in the range of 40 to 50 times.	Over the 30 day time series the dilutions showed no evidence of any increased tendency to exceed threshold with time. This indicates that there was no significant accumulation of salinity in the model over the 30-day time scale.
6 GLpa	The dilution is greater than 50 times dilution everywhere throughout the domain.	The dilution is greater than the minimum 27 times throughout the entire domain. Dilutions in the range of 30 to 40 times were observed up to around 175 m downstream from the discharge location. Dilutions in the range of 40 to 50 times were observed up to around 350 m downstream from the discharge location.	During neap tide periods there were occasions when the minimum 27 times dilution threshold was either approached or breached before the end of a discharge period, however, these events were insufficient to increase the duration of exceedance, which always remained around approximately 1 hour. The full 30 day time series of dilutions from the simulation period showed no evidence of any increased tendency to exceed threshold with time.
8 GLpa	The dilution is greater than 50 times dilution throughout the domain, except at the discharge location where the dilution was in the range of 40 to 50 times.	The dilution level is greater than the minimum 27 times were met throughout the domain. However, dilutions in the range of 27 to 30 times were observed at the discharge location. Dilutions in the range of 30 to 40 times were observed up to around 400 m downstream from the discharge location. Dilutions in the range of 40 to 50 times were consistently observed up to around 550 m downstream from the discharge location and up to around 1 km upstream of the discharge location.	During neap tide periods there were occasions when the minimum 27 times dilution threshold was either approached or breached before the end of a discharge period, however, these events were insufficient to increase the duration of exceedance, which always remained around approximately 1 hour. The full 30 day time series of dilutions from the simulation period showed no evidence of any increased tendency to exceed threshold with time.



Case C: 8 GL/yr

Dilution of Discharge Salinity

80th Percentile

Height: 0.5m Above Bed

Project: Fortescue River Discharge Modelling

Job/Client: MAW0506J.000/Citic Pacific

RPS APASA

Number of Dillutions

0 to 10	27 to 30
10 to 20	30 to 40
20 to 24	40 to 50
24 to 27	>50

Source: RPS APASA 2017

Figure 7-2: Extent of Discharge

7.6 Mitigation

The overall objective for the mitigation of impacts to marine environmental quality is to ensure that the impact on the quality of water, sediment and biota as a result of the Proposal will be minimised.

The Proposal will continue to apply management measures outlined in the DER discharge licence required under Part V of the EP Act. An application to update the licence will be submitted to DER that will continue to apply existing measures.

The mitigation measures proposed include:

Avoidance:

- undertake monitoring in accordance with DER discharge licence to ensure the groundwater salt, metal and nutrient concentrations are consistent with discharge licence requirements.

Minimisation:

- discharging groundwater on outgoing tides to ensure discharge water is rapidly diluted to achieve the target dilution
- discharging via a diffuser in accordance with dilution modelling (RPS APASA 2017)
- to ensure the integrity of infrastructure any debris or other blockages will be cleared as required
- implement DR017219 Hydrocarbons - Hazardous Materials Spill Response Procedure - Land.

7.7 Predicted outcome

When the mitigation and management measures have been implemented, it is expected that the Proposal will result in the following outcomes in relation to Marine environmental quality:

- target dilution for salinity (TDS) is a dilution level of 27 times, which will be achieved throughout the model for both a median and 80th percentile assessment of an 8 GLpa discharge
- an 8 GLpa discharge is rapidly diluted on the falling tide and modelling shows no sign of build-up of salinity.

Based on the predicted residual impacts the Proposal will meet the EPA's objective for marine environmental quality.

8. Flora and vegetation

8.1 EPA objective

To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

8.2 Policy and guidance

The relevant policy and guidelines for flora and vegetation are:

- Environmental Factor Guideline – Flora and vegetation (EPA 2016f)
- Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016g).

On 13 December 2016 the EPA released revised guidelines for flora and vegetation. Relevant policies and guidelines prior to date are:

- Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004)
- Position Statement No. 3 *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002).

8.3 Receiving environment

The Cape Preston area has been studied in detail since 2003, including nine flora and vegetation surveys (Table 8-1). Mattiske Consulting conducted a peer review of all surveys completed to date to determine the adequacy of work undertaken in relation to current guidelines, summarise survey results and provide advice on any additional work required to meet current guidelines (Mattiske 2016).

The survey work to date covers detailed Level 1 studies (now known as Reconnaissance Surveys), targeted work on species, targeted work on communities, targeted work on groundwater dependent ecosystems and Level 2 studies (now known as Detailed Surveys) for the majority of the Cape Preston area. Mattiske (2016) determined that the level of work completed to date across the broader area was sufficient to meet the requirements of Guidance Statement 51 (EPA 2004) and Position Statement 3 (EPA 2002), due to work completed by Astron (2009a) and AECOM (2009) which built on and integrated the earlier studies from the region. To enable the work to meet current Level 2 survey standards Mattiske (2016) identified the requirement to:

1. Update and refine the species list.
2. Identify local conservation significance of vegetation communities.

Based on the advice from Mattiske, the following tasks were undertaken with regard to Item 1 above:

- verified currency of all individual species names using Florabase (WA Herbarium 1998-)
- cross-checked information provided in Table 3 of the Mattiske (2016) advice
- updated species names in cases where names had been superseded
- removed species that have been excluded by the WA Herbarium, where no alternative name is provided by Florabase
- removed species that are considered out of range by the WA Herbarium, where no alternative name is provided by Florabase
- replaced misapplied species names with a genus only, where a species name has been deemed to have been misapplied against multiple species, e.g. *Mukia maderaspatana* / *Cucumis maderaspatanus* has been deemed to have been misapplied against *Cucumis argenteus*, *C. althaeoides* and *C. variabilis*, therefore has been replaced with *Cucumis* sp.

- combined records where multiple 'species affinis' (aff.) were recorded. This notation indicates a very close affinity with the species named, and could potentially be recognised as a separate species. Species recorded in the reports consolidated above that have this notation are not currently recognised as separate species by the WA Herbarium; as such, for the purpose of this document, they have been included with the confirmed species, where present, e.g. *Tephrosia aff. supina* is included with *Tephrosia supina*
- combined instances where multiple 'confer' (cf.) or '?' notations were recorded. These notations indicate that the species name provided the best possible identification given the available material. For the purpose of this document, species with these notations have been included with the confirmed species, e.g. *Senna ?notabilis* included with *Senna notabilis*, *Rhynchosia cf. minima* included with *Rhynchosia minima*
- prepared an updated species list (Appendix 1).

With regard to Item 2 above, the following task was completed:

- reviewed local conservation status of vegetation types in consolidated flora and vegetation reports (Table 8-3).

The results of the additional work undertaken to meet the Level 2 survey requirements are provided in Appendix 1 (updated species list) and Table 8-3 (conservation status of vegetation units).

Table 8-1: Summary of environmental studies and survey effort

Author	Survey/ investigations name	Study area, type and timing	Study standard/guidance and limitations
Recently completed work			
Mattiske 2016	<i>Review of Flora and Vegetation Reports for the Mineralogy project at Cape Preston</i>	Peer Review of previously completed work	NA.
Previously completed work			
Maunsell AECOM 2003	<i>Cape Preston Iron Ore Development. Seasonal Biological Survey – Threatened Flora</i>	- mine footprint - threatened flora survey - June and July 2003	Seasonal conditions led to some limitations in assessment of flora. Also some areas supported degraded vegetation. In part overcome by July assessment in targeted areas.
Astron Environmental Services 2007a	<i>General Purpose Leases G08/52 and G08/53 Additional Vegetation Survey and Mapping</i>	- leases G08/52 and G08/53 - flora and vegetation survey - June 2007	Some limitations on flora coverage due to drier seasonal rainfall conditions prior to the June 2007 assessment.
Mattiske Consulting Pty Ltd 2007a	<i>Flora and Vegetation Survey of Cape Preston Potential Campsites and Airstrips</i>	- flora and vegetation survey - February 2007	Some limitations due to seasonal conditions. Coverage of localized areas only (as requested).
Mattiske Consulting Pty Ltd 2007b	<i>Comparison of Flora and Vegetation Values on Preferred and Original Campsites Cape Preston</i>	February 2007	Some limitations due to seasonal conditions. Coverage of localized areas only (as requested).
Maunsell AECOM 2008	<i>Cape Preston Mining Estate Consolidated Vegetation, Flora and Fauna Assessment</i>	consolidation of surveys by HGM (2001), Maunsell (2003), Maunsell AECOM (2006), Mattiske (2007a), Astron (2007a)	Desktop study only.
Astron Environmental Services 2008a	<i>Sino Iron Project – Cape Preston. Mapping and Surveying of Groundwater Dependent Ecosystems</i>	- leases E08/1414, E08/660, E08/1451, E08/1331, and some adjoining areas to the Northeast on Mardie Station - groundwater-dependent vegetation survey - September – October 2008	Groundwater-dependent vegetation only; limitations due to drier seasonal conditions prior to assessment.

Author	Survey/ investigations name	Study area, type and timing	Study standard/guidance and limitations
AECOM 2009	<i>Balmoral North and Balmoral South Stage 2. Flora and Vegetation Assessment</i>	- desktop, reconnaissance and detailed field survey. Flora and vegetation on Balmoral North and South. Some re-assessment of selected 2000 and 2006 quadrats - August – September 2008	Limitations due to timing of assessments in drier months.
Astron Environmental Services 2009a	<i>Mineralogy Expansion Proposal Desktop Flora and Vegetation Study.</i>	desktop extrapolation of unsurveyed areas based on previous surveys of HGM (2001), Maunsell AECOM (2008), AECOM, (2009), Astron (2007a, 2007b, 2007c), Astron, (2008a, 2008b, 2008c)	Some limitations associated with no field studies and difficulty of covering flora and vegetation values without ground-truthing.
Astron Environmental Services 2009b	<i>Waste Rock Dump and Tailings Expansion Areas Vegetation, Flora and Fauna Survey</i>	- flora and vegetation survey - WRD expansion area and TSF expansion area - May 2009	- Level 2 survey - some limitations associated with seasonal conditions; although good rains in January and early February 2009 the months leading up to the assessment in May 2009 were drier.

8.3.1 Land Systems

Seven Land Systems are represented within the Development Envelope (Figure 8-1).

Regional extent of clearing for each Land Systems occurring in the Development Envelope is shown for the Pilbara Region and Roebourne Subregion in Table 8-2. Less than 2% of each of these Land Systems has been cleared historically within the Pilbara Subregion, showing negligible loss of vegetation to date at a regional scale. Further, less than 10% of each of Land System has been cleared to date within the Roebourne Subregion.

Table 8-2: Extent and clearing of land systems

Land System	Total area of Land System within the Pilbara Region (ha)	% Cleared within Pilbara Region	Total area of Land System within Roebourne Subregion (ha)	% Cleared within Roebourne Subregion	Cleared from the Proposal (ha)	% cleared within Roebourne Subregion including Proposal
Boolgeeda	826,416.12	0.02	27,085.24	0.49	12.36	0.54
Cheerawara	49,210.84	0.01	48,424.73	0.01	734.68	1.53
Horseflat	328,911.14	0.39	297,358.74	0.43	121.51	0.47
Littoral	248,221.78	0.15	212,125.90	0.18	2.79	0.18
Newman	1,458,027.91	0.03	4,872.65	9.17	346.12	16.27
Paraburdoo	64,135.89	1.52	17,850.10	5.46	1745.11	15.24
River	463,955.92	0.01	125,519.60	0.03	3553.16	2.86
Rocklea	2,428,593.74	0.06	43,182.63	3.36	620.86	4.80
Yamerina	120,270.82	0.49	119,391.09	0.5	12.36	0.51

8.3.2 Vegetation mapping

The extent of vegetation surveys (shown in Figure 8-2) conducted of the Cape Preston area cover an area of over approximately 53 000 ha. A total of 98 vegetation communities have been described and mapped within the Cape Preston area of which 69 occur within the Development Envelope (Figure 8-3). Typical for the Pilbara, the majority of vegetation communities are of low or moderate local conservation significance, with areas of elevated conservation significance generally associated with water courses (AECOM 2009).

The landform and conservation significance of the vegetation communities are identified in Table 8-3.

Table 8-3: Landform, vegetation unit and local conservation significance

Landform	Vegetation community	Local conservation significance
Stoney plains	Bx1, Bd1, Bs1	Moderate to High
Clayey plains	Hp, Hp1, Hpg1, Hpg2, Hpg3, Hps1	Moderate to High
Flowlines	Hc1, Hc2	Moderate to High
Beaches	Lb	Low to Moderate
Intertidal zones	Lm	High
Tidal mudflats	Ls1, Ls2, Ls3a	Moderate
Dunes	Ld1, Ld2, Ld3, Ld4, Ld5	High
Sandy plains	Lp1, Lp2, Lp3, Lp4a, Lp4b, Lp5	Moderate
Hills	Lh1, Lh2	Moderate
Plains	Mp1	Moderate
Outcrops	Mr1, Mr2, Mr3, Mr4, Mr5, Mr6	Moderate
Low Hills and slopes	Nh, Nh1, Nh2, Nh3, Nh4, Nh5	Moderate
Minor flowlines	Nc, Nc1, Nc2, Nc3, Nc4	Moderate to High
Rockpiles	Nr, Nr1, Nr2, Nr3, Nr4	Low to Moderate
Plains	Px1, Px2, Px3, Px4, Px5	Moderate
Plains	Pp1, Pp2, Pp3, Pp4	Moderate
Creeklines and Floodplains	Pc, Pc1, Pc2, Pc3, Pc4, Pf1, Pf2, Pf3	High
Creeklines	Rc1, Rc2, Rc3, Rc4	High
Floodplains	Rf1, Rf2, Rf3	Moderate
Low hills and slopes	Roh1, Roh1a, ROh1b, Roh2, ROh2a, ROh2b, ROh2c, ROh3a	Low to Moderate
Plains	ROpl, ROx1, ROp1 (?)	Low to Moderate
Minor flowlines	ROc1, ROc2, ROc3, ROc4, ROc5	Moderate
Rockpiles	Ror, Ror2, Ror1, Ror3	Low to Moderate
Plains	Yp1	Low to Moderate
Tidal creek	Yc1	Moderate

The number of hectares of each local conservation significance rating is presented in Table 8-4.

Table 8-4: Number of hectares of proposed clearing in each conservation significance rating

Local conservation significance rating	Area (ha)
Low - moderate	2848.1
Moderate	3035.1
Moderate – High	794.7
High	314.9
Unknown	8.5

8.3.3 Conservation significant flora and vegetation

No Threatened Flora species as listed under the WC Act are known from within 15 km of the Development Envelope. Thirteen Priority Flora species listed by Parks and Wildlife have the potential to occur within the broader Cape Preston area, with one, *Goodenia pallida* (P1) having the potential to occur within the Development Envelope (Figure 8-4). No Priority Flora species were recorded by vegetation surveys within the Development Envelope.

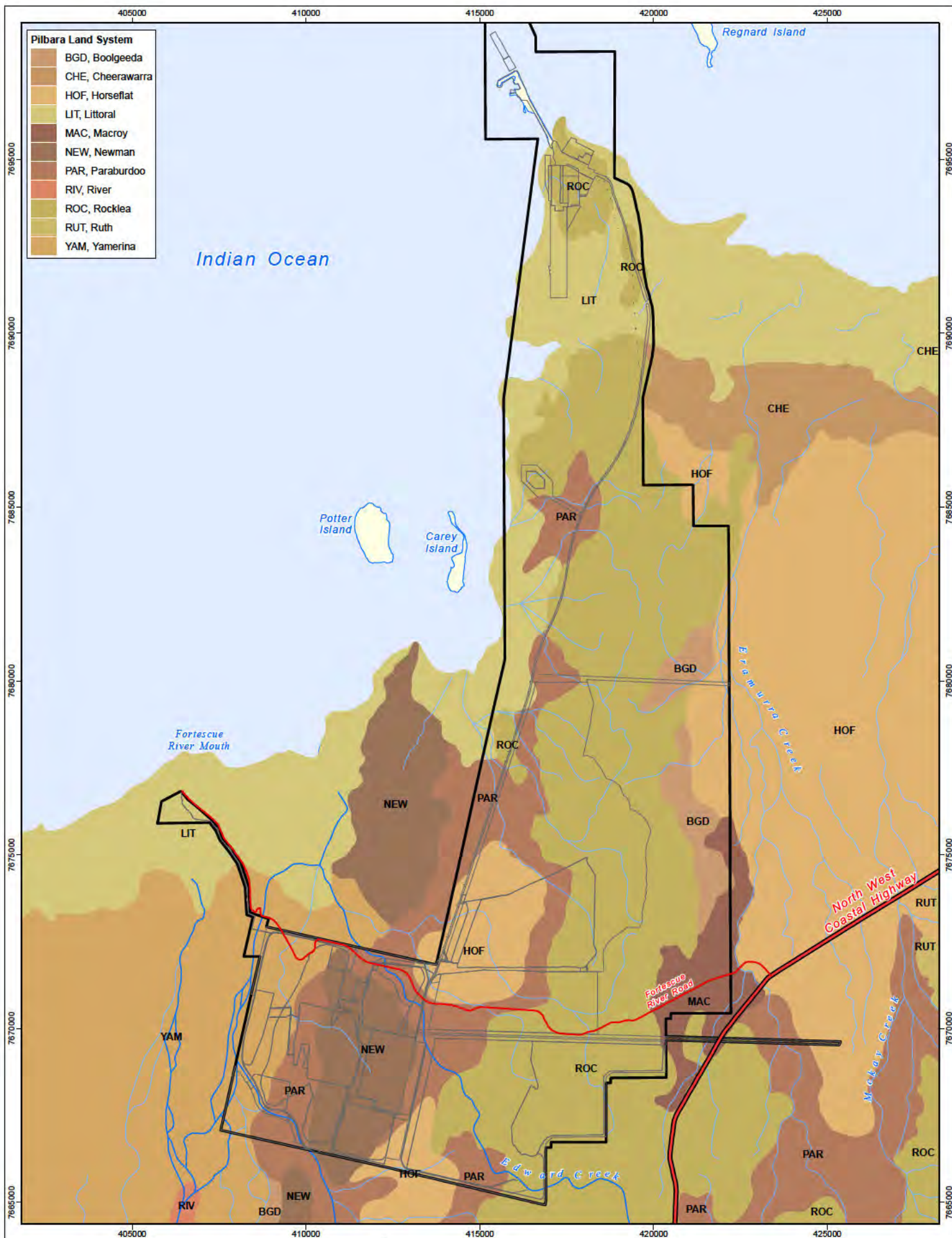
Horseflat Landsystem is listed as a Priority 3 iii Ecological Community (PEC) (Parks and Wildlife 2016), which is defined as

communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc.

As shown in Table 8-2, clearing of the Horseflat Land System, will increase the extent of clearing from 0.43% to 0.47% of the Roebourne Subregion.

A search of the DEE EPBC Act Protected Matters database indicates that there are no Threatened Flora species listed under the EPBC Act known from within 3 km of the Development Envelope.

No Threatened or Priority Ecological Communities (listed under the EPBC Act) occur within the Development Envelope.



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Figure 8 - 1

Land systems mapped
within the Cape Preston area

0 2.5 5
Kilometres
1:140,000
Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 20/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MC, Strategen Internal Reference 4414_01_2017_APP

Legend

- Principal Road
- Major Road
- Development Envelope
- Conceptual Footprint



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Mine Continuation Proposal

Figure 8 - 2

Vegetation surveys within
the Cape Preston area

0 5 10
Kilometres
1:250,000
Datum: GDA94
Projection: MGA Zone 50

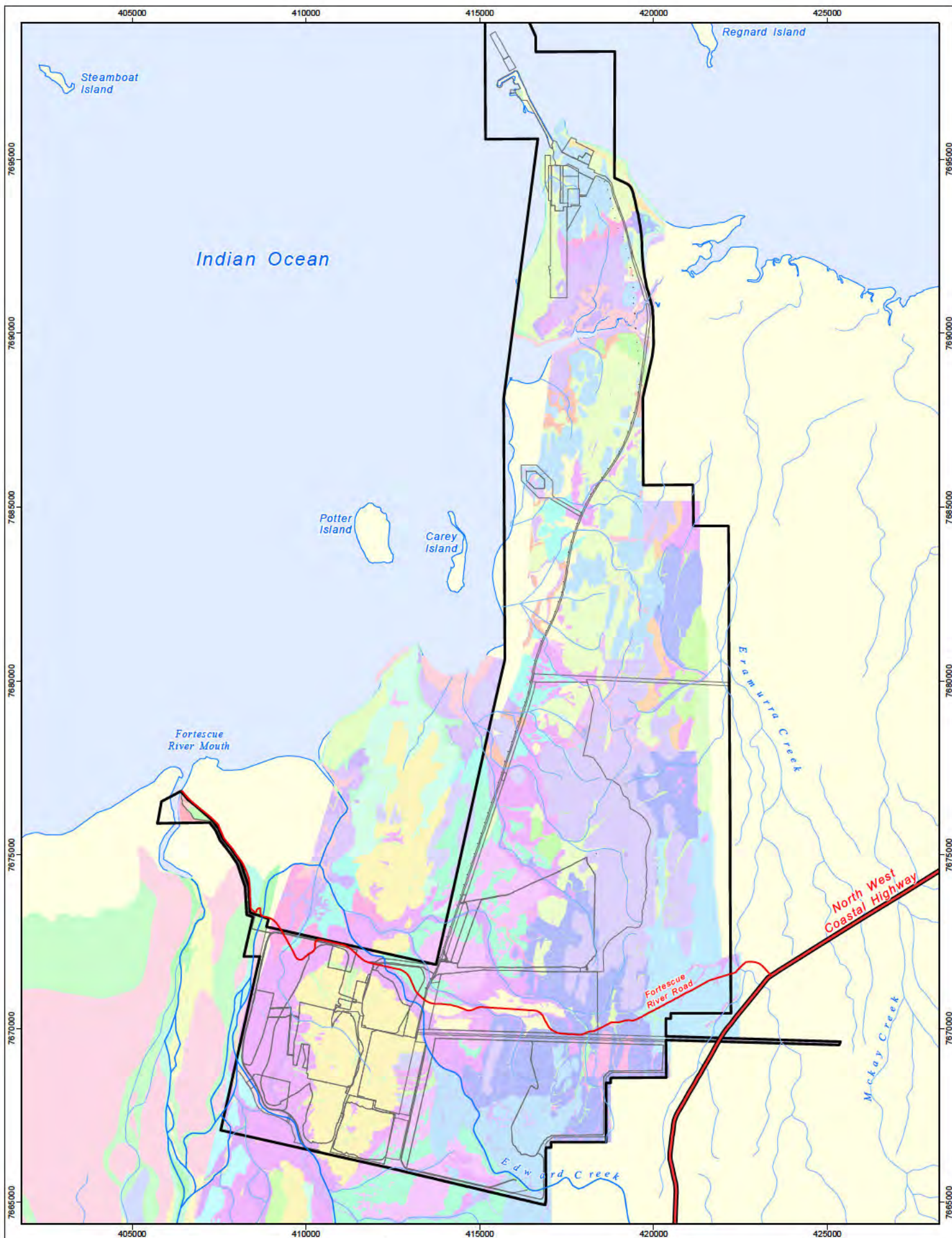
Department: ENV Date: 20/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MC, Strategen Internal Reference 4415_01_2017_APP

Legend

- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Development Envelope
- Vegetation Survey Areas



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Figure 8 - 3
Vegetation units

0 2.5 5
Kilometres
1:140,000
Datum: GDA94
Projection: MGA Zone 50

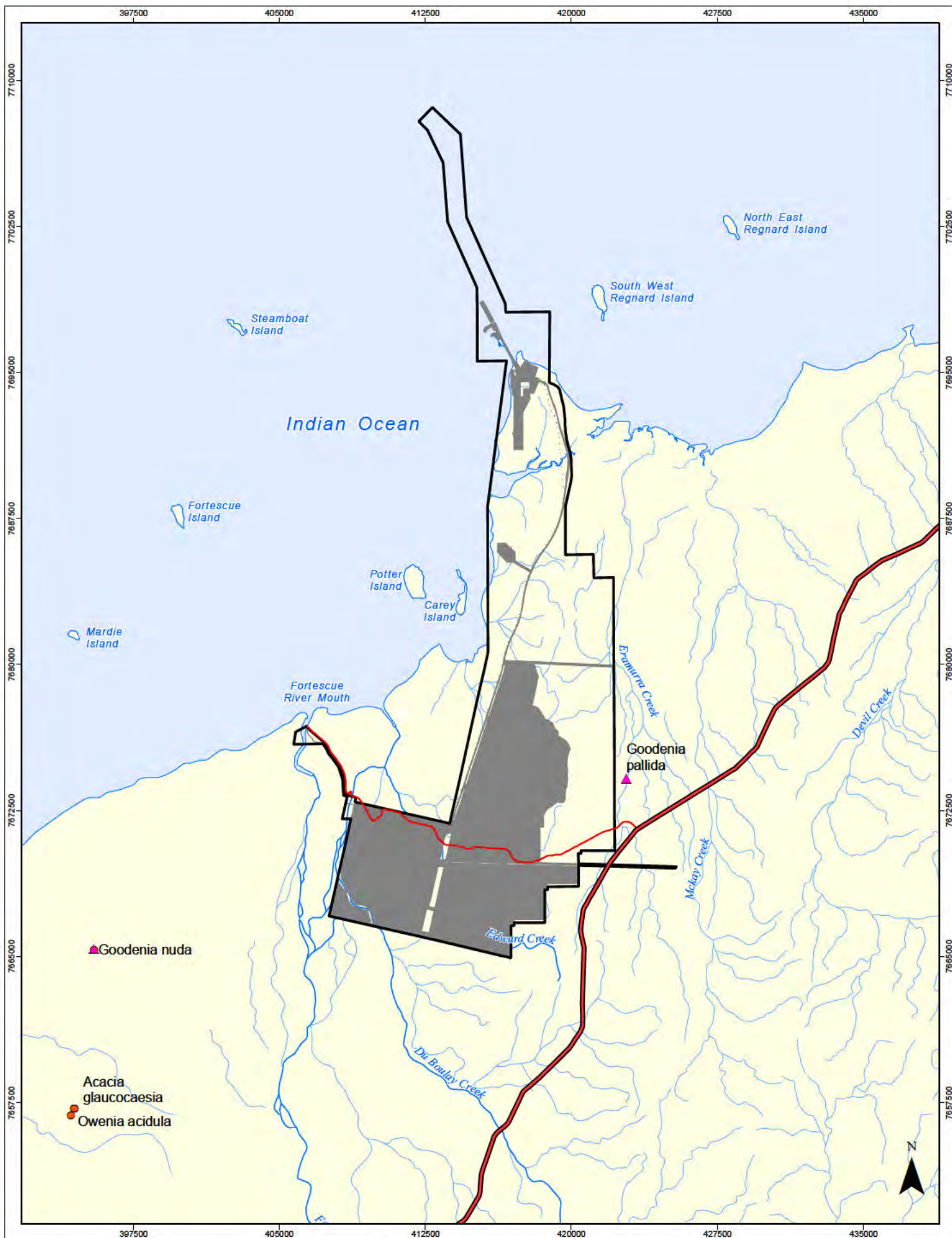
Department: ENV Date: 20/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MC, Strategen Internal Reference 4418_01_2017_APP

Legend

- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Development Envelope
- Conceptual Footprint



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Mine Continuation Proposal

Figure 8 - 4

Location of conservation
significant flora species

0 5 10
Kilometres
1:250,000
Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 1/02/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MC, Strategen Internal Reference 4417_01_2017_APP

Legend

- ▲ Declared Rare Flora
- WA Herbarium
- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Development Envelope
- Conceptual Footprint

8.3.4 Groundwater Dependent Ecosystems

Much of the area to the west of the Development Envelope is low-lying and has shallow but highly variable groundwater levels. Groundwater levels in bores close to the Fortescue River rise rapidly when river flows and decline soon after the river ceases to flow, and fluctuate as much as 6 m (CloudGMS 2017). Where groundwater is close to the surface it may help support groundwater dependent vegetation that exists predominantly in shallow alluvial aquifers associated with creeklines. Groundwater dependent ecosystems (GDEs) require access to groundwater to meet some or all of their water requirements.

The flora and vegetation that make up GDEs in the Cape Preston area were surveyed and mapped by Astron in September 2008 (Astron 2009b). Vegetation was surveyed to the west of the Development Envelope along major and minor watercourses (Fortescue River and Du Boulay Creek respectively) in an area up to 15 km wide and 35 km long. Thirteen groundwater dependent vegetation communities were mapped, ranging from high to low dependence on groundwater (Astron 2009b) (Figure 8-5). The majority of the vegetation along minor ephemeral flowlines was not considered groundwater dependent (Astron 2009b).

In mapping the vegetation communities as groundwater dependent Astron (2008a) also identified whether the unit was highly dependent (obligate) or moderately dependent (facultative). Obligate GDEs are highly reliant on groundwater for maintenance of some or all of their ecosystem function. *Melaleuca argentea* is one species identified in the Fortescue area as an obligate phreatophyte (Astron 2008a). This species was located along sections of the Fortescue River and Du Boulay Creek. *M. argentea* is highly sensitive to lowering groundwater levels and is likely to show early signs of water stress from significant lowering of the watertable over a short period.

Facultative (or opportunistic) GDEs have a low or moderate reliance on groundwater and only require access to groundwater in some landscapes, but in other landscapes can utilise soil moisture to maintain ecosystem function. Species that were identified within the survey area as being facultative included *Eucalyptus camaldulensis*, *E. victrix* and *Corymbia candida*, which were located along sections of the Fortescue River and Du Boulay Creek.

Facultative GDEs occur across the majority of the floodplain, which is consistent with the environmental setting as the floodplain receives periods of floodwaters from large rainfall events.

8.3.5 Presence of weeds

The Development Envelope is within an active pastoral station that has historically been adversely affected by weed invasion and grazing by stock. The condition of the vegetation within the Cape Preston area ranges from Completely Degraded to Very Good (Maunsell 2008, AECOM 2009, Astron 2009a).

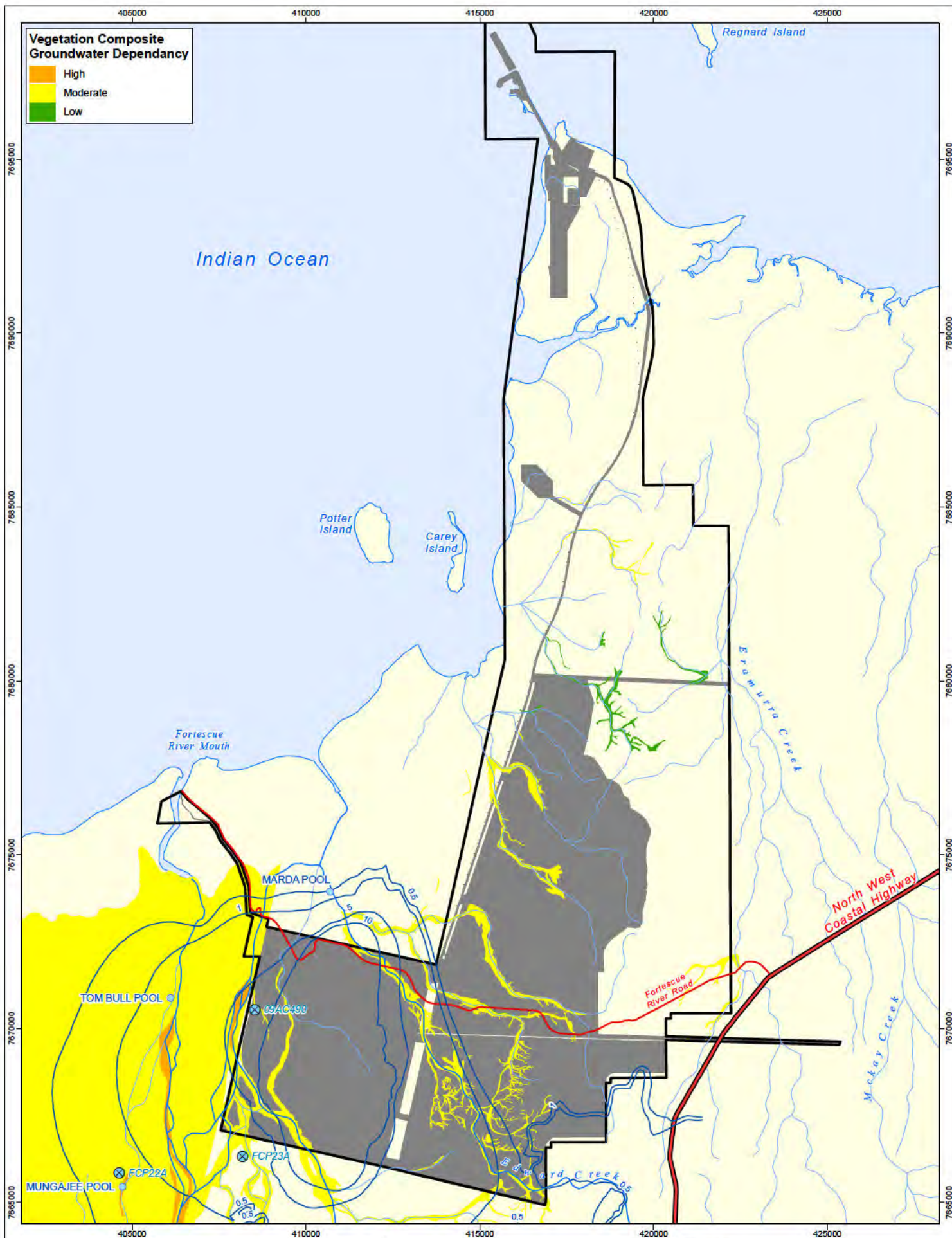
The majority of floodplain in the area is invaded by mesquite (**Prosopis pallida*) and **Parkinsonia aculeata* which are Declared Plants by the Department of Agriculture and Food, pursuant to s 22 of the Biosecurity and Agriculture Management Act 2007 (BAM Act) as well as Weeds of National Significance. Buffel grass (**Cenchrus ciliaris*) is also common throughout the pastoral lease.

Mesquite is one of 20 Weeds of National Significance in Australia, due to its invasiveness and potential for spread across a wide landscape, impacts on the environment, and socioeconomic impacts. Anderson et al. (undated) conducted an aerial survey to determine the extent and density of mesquite infestations throughout the Pilbara. This mapping was used to determine the extent of mesquite infestations throughout the groundwater-dependent vegetation to the west of the Development Envelope, as mapped by Astron (2008a) (Table 8-5, Figure 8-6). Over 80% of the groundwater-dependent vegetation area is infested with mesquite, with over 60% of the area affected by 'scattered' to 'dense' infestations. Infestation level corresponds closely to availability of water, with the densest infestations found within or directly adjacent to river and creek beds.

A field survey was undertaken at 11 sites within the groundwater-dependent vegetation area to ground-truth mesquite infestation levels. Figure 8-7 illustrates the higher levels of infestation ('scattered' to 'dense') present within groundwater-dependent vegetation.

Table 8-5: Density of mesquite infestations within groundwater-dependent vegetation

Infestation density	Area of groundwater-dependent vegetation affected (ha)	% of groundwater-dependent vegetation affected
1 plants per ha	1924	3.1
2 to 9 plants per ha	5753.5	9.4
10 to 29 plants per ha	3293	5.4
30 to 70 plants per ha	1165.5	1.9
Scattered	15632.5	25.6
Medium	11636.5	19.0
Mid-dense	8158.5	13.3
Dense	2460.5	4.0
None	11137	18.2
Total	61161	100



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Figure 8 - 5

Groundwater Dependent
Ecosystem mapping

0 2.5 5
Kilometres
1:140,000
Datum: GDA94
Projection: MGA Zone 50

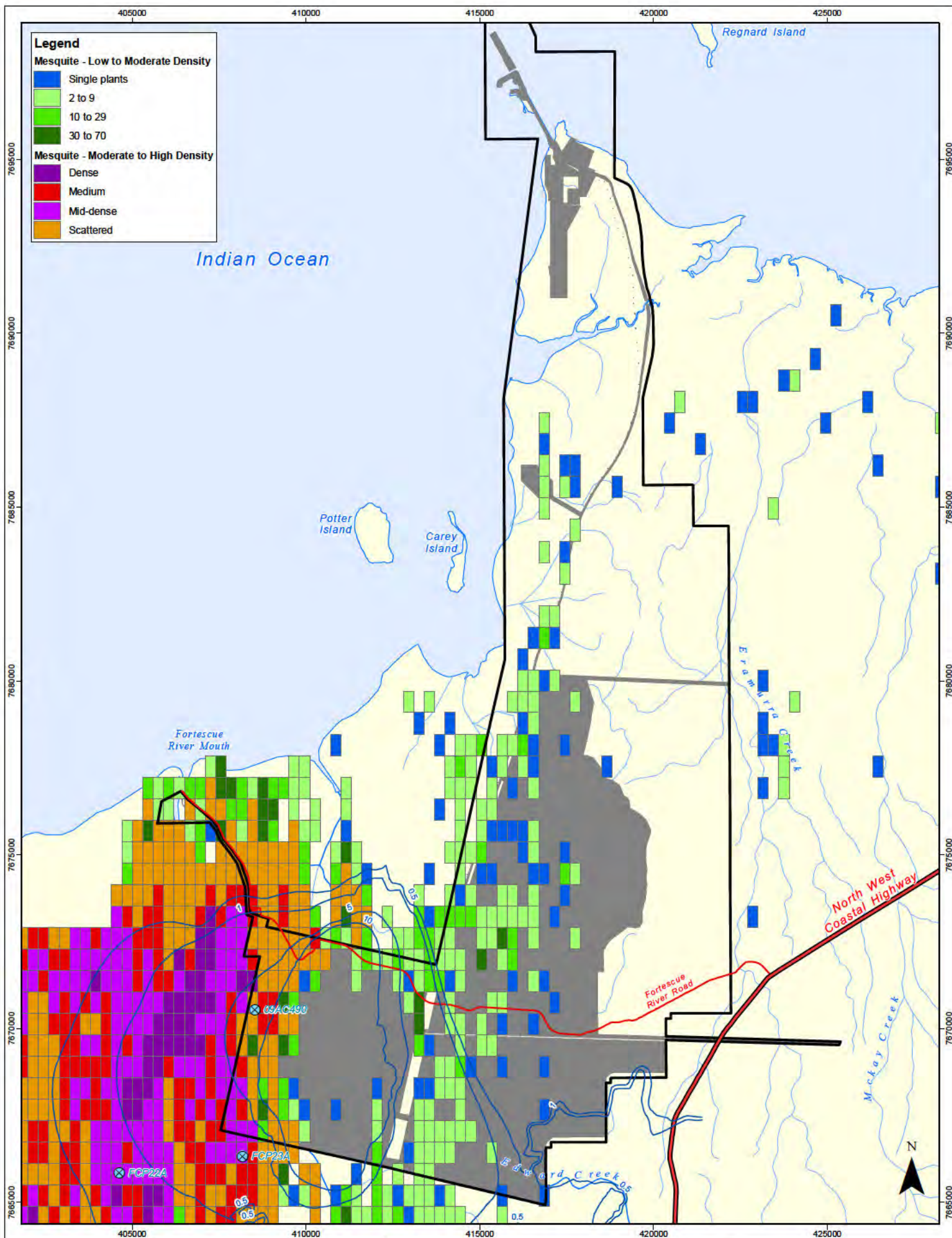
Department: ENV Date: 27/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MC, Strategen Internal Reference 4418_01_2017_APP

Legend

- ⊗ Monitoring bore
- Groundwater Drawdown Mine Continuation Proposal
- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Development Envelope
- Conceptual Footprint



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Mine Continuation Proposal

Figure 8 - 6

Extent of weed mapping

0 2.5 5
Kilometres
1:140,000

Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 27/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MC, Strategen Internal Reference 4419_01_2017_APP

Legend

- Monitoring bore
- Groundwater Drawdown Mine Continuation Proposal
- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Development Envelope
- Conceptual Footprint



Figure 8-7: Mesquite infestation levels within groundwater-dependent vegetation

8.4 Potential impacts

The following potential impacts have been identified:

- clearing of native vegetation has the potential to affect the regional representation of vegetation communities and flora species
- clearing has the potential to introduce/spread weeds
- groundwater drawdown from dewatering has the potential to affect groundwater dependent ecosystems.

This section describes the impacts of groundwater drawdown on groundwater-dependent ecosystems. The extent and impact of groundwater drawdown and discharge on hydrological processes is outlined in Section 5.5.1 while Section 7.5.1 describes the impact of groundwater discharge on marine environmental quality.

8.5 Assessment of impacts

8.5.1 Clearing

Table 8-2 identifies that of the Land Systems present in the Development Envelope less than 2% of each of these has been cleared historically within the Pilbara Subregion, showing negligible loss of vegetation to date at a regional scale. Further, less than 10% of each Land System has been cleared to date within the Roebourne Subregion. This illustrates that the Land Systems present in the Development Envelope are all well represented in the wider region.

While 69 distinct vegetation units have been identified in the Development Envelope, these correspond closely with a limited number of landform elements (i.e. hills, plains and creeks). The landform elements in the Development Envelope are closely linked to the Land Systems. The fact that the Land Systems are well represented in the Roebourne Subregion indicates that the landforms and vegetation units are also likely to also be well represented in the Roebourne Subregion.

The majority of the disturbance (over 5000 ha or more than 70%) occurs within either the Low Hills and Slopes or Plains landforms. These landforms contain vegetation units, which are of low to moderate local conservation significance and are well represented in the local area.

As shown in Table 8-6, (the clearing within 50 of the 69 vegetation units recorded within the Development Envelope (including both the clearing for the existing project and the Proposal) will be less than 60% of their mapped extent. This indicates that for the majority of the vegetation units the additional clearing associated with the Proposal will not be significant.

Of the 17 vegetation units that will have a total clearing of more than 70% clearing, eight of these were already more than 70% cleared as a result of the existing project. The remaining nine units are within landform elements (i.e. plains) that contain other similar vegetation units that are all well-represented.

Within the above context the Proposal will not significantly reduce the extent of vegetation types within any landform and it is considered unlikely that the additional clearing will significantly affect Flora and Vegetation values.

Table 8-6: Area of clearing within Development Envelope and Proposal Footprint

Landform	Vegetation unit	Total	Development Envelope		Existing clearing		Proposal Footprint (including existing clearing)	
		(ha)	(ha)	(%)	(ha)	(%)	(ha)	(%)
Clayey plains	Hp	3838.1	880.4	22.9	281	7.3	792.1	20.6
	Hp1	20.1	20.1	100	19.7	98.2	20.1	100
Beaches	Lb	53.3	31.7	59.5	0.4	0.8	2.4	4.5
Dunes	Ld1	38.5	19.2	49.9	0.6	1.6	0.7	1.8
	Ld2	413.3	312.9	75.7	4.2	1	80.5	19.5
	Ld3	47	23.4	49.8	9.1	19.3	11	23.4
	Ld4	51.6	51.6	100	0	0	2.5	4.8
Hills	Lh2	22.7	2.8	12.3	0	0	0	0
Intertidal zones	Lm	374.2	168.1	44.9	0	0	0.9	0.3
Sandy Plains	Lp1	109	108.9	99.9	0	0	21	19.3
	Lp3	5.9	1.7	28.8	0	0	0.6	10.2
	Lp4a	35.1	18	51.3	0	0	0.9	2.6
	Lp4b	17.5	17.4	99.4	2.8	15.8	2.8	16
	Lp5	14.2	12.5	88	0	0	0.1	0.7
Tidal Mudflats	Ls1	614.4	365.5	59.4	0	0	12.9	2.1
	Ls2	354.9	158	44.5	0.5	0.1	7.8	2.2
	Ls3a	1.5	1.5	100	0	0	0.5	33.3
	Mf1	3.3	2	60.6	0	0	2	60.6
Plains	Mp1	523.4	802.2	153.3	17.2	3.3	24.9	4.8
Minor Flowlines	Nc	968.6	656.1	67.7	172.9	17.9	427.3	44.1
Low Hills and Slopes	Nh	2670.2	1187.4	44.5	808.7	30.3	1179	44.2
	Nh1	173.1	82	47.4	5	2.9	73.9	42.7
	Nh2	861.4	4.4	0.5	0	0	0	0.0

Landform	Vegetation unit	Total	Development Envelope		Existing clearing		Proposal Footprint (including existing clearing)	
		(ha)	(ha)	(%)	(ha)	(%)	(ha)	(%)
	Nh3	345.6	148.9	43.1	22.6	6.5	49.1	14.2
Rockpiles	Nr	4.2	2.2	52.4	2.2	51.9	2.2	52.4
Creeklines and Floodplains	Pc	600.6	184.4	30.7	9.3	1.5	179.2	29.8
	Pc2	732.3	52.3	7.1	1.5	0.2	18.1	2.5
	Pc3	11.5	90.3	785.2	0.2	1.3	9.1	79.1
	Pc4	3.1	3.1	100	0	0	3.1	100.0
	Pf1	1.5	1.5	100	0.1	4.1	1.5	100.0
Plains	Pp1	406.7	406.7	100	15.8	3.9	220.8	54.3
	Pp2	510.8	322	63	9.2	1.8	107.8	21.1
	Px1	2890.6	2120.6	73.4	391.3	13.5	1719.5	59.5
	Px2	3006.2	692.7	23	179.2	6	535.9	17.8
	Px4	4.3	4.3	100	4.3	100	4.3	100.0
	Px5	1.2	1.2	100	1.2	100	1.2	100.0
	Px6	1.6	1.6	100	1.6	99.8	1.6	100.0
Creeklines	Rc1	742	19.7	6	0	0	14.9	2.0
	Rc3	226.9	38.7	17.1	0.1	0	21	9.3
	Rc4	698.9	3.7	0.5	0.2	0	0.9	0.1
Floodplains	Rf1	3589.3	504.4	14.1	90.2	2.5	425.1	11.8
	Rf2	1154	48.8	4.2	0	0	45.7	4.0
	RO3a	1.2	1.2	100	1.2	99.7	1.2	96.7
Minor flowlines	ROc1	38.6	50.5	130.8	0.7	1.9	32.5	84.2
	ROc2	99.8	86.7	86.9	0.7	0.7	23.9	23.9
	ROc3	14.8	14.8	100	0	0	14.8	100.0
	ROc4	54.4	54.1	99.4	1.8	3.3	17	31.3

Landform	Vegetation unit	Total	Development Envelope		Existing clearing		Proposal Footprint (including existing clearing)	
		(ha)	(ha)	(%)	(ha)	(%)	(ha)	(%)
	ROc4/ROh2a	8.3	8.3	100	3.8	45.7	7.3	88.0
	ROc5	3.5	3.5	100	0	0	0.4	11.4
	ROc6	39.7	34.9	87.9	1.7	4.3	30.2	76.1
	ROc7	0.7	0.7	100.0	0.5	71.4	0.7	100.0
	ROc8	1.6	1.6	100	1.6	99.8	1.6	100.0
Low hills and slopes	ROh1	1858.8	2260.8	121.6	117.9	6.3	1117.8	60.1
	ROh1a	116.4	116.4	100	1	0.8	57.5	49.4
	ROh1b	2364.8	1864.9	78.9	117.6	5	897.9	38.0
	ROh2	1384.8	1623.8	117.3	152.6	11	346.3	25.0
	ROh2a	55.6	55.6	100.0	6.3	11.4	43	78.0
	ROh2b	1426.7	1645.5	115.3	245.5	17.2	1130.5	79.2
	ROh3a	2.3	2.3	100	2.3	100	2.3	100.0
Plains	ROp1	217.1	153.5	70.7	2.4	1.1	5.3	2.4
	Ropl	22.3	0.3	1.3	0	0	0	0.0
Rockpiles	ROr	22.4	22.4	100	4.1	20.4	5.1	25.5
	ROr1	5	5	100	0	0	0	0.0
	ROr2	3	3	100	0.4	13.8	0.6	20.0
	ROr3	1.1	0.2	18.2	0	0	0	0.0
Tidal Creek	Yc1	0.9	0.9	100	0	0	0	0.0
	Yf1	11691.6	17.1	0.3	0	0	0.7	0.0
	Yf1d	4113.8	0	0.2	0	0	0.3	0.0
Plains	Yp1	225.6	53.9	23.9	3.1	1.4	53.9	23.9

8.5.2 Spread of weeds

Thirteen species of introduced flora were recorded from the surveyed area. The most problematic is Mesquite (*Prosopis* sp.) which is a Weed of National Significance and a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Its occurrence in this area is part of the largest infestation in Australia, and is often associated with creek lines and floodplains. A number of other introduced species are also present in the area but most are commonplace throughout the rest of the Pilbara. Vehicle or earth movements have the potential to spread existing weed species and to introduce new weed species, particularly if equipment is not adequately inspected and cleaned prior to arrival or departure from site. Activities that disturb native vegetation (such as clearing) can create favourable conditions for weeds to establish. If appropriate management measures are not implemented, weed infestations can outcompete native vegetation and result in alterations to existing ecosystems.

8.5.3 Groundwater drawdown

Groundwater drawdown has the potential to reduce health of phreatophytic species (e.g. *Melaleuca argentea*, *Eucalyptus camaldulensis* and *E. victrix*), which can result in plant deaths and consequently changes in structure of GDEs. Astron 2009b mapped the extent of GDEs and quantified the distribution of highly dependent and moderately dependent ecosystems.

As described in Section 5.3.2, the existing project includes dewatering to allow mining to a depth of 220 m. Aquaterra (2001) identified that drawdown of 0.5 m would extend 3.5 km to the west, 5 km to the east and 15 km to the north and south of the George Palmer Orebody (shown in Figure 5-5). The drawdown zone covers approximately 15 730 ha. Section 5.5.1 identifies that the groundwater modelling for the Proposal predicts that the shape of the drawdown would be less elongated than the previous modelling. The revised modelling for the Proposal shows that the 0.5 m contour will extend approximately 5 km further west and covering a total area of approximately 14 400 ha.

Table 8-7 presents the total areal extent of GDEs within the 0.5 m, 5.0 m and 10.0 m drawdown contours. As summarised in Section 5.5.1, while the extent of the 0.5 m drawdown contour is predicted to be smaller in area than that for the existing project, it will extend further west. By extending further west the 0.5 m drawdown contour increases the area of GDEs potentially affected. In contrast both the 5.0 m and 10.0 m drawdown contour for the Proposal will decrease the extent of GDEs affected.

The key difference between the existing project and the Proposal are:

- extent of GDEs within the 0.5 m drawdown contour will increase
- extent of GDEs within the 5.0 m drawdown contour will decrease
- extent of GDE classed as High Dependence that will experience drawdown will increase.

Table 8-7: Area of groundwater dependent vegetation affected

Drawdown (m)	Existing project area (ha)				Extent of Proposal at 2060 (ha)		
	High Dependence	Moderate Dependence	Low Dependence	Total	High Dependence	Moderate Dependence	Total
0.5	27.4	1723.9	4.3	1755.7	171.1	4984.0	5155.2
5.0		1091.2	0.8	1092.0	28.3	342.3	370.61
10.0		773.5		773.5	0.0	164.2	164.2

Despite the increase in size of the drawdown zone, vegetation quality is not expected to be significantly affected, for the following reasons:

1. Depth to groundwater in the GDE area is currently relatively deep (5 – 20 m) and thus additional drawdown is unlikely to cause significant additional stress on groundwater-dependent vegetation (Figure 5-14).
2. The majority of GDE within the Proposal Footprint contains species with low to moderate dependence on groundwater, with a small amount of high dependence vegetation within river and creek lines (Figure 8-5).
3. Groundwater levels at monitoring points within the approved drawdown area have been predicted to decrease by 3 – 4 m (monitoring site FCP23a) and 7 – 8 m (monitoring site 09AC490) over a 43 year period (Figure 5-10). Groundwater level decreases outside of the approved drawdown area (i.e. within the GDE area) will be subject to less substantial change at a slower rate, enabling GDEs to adapt.
4. Thirty-six per cent of the GDE area is infested with 'medium' to dense mesquite infestations (Table 8-5, Figure 8-6), and 60% is subject to 'scattered' to dense infestations; as such, this portion of the area already has limited native vegetation value.

Based on the slow rate of change within the 0.5 m drawdown contour, the limited ecosystem value (as a result of the Mesquite infestation), the seasonal surface water availability (as shown in Figure 5-10) and decrease in the extent of GDEs affected by the 5.0 m drawdown contour the Proposal is not expected to significantly affect the Flora and vegetation values as a result of groundwater drawdown.

Consideration of cumulative effects

Section 5.5.1 identified that, with the exception of the Fortescue River floodplain borefield associated with the Balmoral South Proposal, the cumulative effect of the development of all mines in the Cape Preston Area would not substantially increase the extent of groundwater drawdown relative to the Proposal. Table 8-8 shows that the extent of GDEs affected by the cumulative development of all mines. The Fortescue River floodplain borefield, which is a component of the Balmoral South Project (i.e. Stage 2, not progressed), substantially increase the extent of GDEs within the 0.5 m drawdown contour. However, the extent of GDEs within the 5.0 m and 10.0 m drawdown contours is actually less than that of the existing project.

To consider the potential cumulative extent of groundwater drawdown the model has relied only on publically available information that was available for the MEP. Therefore, this assessment approximates the likely result of the inclusion of the mines in this model. The proponents of the other mines would still need to develop their own modelling to take into account their own geological data and mine planning requirements as well as undertaking their own assessment of cumulative impacts to GDEs if they seek approval for their projects.

Table 8-8: Cumulative effect of all mines on GDEs

Drawdown (m)	Cumulative drawdown of all Cape Preston mines (ha)			
	High Dependence	Moderate Dependence	Low Dependence	Total
0.5	171.1	11 247.8	3.1	11 422.0
5	34.6	929.9		964.5
10.00		393.8		393.8

8.6 Mitigation

The overall objective for the mitigation of impacts to flora and vegetation is to ensure that the impact on the quality of flora and vegetation as a result of implementation of the Proposal are minimised.

The following mitigation measures are proposed:

Avoid:

- inspection of the site for the presence of Mesquite or Parkinsonia prior to any machinery being moved to a site
- maintenance of adequate fire breaks across the mine site and around working areas.

Minimise:

- clearing constrained within approved footprint by clearly delineated clearing footprint boundaries
- restricting all vehicles and equipment to within designated tracks and parking areas
- restricting all earthworks and movements of machinery and vehicles to within marked clearing or disturbance boundaries
- weed hygiene measures are implemented to ensure spread of weeds, in particular mesquite, is prevented
- monitoring of GDE vegetation as outlined in the GDVMP (Astron 2015) (Section 8.6.2) will be conducted and contingency responses activated when trigger levels are exceeded.

8.6.1 Weed management

As mesquite is a Declared Pest Plant under the BAM Act, new infestations will be reported to the Pest and Disease Information Service, and management of and control of the species will follow guidelines provided by the Department of Agriculture and Food and the Pilbara Mesquite Management Committee in the *Pilbara Mesquite Management Strategy 2014 to 2017* (Astron 2014). Weed management measures described in the OEMP (Appendix 3) will be implemented.

8.6.2 Groundwater dependent vegetation management

A Groundwater Dependent Vegetation Monitoring Program (GDVMP) comprising biannual monitoring surveys was established in May 2009, when groundwater abstraction commenced (Astron 2015). Monitoring surveys have been conducted in November (towards the end of the dry season) and May (towards the end of the wet season). Monitoring sites have been located along Edwards Creek, Du Boulay Creek and Fortescue River within the predicted drawdown zone (drawdown sites) and outside the predicted drawdown zone (reference sites) (Astron 2015). Comprehensive baseline data has been collected from these sites between 2009 and 2013. Drawdown in the alluvial aquifer has likely only extended beyond the immediate pit area since 2013; as such, monitoring has not continued beyond 2013 (Astron 2015). The only impacts on GDEs attributable to Project activities was a decline in tree health (no deaths observed) detected in May 2014 at Site 6 on Du Boulay Creek to the immediate west of the mining operations. Tree health parameters have varied in response to seasonal and interannual patterns of rainfall (Astron 2015).

The following parameters will be monitored at each site to determine vegetation health in relation to groundwater depth and quality:

- depth to groundwater
- pH and salinity
- leaf water potential
- visual health
- dead/live count
- Projected Foliar Cover
- remotely sensed index of tree condition
- stem diameter
- regeneration
- perennial species presence
- cover by category and species.

Sites will be monitored six-monthly. Two zones have been defined, relating to the extent of groundwater drawdown zone during two time periods, 2015 to 2018 and 2018 to 2025. Monitoring sites in the outer zone are only required to be monitored from the time when the drawdown zone is expected to approach these sites.

8.7 Predicted outcome

When the mitigation and management measures have been implemented, it is expected that the Proposal will result in the following residual impacts and outcomes in relation to flora and vegetation:

- approximately 7366 ha of vegetation will be cleared by the Proposal with the majority of this occurring in habitat of low to moderate conservation significance and well represented in the region
- loss of 121.51 ha of vegetation from the Horseflat Land System, a Priority 3iii Ecological Community although this will not result in a significant reduction in the extent of this community with total clearing in the Roebourne Subregion less than 0.5%
- no Threatened Flora species listed under either the WC Act or EPBC Act will be affected by the Proposal
- no Priority Flora species as listed by Parks and Wildlife will be affected by the Proposal
- no change to GDE health is predicted with implementation of the GDE the monitoring plan and related adaptive management actions; and as a result of minimal changes to of groundwater levels (0.5 m)
- the Proposal will not conflict with the WC Act as no flora species will significantly affected or have its conservation status affected by the Proposal's implementation.

Based on the predicted residual impacts, the Proposal will meet the EPA's objective for the Flora and vegetation factor.

9. Terrestrial fauna

9.1 EPA objective

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

9.2 Policy and guidance

The relevant policy and guidelines for Terrestrial fauna are:

- Environmental Factor Guideline - Terrestrial Fauna (EPA 2016h)
- Technical Guidance - Sampling methods for terrestrial vertebrate fauna (EPA 2016i) – replaces EPA and DEC 2010
- Technical Guidance - Terrestrial fauna surveys (EPA 2016j) – replaces (EPA 2004)
- Technical Guidance – Sampling of short range endemic fauna (EPA 2016k) – replaces (EPA 2009).

On 13 December 2016 the EPA released revised guidelines for Terrestrial fauna. Relevant policies and guidelines prior to this date are:

- EPA Guidance Statement 20, *Sampling of Short-Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia* (EPA 2009)
- EPA Guidance Statement 56, *Terrestrial Fauna Surveys for Environmental Impact Assessment in WA* (EPA 2004)
- EPA Position Statement 3, *Terrestrial Biological Surveys as an element of Biodiversity Protection* (EPA 2002)
- *Technical Guide -Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and DEC 2010).

9.3 Receiving environment

A summary of work completed to describe the receiving environment regarding terrestrial fauna is included in Table 9-1.

The Cape Preston area has been studied in detail since 2000, including ten fauna assessments surveys (Table 9-1). Ecoscape (2016a) conducted a peer review of previously completed fauna surveys to determine the adequacy of work undertaken in relation to current guidelines, summarise survey results and provide advice on any additional work required to meet current guidelines. Ecoscape (2016a) assessed the previous fauna surveys as adequate in relation to current guidelines for vertebrate fauna assessments and that additional work is unlikely to record any species of conservation significance not identified during previous surveys or assessed as potentially occurring. The level of surveying in the area is believed to be sufficient, in particular when considering data made available by Parks and Wildlife, the WA Museum (NatureMap) and the Atlas of Living Australia (ALA).

Table 9-1: Summary of environmental studies and survey effort

Author	Survey/ investigations name	Study area, type and timing	Study standard/guidance and limitations
Recently completed work			
Ecoscape 2016a	Vertebrate fauna desktop review	A review of previously completed vertebrate fauna surveys and assessments within the Development Envelope.	Guidance Statement No. 56 Position Statement No. 3
Ecoscape 2016b	Northern Quoll reconnaissance survey	Northern Quoll reconnaissance survey conducted in 2016 within the Development Envelope.	Guidance Statement No. 56. <i>Limitations:</i> Reconnaissance survey only.
Ecoscape 2016c	Targeted Northern Quoll survey	Targeted Northern Quoll survey conducted in 2016 within the Development Envelope.	Guidance Statement No. 56.
Previously completed work			
Pendoley Environmental 2010	Marine turtle survey	Marine turtle survey undertaken in 2010 at Cape Preston.	Guidance Statement No. 56
Pendoley Environmental 2009	Marine turtle survey	Marine turtle survey undertaken in 2009 along the western and eastern side of Cape Preston.	Guidance Statement No. 56
Bennelongia 2008	Shorebird survey	Shorebird survey along the Cape Preston coastline.	Guidance Statement No. 56
Phoenix 2008a	Level 2 fauna survey	Vertebrate fauna assessment within the Development Envelope.	Guidance Statement No. 56
Phoenix 2008b	Level 2 fauna survey	Vertebrate fauna assessment within the entire Cape Preston Iron Ore Mining Precinct.	Guidance Statement No. 56
Phoenix 2008c	Short-range endemic invertebrate fauna survey	Short-range endemic invertebrate fauna survey within the Balmoral area.	Guidance Statement No. 56
Maunsell 2008	Consolidated vegetation, flora and fauna assessment	A review of flora, vegetation and fauna data (2000-2007) and detailed assessments in previously unsurveyed areas, covering all mining leases (M08/118 to M08/130).	Guidance Statement No. 56
Maunsell 2006	Level 2 fauna survey	Vertebrate fauna assessment within the Balmoral area.	Guidance Statement No. 56
Maunsell 2003	Baseline turtle survey	Turtle survey conducted in the 2002/2003 nesting season within the Cape Preston shore surrounding the proposed Mineralogy project site.	EPA condition 2.2 (Bulletin 1056, EPA 2002)
Hassell 2002	Shorebird survey	Shorebird survey at Cape Preston.	Guidance Statement No. 56
HGM <i>et al.</i> 2001	Level 2 fauna survey	Vertebrate fauna assessment within the Development Envelope.	Guidance Statement No. 56

9.3.1 Fauna habitat

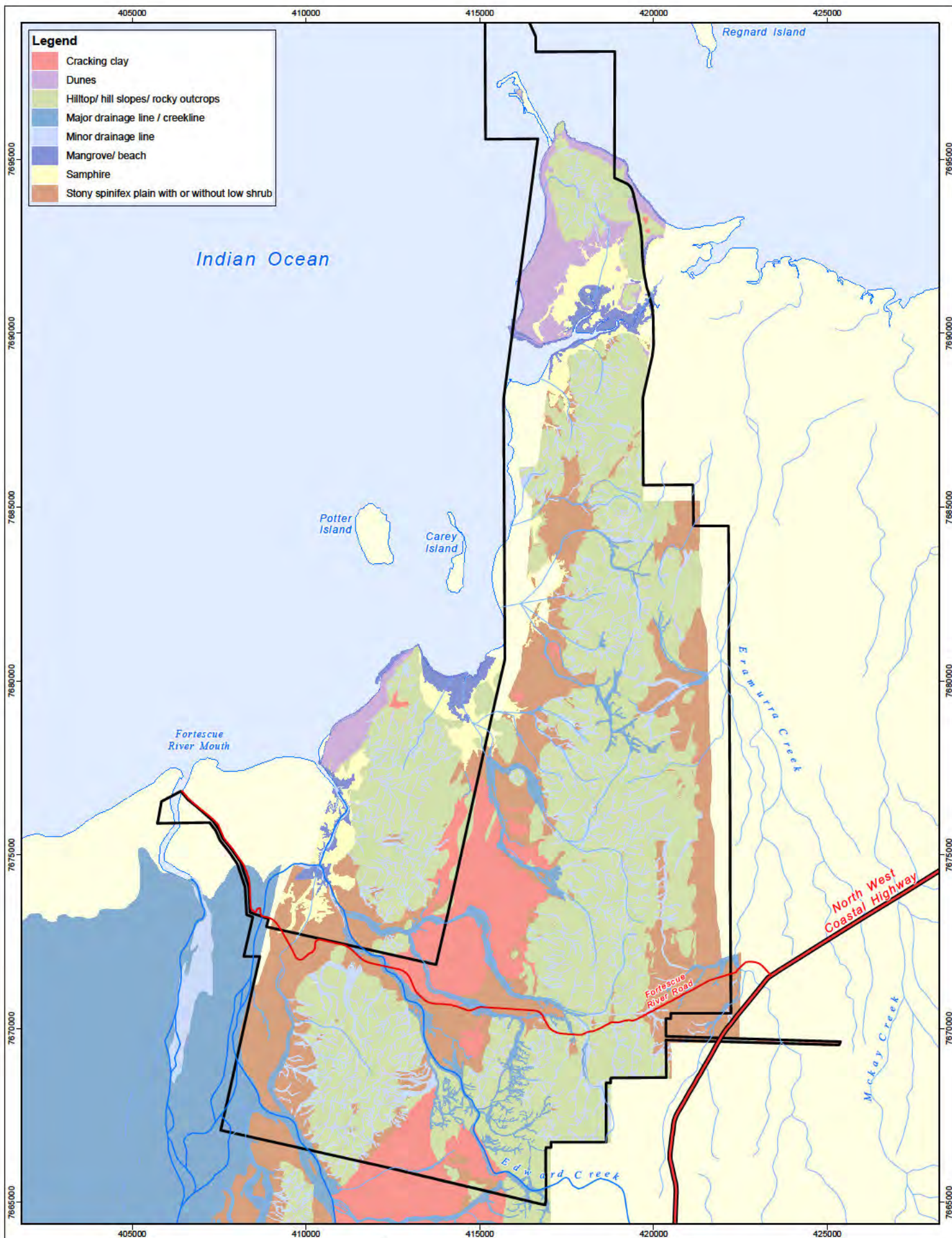
The Cape Preston area contains seven broad terrestrial habitat types (Ecoscape 2016a) (Table 9-2 and Figure 9-1). The majority of habitat within the Development Envelope is low open shrubland over low spinifex on flat plains, which are of low conservation significance. The highest conservation value terrestrial fauna habitats within the Development Envelope are associated with drainage lines.

Table 9-2: Terrestrial fauna habitats

Habitats defined in 2008 survey	Significance of habitat*	Habitats defined in 2001 survey	Land Systems
Cracking clay	Moderate – habitat value and significant species	Cracking clay	Horseflats and Paraburdoo
Drainage line (minor and major)	Moderate - High - contains mature trees with hollows that provide roosting sites. May also provide fauna linkages for amphibians and some mammals	Creeklines	Riverland and Paraburdoo
Dunes	Moderate – habitat is restricted in distribution in the Pilbara to the coast	- Coastal dunes - Sandplain	Littoral
Hilltop/ hill slopes/ rocky outcrops	Low – habitat is widespread in the Pilbara	- Rocky hills and outcrops - Low stony hills	Newman, Rocklea and Macroy
Mangrove/ beach	High - significant species, habitat value and ecological	- Beach - Mangrove (Mangals)	Littoral
Samphire	Moderate – habitat is restricted in distribution in the Pilbara to the coast	Samphire	Littoral
Stony Spinifex plain with or without low shrub	Low – habitat is widespread in the Pilbara	Stony plains	Paraburdoo

*Based on importance as a potential habitat for significant fauna species, habitat value (extent of fauna diversity supported) and ecological function.

Fauna habitat along ridgelines and Edward Creek are corridors of particular habitat types and are considered to be fauna linkages. Whilst no Priority Fauna species are dependent on the area around the creeks for movement or dispersal it is possible that this habitat is important for other species (Phoenix 2009).



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Figure 9 - 1

Fauna habitat

0 2.5 5
Kilometres
1:140,000
Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 20/01/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MC, Strategen Internal Reference 4420_01_2017_APP

Legend

- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Development Envelope

9.3.2 Conservation significant fauna

In addition to the surveys undertaken, Ecoscape (2016a) carried out a database search to determine the fauna species that could potentially occur within the Development Envelope, with an emphasis on species of conservation significance. A total of 57 species of conservation significance (three mammals, 50 birds, and four reptiles) have been recorded during previous surveys at Cape Preston and surrounding areas. An additional 15 species (three mammals, six birds, and six reptiles) have a medium to high likelihood of occurrence based on habitat, database searches and previous records (Table 9-3).

Baseline studies (Hassell 2002, Bennelongia 2008) recorded three Critically Endangered Marine Migratory species (*Calidris ferruginea*, *Calidris tenuirostris*, *Numenius madagascariensis*), two Endangered Marine Migratory species (*Charadrius mongolus*, *Macronectes giganteus*) and one Vulnerable Marine Migratory species (*Charadrius leschenaultii*) listed under the EPBC Act (Figure 9-1). The majority of conservation significant species that were recorded in the area occur over a number of habitat types or occur in habitats that are widespread in the region. None of the habitat types present in the Development Envelope are unique to the locality or regionally significant.

Based on the likely presence in the Development Envelope, Northern Quoll was considered to be potentially affected by the Proposal and subject to a more detailed assessment (Section 9.3.3).

Table 9-3: Conservation significant species likely to occur within the Development Envelope

Species	EPBC Act Status	WA conservation status #	Parks and Wildlife	Likelihood
Mammals				
<i>Dasyurus hallucatus</i> (Northern Quoll)	Endangered	Schedule 2		Recorded
<i>Rhinonictis aurantia</i> (Pilbara Leaf-nosed Bat)	Vulnerable	Schedule 3		High
<i>Macroderma gigas</i> (Ghost Bat)	Vulnerable	Schedule 3		Medium
<i>Ozimops cobourgiensis</i> (Northern Coastal Free-tailed Bat)	-	-	Priority 1	Recorded
<i>Hydromys chrysogaster</i> (Water-rat)	-	-	Priority 4	High
<i>Leggadina lakedownensis</i> (Lakeland Downs Mouse)	-	-	Priority 4	Recorded
Birds				
<i>Limosa lapponica</i> (Bar-tailed Godwit)	Migratory, Marine	Migratory (S5)	VU	Recorded
<i>Limosa lapponica menzbieri</i> (Bar-tailed Godwit, Northern Siberian)	Critically Endangered		VU	Recorded
<i>Limosa lapponica baueri</i> (Bar-tailed Godwit, Western Alaskan)	Vulnerable		VU	Recorded
<i>Numenius madagascariensis</i> (Eastern Curlew)	Critically Endangered, Migratory, Marine	Schedule 3/ Schedule 5	VU	Recorded
<i>Calidris tenuirostris</i> (Great Knot)	Critically Endangered Migratory, Marine	Schedule 3 /Schedule 5	VU	Recorded
<i>Calidris ferruginea</i> (Curlew Sandpiper)	Critically Endangered, Migratory, Marine	Schedule 3 /Schedule 5	VU	Recorded
<i>Charadrius mongolus</i> (Lesser Sand Plover)	Endangered	Schedule 2 /Schedule 5	EN	Recorded

Species	EPBC Act Status	WA conservation status #	Parks and Wildlife	Likelihood
<i>Charadrius leschenaultii</i> (Greater Sand Plover)	Vulnerable, Migratory, Marine	Vulnerable (S3) Migratory (S5)	VU	Recorded
<i>Sternula nereis nereis</i> (Australian Fairy Tern)	Vulnerable	Schedule 3	VU	High
<i>Pandion haliaetus cristatus</i> (Eastern Osprey)	Migratory, Marine	Migratory (S5)	-	Recorded
<i>Pluvialis fulva</i> (Pacific Golden Plover)	Migratory, Marine	Schedule 5	-	High
<i>Pluvialis squatarola</i> (Grey Plover)	Migratory, Marine	Schedule 5	-	Recorded
<i>Charadrius veredus</i> (Oriental Plover)	Migratory, Marine	Schedule 5	-	Recorded
<i>Numenius phaeopus</i> (Whimbrel)	Migratory, Marine	Schedule 5		Recorded
<i>Tringa stagnatilis</i> (Marsh Sandpiper)	Migratory, Marine	Schedule 5		Recorded
<i>Tringa nebularia</i> (Common Greenshank)	Migratory, Marine	Schedule 5		Recorded
<i>Tringa glareola</i> (Wood Sandpiper)	Migratory, Marine	Schedule 5		Medium
<i>Tringa brevipes</i> (Grey-tailed Tattler)	Migratory, Marine	Schedule 5		Recorded
<i>Tringa cinerea</i> (Terek Sandpiper)	Migratory, Marine	Schedule 5		Recorded
<i>Tringa hypoleucos</i> (Common Sandpiper)	Migratory, Marine	Schedule 5		Recorded
<i>Arenaria interpres</i> (Ruddy Turnstone)	Migratory, Marine	Schedule 5		Recorded
<i>Calidris alba</i> (Sanderling)	Migratory, Marine	Schedule 5		Recorded
<i>Calidris ruficollis</i> (Red-necked Stint)	Migratory, Marine	Schedule 5		Recorded
<i>Glareola maldivarum</i> (Oriental Pratincole)	Migratory, Marine	Schedule 5		Medium
<i>Sterna nilotica</i> (Gull-billed Tern)	Migratory, Marine	Schedule 5		Recorded
<i>Sterna caspia</i> (Caspian Tern)	Migratory, Marine	Schedule 5		Recorded
<i>Sterna anaethetus</i> (Bridled Tern)	Migratory, Marine	Schedule 5		Recorded
<i>Apus pacificus</i> (Fork-tailed Swift)	Migratory, Marine	Schedule 5		Medium
<i>Ardea modesta</i> (Eastern Great Egret)	Marine	Schedule 5		Recorded
<i>Sterna bergii</i> (Crested Tern)	Migratory, Marine			Recorded
<i>Threskiornis spinicollis</i> (Straw-necked Ibis)	Marine			Recorded
<i>Nycticorax caledonicus</i> (Nankeen Night Heron)	Marine			Recorded

Species	EPBC Act Status	WA conservation status #	Parks and Wildlife	Likelihood
<i>Ardea garzetta</i> (Little Egret)	Marine			Recorded
<i>Ardea sacra</i> (Eastern Reef Heron)	Marine			Recorded
<i>Pelecanus conspicillatus</i> (Australian Pelican)	Marine			Recorded
<i>Accipiter fasciatus</i> (Brown Goshawk)	Marine			Recorded
<i>Circus approximans</i> (Swamp Harrier)	Marine			Recorded
<i>Haliastur sphenurus</i> (Whistling Kite)	Marine			Recorded
<i>Haliastur indus</i> (Brahminy Kite)	Marine			Recorded
<i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)	Marine			Recorded
<i>Esacus magnirostris</i> (Beach Stone-curlew)	Marine			Recorded
<i>Himantopus himantopus</i> (Black-winged Stilt)	Marine			Medium
<i>Larus novaehollandiae</i> (Silver Gull)	Marine			Recorded
<i>Sterna bengalensis</i> (Lesser Crested Tern)	Marine			Recorded
<i>Chrysococcyx basalis</i> (Horsfield's Bronze Cuckoo)	Marine			Recorded
<i>Chrysococcyx osculans</i> (Black-eared Cuckoo)	Marine			Recorded
<i>Cacomantis pallidus</i> (Pallid Cuckoo)	Marine			Recorded
<i>Ninox boobook boobook</i> (Southern Boobook)	Marine			Recorded
<i>Eurostopodus argus</i> (Spotted Nightjar)	Marine			Recorded
<i>Todiramphus sanctus</i> (Sacred Kingfisher)	Marine			Recorded
<i>Merops ornatus</i> (Rainbow Bee-eater)	Marine			Recorded
<i>Falco cenchroides</i> (Nankeen Kestrel)	Marine			Recorded
<i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)	Marine			Recorded
<i>Grallina cyanoleuca</i> (Magpie-lark)	Marine			Recorded
<i>Hirundo neoxena</i> (Welcome Swallow)	Marine			Recorded
<i>Petrochelidon nigricans</i> (Tree Martin)	Marine			Recorded
<i>Anthus australis</i> (Australian Pipit)	Marine			Recorded

Species	EPBC Act Status	WA conservation status #	Parks and Wildlife	Likelihood
<i>Falco peregrinus</i> (Peregrine Falcon)		Schedule 7		Medium
<i>Falco hypoleucos</i> (Grey Falcon)		Schedule 3		Recorded
Reptiles				
<i>Caretta caretta</i> (Loggerhead Turtle)	Endangered Migratory, Marine	Schedule 2	VU	High
<i>Chelonia mydas</i> (Green Turtle)	Vulnerable Migratory, Marine	Schedule 3	VU	Recorded
<i>Eretmochelys imbricata</i> (Hawksbill Turtle)	Vulnerable Migratory, Marine	Schedule 3	VU	High
<i>Natator depressus</i> (Flatback Turtle)	Vulnerable Migratory, Marine	Schedule 3	VU	High
<i>Ctenotus angusticeps</i> (Airlie Island Ctenotus)	Vulnerable	Schedule 3	VU	Medium
<i>Liasis olivaceus barroni</i> (Pilbara Olive Python)	Vulnerable	Schedule 3	VU	Medium
<i>Aipysurus laevis</i> (Olive Sea Snake)	Marine			High
<i>Ephalophis greyae</i> (North-western Mangrove Sea Snake)	Marine			Recorded
<i>Hydrelaps darwiniensis</i> (Black-ringed Sea Snake)	Marine			Recorded
<i>Notoscincus butleri</i> (Lined Soil-Crevise Skink)	-		Priority 4	Recorded

Schedule 2 – Fauna that is rare or is likely to become extinct as endangered fauna, Schedule 3 – Fauna that is rare or is likely to become extinct as vulnerable fauna, Schedule 5 – Migratory birds protected under an international agreement, Schedule 7 – Other specially protected fauna

9.3.3 Northern Quoll habitat

Northern Quoll reconnaissance survey

Following identification of potential habitat, a Northern Quoll reconnaissance survey was conducted in May 2016 in accordance with the *EPBC Act Referral guideline for the endangered Northern Quoll*, *Dasyurus hallucatus* (DotE 2016). Scat searches were carried out and 60 motion cameras were installed in a variety of potential Northern Quoll habitat (denning, foraging and dispersal) which included boulder piles in the mine and port areas (Ecoscape 2016b) (shown in Figure 9-2). All motion cameras were baited with non-food reward lures (burley oil soaked cloth ropes) and remained in the field for a minimum of 19 nights.

Motion cameras within the potential habitat recorded Northern Quolls at four locations within the port area within man-made structures (Figure 9-3). All four locations were outside the Proposal footprint. Two recordings were in a water seep and may be associated with denning habitat. The remaining two recordings were along the breakwater, which is located outside the Proposal footprint (Ecoscape 2016b).

The Northern Quoll reconnaissance survey identified a total of 49.75 ha of potential habitat within the Development Envelope, including 49.65 ha within the mine area and 0.12 ha within the port area. Northern Quoll habitat included rugged, rocky areas (boulder piles) and creeklines within the Development Envelope (Ecoscape 2016b). In proximity to mine area there was no evidence of the presence of Northern Quoll and no records from site personnel. The proposed mine area footprint (i.e. as distinct from the port area) was therefore assessed as not containing a population of Northern Quolls. The extent of habitat in the port area is shown in Figure 9-4.

Northern Quoll targeted survey

Based on results from reconnaissance survey, a targeted survey was conducted within the Port area in July 2016 (Ecoscape 2016c).

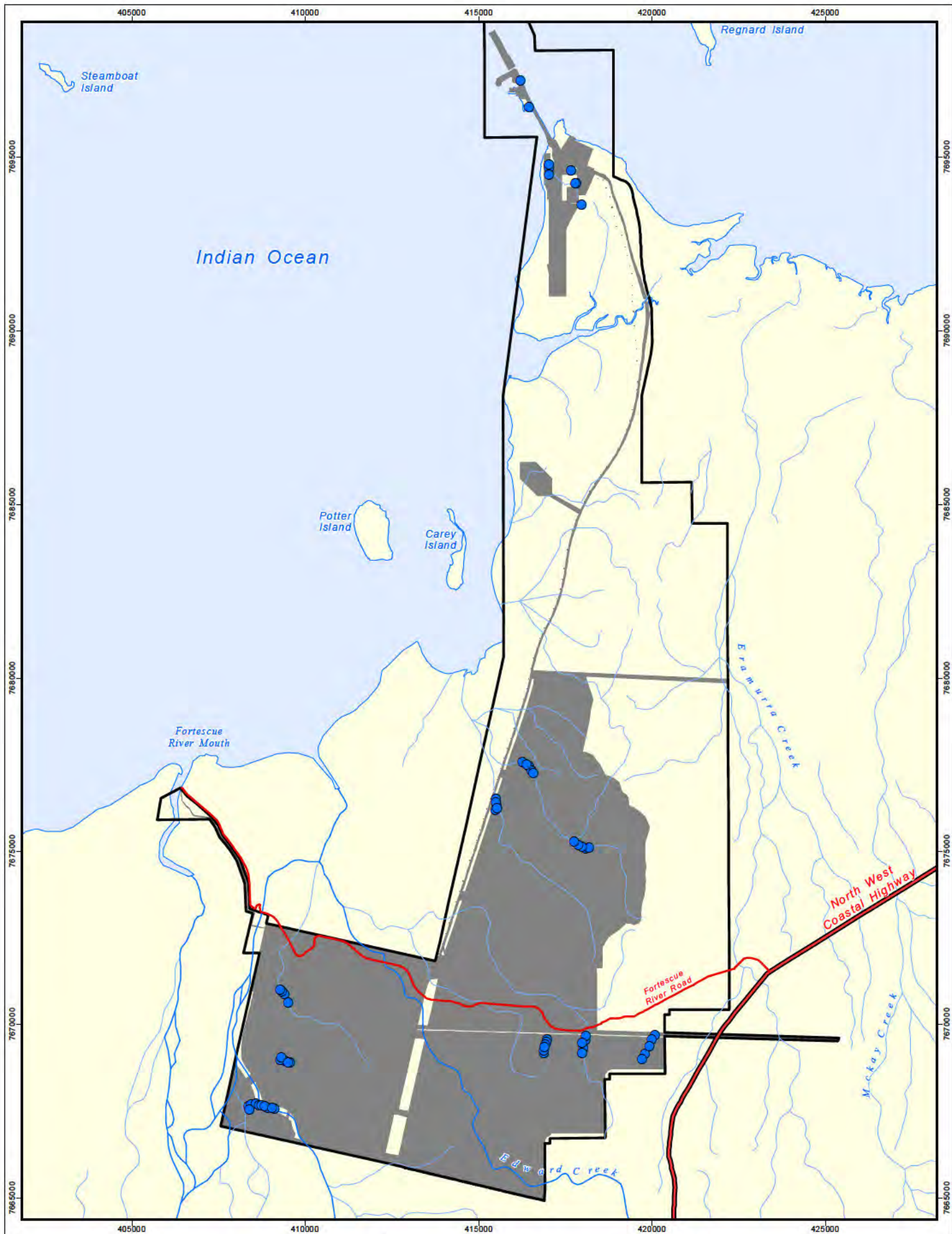
The targeted survey for Northern Quolls was completed with methodology following the EPBC Act Referral guideline for the Northern Quoll, *Dasyurus hallucatus* (DotE 2016). The results of the reconnaissance survey were used to set the design parameters for the targeted survey. The targeted survey was focussed on the Port area including non-impacted areas on Cape Preston.

Trap sites were established at seven locations based on the outcomes from the reconnaissance survey (identification of suitable habitat and recorded Northern Quolls). A total of 80 cage traps and large Elliott box traps were established across seven areas of suitable and critical habitat and left in place for seven consecutive nights (between 18 and 26 July 2016) (Figure 9-5). Each trap was baited using a bolus of rolled oats, peanut butter and sardines (as outlined in the EPBC Act referral guideline) with the bait refreshed every second day. All traps were checked daily within two hours of sunrise and all captured Northern Quoll processed to determine weight, short pes length, caudal width, head length, sex, and reproductive condition. All captured Northern Quoll were also injected with a PIT microchip for identification of recaptures and a small ear notch taken for future DNA analysis by research institutions (Ecoscape 2016b).

During the targeted survey, three male Northern Quolls were captured on several occasions (Figure 9-6) (Ecoscape 2016c). All captures were located on the northern end of the breakwater (outside the Proposal). Despite the relatively intensive trapping effort, no females were recorded from the site; however, they are likely to reside in close proximity to the existing project. Males are likely to travel to the Port area for foraging and dispersal since males are known to have extensive roaming behaviour. Attributes such as shelter, high humidity, and abundance of food resources (black rats, house mice, crabs etc.) are a likely driving factor for Northern Quolls to utilise this area (Ecoscape 2016c).

Based on habitat mapping and the density and location of records, the northern section of the port infrastructure contains a small amount of critical habitat (both natural and artificial) for the species which is likely to be utilised as foraging ground due to the proximity to the breakwater (Ecoscape 2016c).

In summary, Northern Quolls were not found to utilise the potential habitat within the Proposal footprint during the reconnaissance and targeted surveys.



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Cape Preston Northern Quoll
Reconnaissance Survey
Figure 9 - 2

Motion Camera Locations

0 2.5 5

Kilometres

1:140,000

Datum: GDA94
Projection: MGA Zone 50

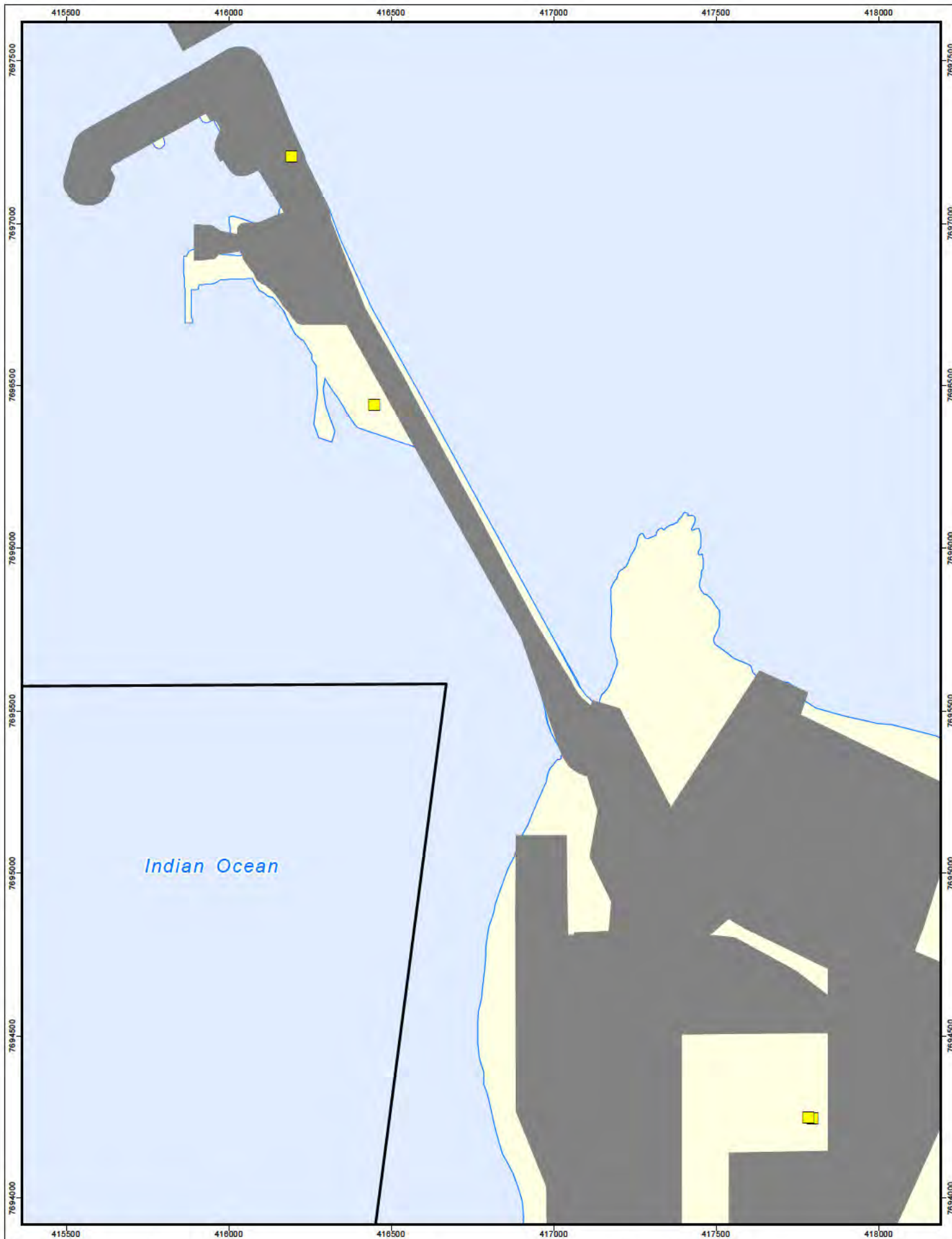
Department: ENV Date: 2/02/2017

Sheet Size: A4 Status: Draft

Drawn by: CF Requested by: MC, Strategen Internal Reference: 4464_00_2017_APP

Legend

- Camera Locations
- Development Envelope
- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Conceptual Footprint



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Cape Preston Northern Quoll
Reconnaissance Survey
Figure 9 - 3

Records of Occurrences During
Reconnaissance

0 0.3 0.6
Kilometres
1:15,000
Datum: GDA94
Projection: MGA Zone 50

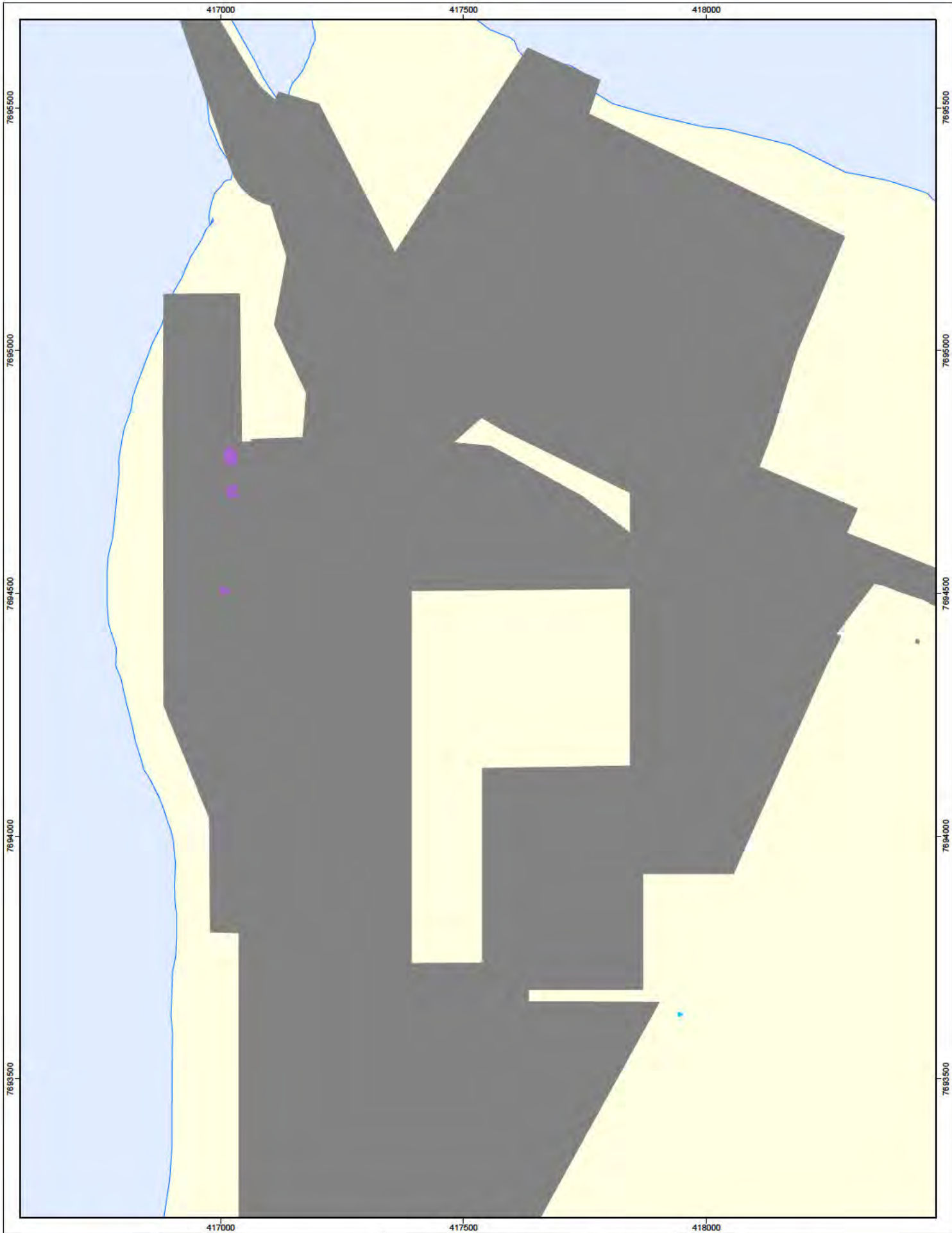
Department: ENV Date: 2/02/2017

Sheet Size: A4 Status: Draft

Drawn by CF Requested by MC, Strategen Internal Reference 4466_00_2017_APP

Legend

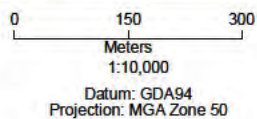
- Northern Quoll
- Development Envelope
- Conceptual Footprint



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Cape Preston Northern Quoll Targeted Survey

Figure 9 - 4
Northern Quoll Habitat



Department: ENV Date: 2/02/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MC, Strategen Internal Reference 4468_01_2017_APP

Legend

- Conceptual Footprint
- Moderate Quality
- Potential Foraging Habitat
- Potential Denning Habitat
- Cape Preston Coast



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Cape Preston Northern Quoll Targeted Survey

Figure 9 - 5

Northern Quoll Trap Locations

0 0.5 1
Kilometers
1:30,000
Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 2/02/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MC, Strategen Internal Reference 4467_00_2017_APP

Legend

- Trap Location
- Development Envelope
- Conceptual Footprint
- Cape Preston Coast

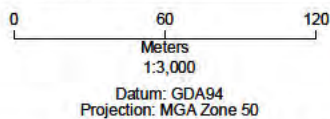


CITIC PACIFIC MINING
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Cape Preston Northern Quoll Targeted Survey

Figure 9 - 6

Records of Northern Quoll



Department: ENV Date: 2/02/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by MC, Strategen Internal Reference 4485_00_2017_APP

Legend

- Captured Quoll
- Recaptured Quoll
- Trap Location
- Conceptual Footprint

9.3.4 Invertebrate short-range endemic species

Invertebrate SREs are defined as having a restricted geographic distribution of less than 10,000 km² (Harvey 2002). The likelihood of recording SRE invertebrate taxa within the Cape Preston Project Area is considered to be generally low as there are a few landscape and biogeographical features present that would drive short-range endemism (Phoenix 2009).

An SRE invertebrate fauna survey of the Cape Preston area was conducted in 2008 by Phoenix. Sampling methods included wet pitfall trapping, active searches (foraging) and the collection of leaf litter samples.

Wet pitfall trapping was conducted at 50 sites; ten traps were dug in at each site in suitable microhabitats. The traps comprised of one litre plastic containers with a 70 mm diameter that were partly-filled with a solution of ethylene glycol and formaldehyde (2.5% by volume). All traps were left open for a period of 30 days.

Foraging incorporated the systematic inspection of logs, larger plant debris, under the bark of larger trees and the underside and of larger rocks. Methodical searches were also conducted amongst the leaf litter of shade-bearing tall shrubs and trees. Rocks and rock crevices were also inspected, particularly for pseudoscorpions. A temporally and spatially standardised approach was undertaken, whereby each site was sampled for 60 – 90 minutes within a 50 m x 50 m area.

Leaf litter samples were taken from sites where target taxa were not recorded during the foraging component but where they were considered likely to occur. Leaf litter samples were collected from 62 sites.

A total of nine families known to include SRE species were recorded during the survey. These families were represented by 13 genera and 24 species, which included one species of araneomorphae spider, five species of mygalomorphae trapdoor spiders, six species of pseudoscorpions, four species of scorpions, three slaters species and five species of land snails. Of these, three potential SRE species (*Meedo* n. sp., *Beierolpium* sp. (uncoded) and *Buddelundia* n. sp.1) occurred within or in close proximity to the Development Envelope. Table 9-4 describes the distribution and status of the species.

Table 9-4: Potential SRE species recorded

Species	Distribution within survey area	SRE status
Spiders		
<i>Meedo</i> n. sp.	Recorded from two rocky outcrop sites. Possible rock specialist based on current study and studies of other members of the family Gallieniellidae. Known records on the Newman Land System (iron ore containing Land System / geology).	Likely
Pseudoscorpions		
<i>Beierolpium</i> sp. (uncoded)	Genus suspected of containing SRE species, but taxonomy poorly resolved. A single record from Newman Land System (iron ore containing system). Identity not resolved.	Possibly
Isopods		
<i>Buddelundia</i> n. sp.1	Restricted to three rocky outcrop and rocky slope habitats, including two on the Cape. Likely rock specialist.	Possibly

9.3.5 Introduced fauna

Three introduced fauna species were recorded (Ecoscape 2016c); cat (*Felis catus*), black rat (*Rattus rattus*), House Mouse (*Mus Mus musculus*) sheep (*Ovis aries*) and fox (*Vulpes vulpes*).

9.4 Potential impacts

The following potential impacts have been identified:

- clearing has the potential to reduce the extent of fauna habitat
- clearing has the potential to disrupt localised fauna linkages for native fauna
- clearing of Northern Quoll habitat has the potential to affect habitat availability for this species
- development has the potential to introduce/attract feral animals
- mining development has the potential to reduce habitat quality or result in the death or injury of terrestrial fauna.

9.5 Assessment of impacts

9.5.1 Loss of fauna habitat

The clearing of vegetation for mine pits, waste dumps and access roads will result in the direct loss of a substantial loss of fauna habitat.

In total, disturbance for the Proposal will result in the disturbance of approximately 7366 ha. Rehabilitation is expected to return some habitat value to WRD and TSF. The majority of the disturbance (approximately 5100 ha of the 7366 ha Proposal) occurs in the Low conservation significance Stony Spinifex plain with or without low shrub and Hilltop/hill slopes/rocky outcrops habitat types. These two units are widespread in the area (Table 9-5). Habitats with Moderate or High local conservation significance affected included drainage lines and cracking clay units; disturbance within other habitat types (i.e. dunes, samphire and mangrove) is limited.

Table 9-6 assesses the impact of clearing based on the total extent of disturbance (i.e. including both the existing project and the Proposal).

The addition of the Proposal to the existing disturbance increases the proportion of cracking clay to 84.7 of the survey area. The cracking clay habitat may contain habitat for some species of conservation significance, such as *Leggadina lakedownensis* (Short-tailed Mouse) and the *Ardeotis australis* (Australian Bustard). However, the cracking clay habitat is degraded as a result of historical pastoral activities and does not contain substantial or unique habitat values.

The major drainage line / creekline habitat has been identified as having high conservation significance due to the potential mature trees with hollows that provide roosting sites and the potential fauna linkages the habitat could provide. The combined extent of disturbance within this habitat type will be approximately 71%. The mangrove habitat has also been identified as having high conservation significance due to its limited distribution. The combined disturbance to this habitat type is approximately 1.5%.

The extent of disturbance to habitats with moderate conservation significance (dunes, minor drainage lines and samphire) is expected to vary from low to moderate significance.

Land clearing activities may directly affect small mammals and reptiles, while some species of fauna may be indirectly affected by not being able to relocate into nearby habitats. Indirect effects may occur within nearby habitats from increased competition, lack of vacant niches and increased densities may cause predation.

The Proposal is unlikely to have a significant impact on conservation significant fauna. The majority of conservation significant species that were recorded either occur in a number of habitat types or occur in habitats that are widespread in the region. Conservation significant species identified during clearing will be translocated where feasible and all native animals encountered on site will be given the opportunity to move on.

Table 9-5: Disturbance of habitats within survey area by the Proposal

Habitat	Extent within survey area (ha)	Extent of disturbance from the existing project		Extent of disturbance from Proposal		Total extent of disturbance	
		ha	%	ha	%	ha	%
Cracking clay	1600	486.9	30.4	868.1	54.3	1355	84.7
Stony Spinifex plain with or without low shrub	4370	439.0	10.0	1707.0	39.1	2146	49.1
Hilltop/hill slopes/rocky outcrops	9356	1500.5	16.0	3410.5	36.5	4911	52.5
Dunes	518	16.4	3.2	99.6	19.2	116	22.4
Major drainage line / creekline	1019	103.0	10.1	621.0	60.9	724	71.1
Minor drainage line	937	183.8	19.6	379.2	40.5	563	60.1
Samphire	525	7.1	1.4	13.9	2.6	21	4
Mangrove	200	3	1.5	0	0.0	3	1.5

The conservation significance of the disturbance from the Proposal is described in Table 9-6. The conservation significance is based on the extent of clearing and the significance of the habitat.

Table 9-6: Significance of habitat disturbance resulting from the Proposal

Habitat	Total disturbance within survey area (including existing project and Proposal) ha (%)	Regional distribution	Significance of habitat	Significance of existing project and Proposal disturbance
Cracking clay	1355 (84.7)	Widespread in the surrounding area	Moderate – contains some habitat used by <i>Leggadina lakedownensis</i> (Short-tailed Mouse) and the <i>Ardeotis australis</i> (Australian Bustard).	Moderate – approximately 85% but this habitat is widespread in the surrounding area.
Stony Spinifex plain with or without low shrub	2146 (49.1)	Widespread in the Pilbara region	Low – habitat is widespread in the Pilbara.	Low – less than 50% of the survey area and this habitat is widespread in the Pilbara.
Hilltop/hill slopes/rocky outcrops	4911 (52.5)	Widespread in the Pilbara region	Low – habitat is widespread in the Pilbara.	Low – less than 70% of the survey area and this habitat is widespread in the Pilbara.
Dunes	116 (22.4)	These are restricted in distribution to the coast but are present along long distances of the coast	Moderate – habitat is restricted in distribution in the Pilbara to the coast.	Low – less than 50% of the survey area and dunes occur along the coast in the region.
Major drainage line / creekline	724 (71.1)	Widespread throughout region but limited in area	High – contain mature trees with hollows that provide roosting sites. May also provide fauna linkages for amphibians and some mammals.	Moderate – approximately 71% but this habitat is widespread in the surrounding area.

Habitat	Total disturbance within survey area (including existing project and Proposal) ha (%)	Regional distribution	Significance of habitat	Significance of existing project and Proposal disturbance
Minor drainage line	563 (60.1)	Widespread throughout region but limited in local survey area	Moderate – may contain some mature trees with hollows that provide roosting sites although unlikely to provide any significant fauna linkages.	Moderate – less than 70% of the habitat will be affected by the Expansion Proposal disturbance and this habitat is well represented outside the survey area.
Samphire	21 (4)	These are restricted in distribution to the coast	Moderate – habitat is restricted in distribution in the Pilbara to the coast.	Low – approximately 4% and the habitat is not restricted to the survey area.
Mangrove	3 (1.5)	These are restricted in distribution to the coast	High – contains some habitat used by <i>Mormopterus loriae cobourgiana</i> (Little North-western Mastiff Bat). Habitat is restricted in distribution in the Pilbara to the coast.	Low – approximately 1.5% and the habitat is not restricted to the survey area.

9.5.2 Disruption to fauna linkages

Disruption of fauna linkages has the potential to restrict fauna movement between or within habitats. Linear habitats, such as the drainage line habitats, are considered the most susceptible to disruption. The drainage lines along Edward and Du Boulay Creeks have the potential to allow fauna movement and are considered to be fauna linkages.

Edward Creek and Du Boulay Creek are minor tributaries of the Fortescue River and run between mining areas and waste rock landforms in the Development Envelope to the Fortescue River. A buffer will be maintained alongside Du Boulay Creek to allow potential movement of fauna. Edwards Creek will be realigned in two sections as discussed in Section 5.5.3.

9.5.3 Northern Quolls

The assessment of Northern Quoll habitat identified 49.65 ha within the mine area and 0.12 ha within the port area potential Northern Quoll habitat (Ecoscape 2016b). Potential Northern Quoll habitat included rugged, rocky areas (boulder piles) and creeklines within the Development Envelope.

The reconnaissance survey identified that Northern Quolls do not occur in the mine area and are limited to the port area. The northern section of the port infrastructure contains a small amount of critical habitat (both natural and artificial) for the species which is likely to be utilised as foraging ground due to the proximity to the breakwater.

On this basis the predicted loss of Northern Quoll habitat as a result of the Proposal is 0.12 ha. However, Northern Quolls were not found to utilise the potential habitat within the Proposal footprint during the reconnaissance and targeted surveys.

9.5.4 Feral animals

An increase in feral animals has the potential to occur from direct and indirect interaction with feral animals. Direct interaction includes feeding the animals and indirect interaction could occur through the increase in food supply from scraps. The potential increase in feral animals such as feral cats could increase predation on native animals, particularly small mammals.

9.5.5 Mining operations

Mining development and operation could potentially affect fauna and alter their behaviour or distribution through light spill, noise and vibration.

Light spill

The impact of light spill is predominantly restricted to turtles and shorebirds; with the potential impacts on turtles listed in Table 9-3. Lighting will be used to ensure the safe operations and security of the mine sites and associated facilities located at the approved port. The effect of lighting is not expected to result in any significant impact to vertebrate fauna. Lighting will be directed at target work areas to ensure impacts to fauna are reduced as far as practicable.

Noise

Construction and operation of the mine site will create noise, which has the potential to affect fauna. Noise may alter fauna behaviour and distribution; however this is not expected to affect the viability of species populations. Bats and shorebirds are likely to be affected; however, this can be minimised by having a setback of 100 m from the mangroves and 50 m from beaches (their respective habitats).

Vehicle movements

Mining development and operations will involve the utilisation of vehicles. The passage of vehicles on haul roads and access tracks has the potential to result in the injury or fatality of native fauna. The implementation of speed limits to prevent the likelihood of fauna road deaths, and avoidance of driving at dusk and dawn will limit the impact of the mining development. It is unlikely that isolated deaths of individuals will affect the conservation status and distribution of any fauna species.

9.6 Mitigation

The overall objective for the mitigation of impacts to fauna is to ensure that the impact on native fauna as a result of implementation of the Proposal is minimised.

The following mitigation measures are proposed:

Avoid:

- the Proposal footprint will avoid drainage line habitat alongside Du Boulay creek
- maintaining a buffer alongside the Du Boulay Creek to allow potential movement of fauna
- preventing unauthorised access to Northern Quoll habitat
- record Northern Quoll habitats to ensure baiting exclusion zones to reduce risk of secondary or accidental poisoning.

Minimise:

- informing the workforce of the fauna present and preventing direct and inadvertent feeding of feral animals
- implementing and signposting speed limits for both mining equipment and light vehicles in the Development Envelope and on access roads
- undertake baiting outside of Northern Quoll breeding season, outside of known habitat and bury baits to prevent non-target species locating the baits.

9.7 Predicted outcome

When the mitigation and management measures have been implemented, it is expected that the Proposal will result in the following residual impacts and outcomes in relation to terrestrial fauna:

- the majority of the disturbance (approximately 5100 ha of the 7366 ha Proposal) occurs in the Low conservation significance Stony Spinifex plain with or without low shrub and Hilltop/hill slopes/rocky outcrops habitat types
- disturbance of habitats of Moderate or High local conservation significance occurs in habitats that have been degraded as a result of historical pastoral activities, such as drainage lines and cracking clay units; disturbance within other habitat types (i.e. dunes, samphire and mangrove) is limited
- clearing of Northern Quoll habitat is limited to 0.12 ha and impact on Northern Quoll populations is unlikely as they were not found to utilise the potential habitat within the Proposal footprint during the reconnaissance and targeted surveys
- the Proposal will not conflict with the WC Act as no fauna species will be made extinct or have its conservation status affected as the result of the implementation of the Proposal
- no species listed as Endangered or Vulnerable under either the WC Act or EPBC Act will be affected by the Proposal.

Based on the predicted residual impacts the Proposal will meet the EPA's objective for Terrestrial fauna.

10. Air quality

10.1 EPA objective

To maintain air quality and minimise emissions so that environmental values are protected.

10.2 Policy and guidance

The relevant guideline for Terrestrial environmental quality is:

- *Environmental Factor Guideline – Air Quality* (EPA 2016q)
- *Management of fibrous minerals in Western Australian mining operations – guideline* (DMP 2015)
- *Guidance Note on Public Health Risk Management of Asbestiform Minerals Associated with Mining* (DoH 2013).

EPA (2016) defines air quality as “the chemical, physical, biological and aesthetic characteristics of air” and identifies that “in the context of this factor and objective, the EPA’s primary focus is maintaining air quality and minimising emissions for human health and amenity”.

This section considers the risks of the Proposal to Air Quality as defined in terms of the chemical, physical, biological and aesthetic characteristics of air. Consistent with the EPA Factor Guideline for Air Quality (EPA 2016q) the potential of the Proposal to modify these characteristics and the significance of any changes to air quality is addressed. Standards previously utilised for the assessment of potential air quality impacts for the existing mining operation have been applied to this Proposal. Those standards for air quality were developed in consultation with other agencies, as follows:

- Nitrogen oxides limit in consultation with DER as part of the Part V limit
- Greenhouse Gas Emissions as part of NGER requirements
- Dust in consultation with EPA as specified in the Operational Environmental Management Plan (OEMP) as part of the requirements under Statement 635
- Fibrous Minerals with DMP/DoH as part of the Fibrous Minerals Management Plan which was first submitted to DMP.

10.3 Receiving environment

10.3.1 Regional context

The climate of the Pilbara is characterised as arid-tropical with two distinct seasons including a hot summer (October to April) and mild winter (May to September). The summer season brings large amounts of rain with the possibility of tropical cyclones. Humidity is high with temperatures ranging from the high 30s to low 40s. The winter season is renowned for its pleasant winter climate with maximum temperatures in the mid-20s.

The Pilbara region has highly variable rainfall dominated by the occurrence of tropical cyclones mainly from January to March. Tropical cyclones bring sporadic and drenching rainfall events. With the exception of these large events, rainfall can be erratic and localised due to thunderstorm activity. Rainfall from a single site may not be representative of the spatial variability of rainfall over a wider area. During winter, cold fronts sometimes reach the Pilbara region producing light winter rains.

The nearest Bureau of Meteorology climate station to the project area is at Mardie (approximately 30 km to the southwest (Figure 10-1) (there is also a site meteorological station referred to in this report for site specific data). Mean monthly maximum temperatures at Mardie range from 28°C in July to 38°C in January and mean monthly minimum temperatures range from 12°C in July to 25°C in February (BoM 2017). Mean monthly rainfalls vary from 1 mm in October to 63 mm in February.

The limited hot dry climate and pastoral land use means that airborne dust is a common occurrence throughout the Pilbara.

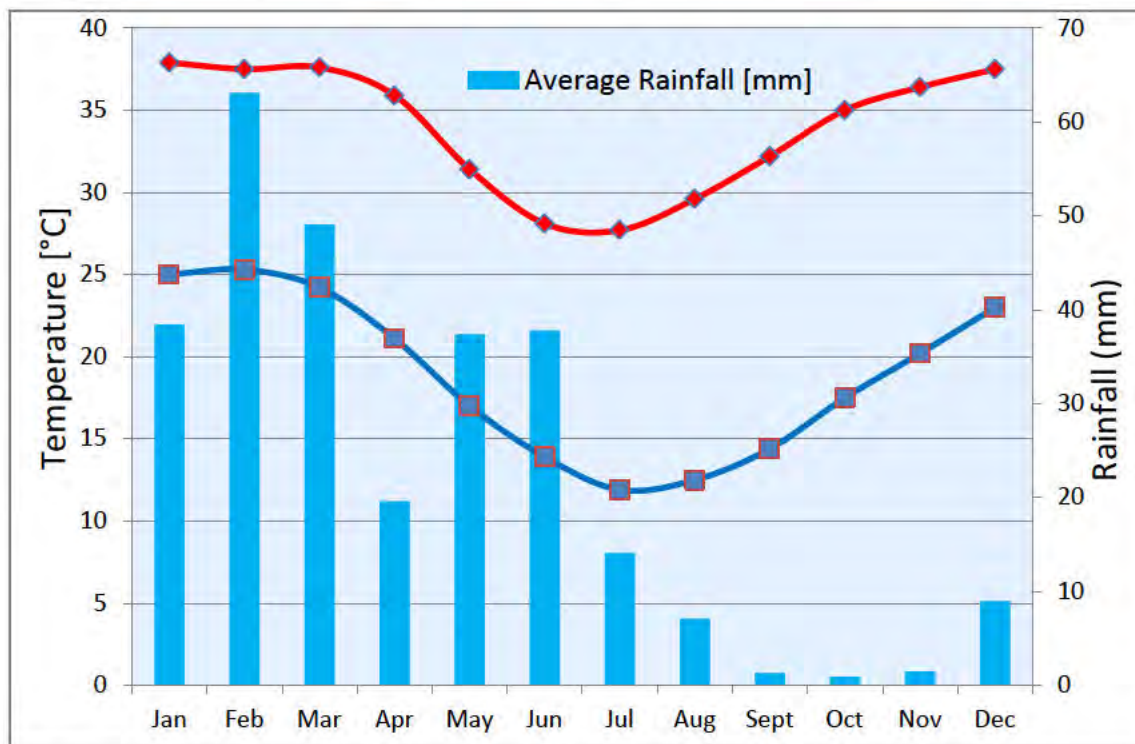


Figure 10-1: Climate at Mardie Station (BOM 005008)

10.3.2 Potential sensitive receptors

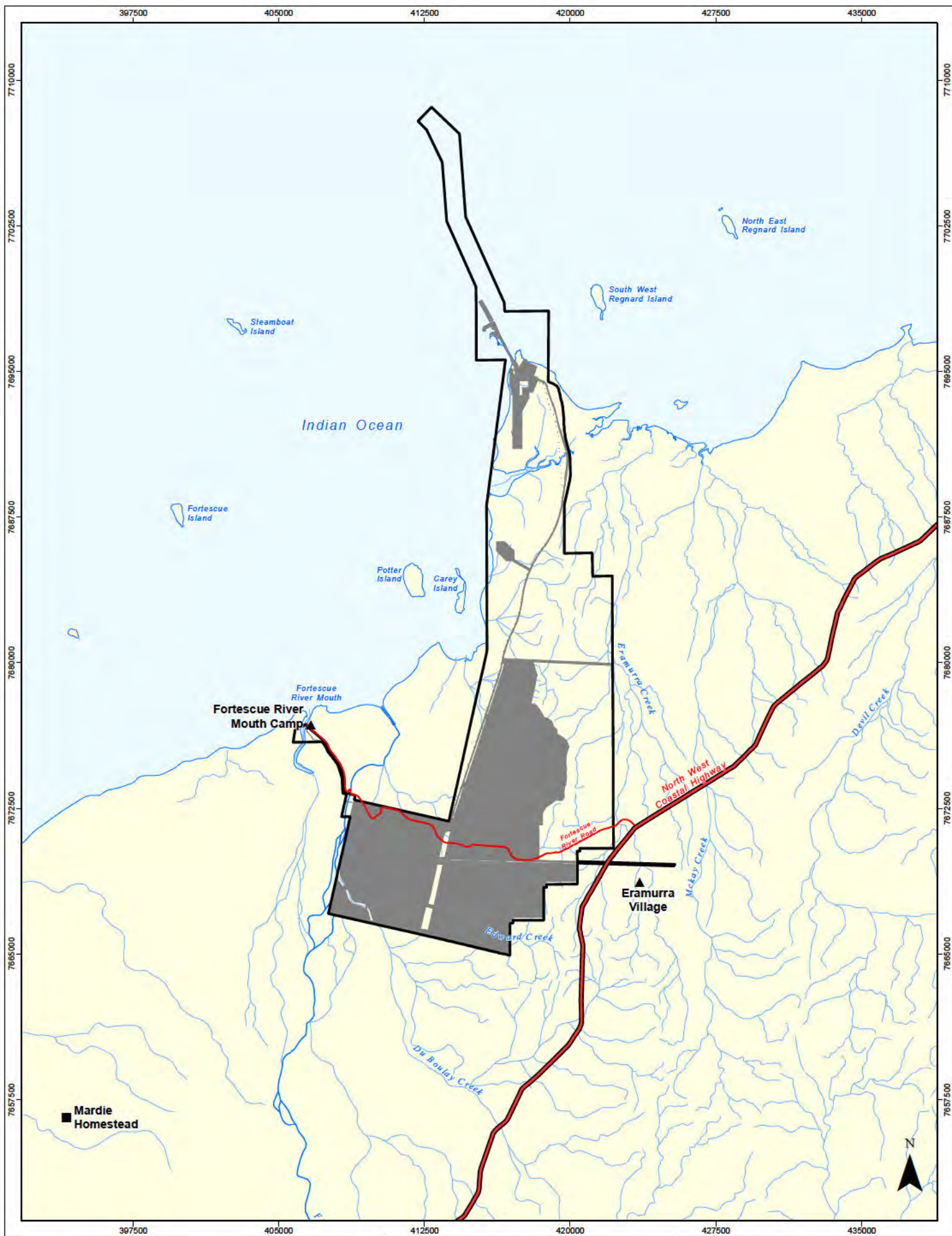
The Proposal is located within the Mardie Station Pastoral Lease (approximately 225 000 ha), which is operated by Pastoral Management Pty Ltd (PMPL) (also a subsidiary company of CITIC Limited) as a cattle station outside the approved mining areas. The Mardie homestead is the only residence on the Station and that residence is more than 30 km from the Development Envelope (Figure 10-2).

CPM will maintain access to the mouth of the Fortescue River (approximately 7 km), which is used for recreational activities from both day-trippers (locals and passing tourists) and long-term campers (although the area is not an authorised campground).

DER undertook an assessment of the potential impacts to sensitive receptors as a requirement of the Part V Licence for the Power Plant. DER determined that at the closest sensitive receptor:

"The Delegated Officer considers the distance to human receptors to be acceptable to prevent health impacts to occur. Fortescue River Mouth recreational area is at the recommended separation distance of 5,000 m. The area is utilized to access the boat ramp so visitation is typically only for short periods. In addition, commissioning activities will not extend for a long-term duration".

The Proposal's accommodation village (Eramurra) is also considered as a sensitive receptor and public health standards are applied (Figure 10-2).



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Mine Continuation Proposal

Figure 10-2
Closest Sensitive Receptor

0 3 6
Kilometres
1:250,000
Datum: GDA94
Projection: MGA Zone 50

Department: ENV Date: 19/04/2017

Sheet Size: A4 Status: Final

Drawn by DS Requested by BW Internal Reference 4550_01_2017_APP

- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Development Envelope
- Conceptual Footprint
- Homesteads

10.3.3 Existing operations

The existing operations approved under Statement 635 include the operation of a mine, power station, desalination plant, processing plant and accommodation and port facilities. The operation of the mine includes use of Waste Rock Dumps (WRD) and a Tailings Storage Facility (TSF). Statement 635 approves construction of a power plant with a capacity of up to 640 MW with the Part V licence approved to a capacity of up to 480 MW. The Power Plant has been constructed with a capacity of 480 MW.

Prior to construction of the power plant Condition 10 of Statement 635 required CPM to establish a meteorological station (shown in Figure 10-3) to gather site-specific data and then revise air emission modelling using detailed design emissions rates using at least twelve months of site-specific data. Air emission modelling was conducted in 2008 by Air Assessments to meet Condition 10.

The operation of the approved facilities as well as earth moving and material handling activities on-site has the potential to generate air quality impacts. The existing operations are subject to management and mitigation requirements as outlined in the Operational Environmental Management Plan (OEMP) and Fibrous Minerals Management Plan (FMMP), including ongoing monitoring and reporting arrangements.

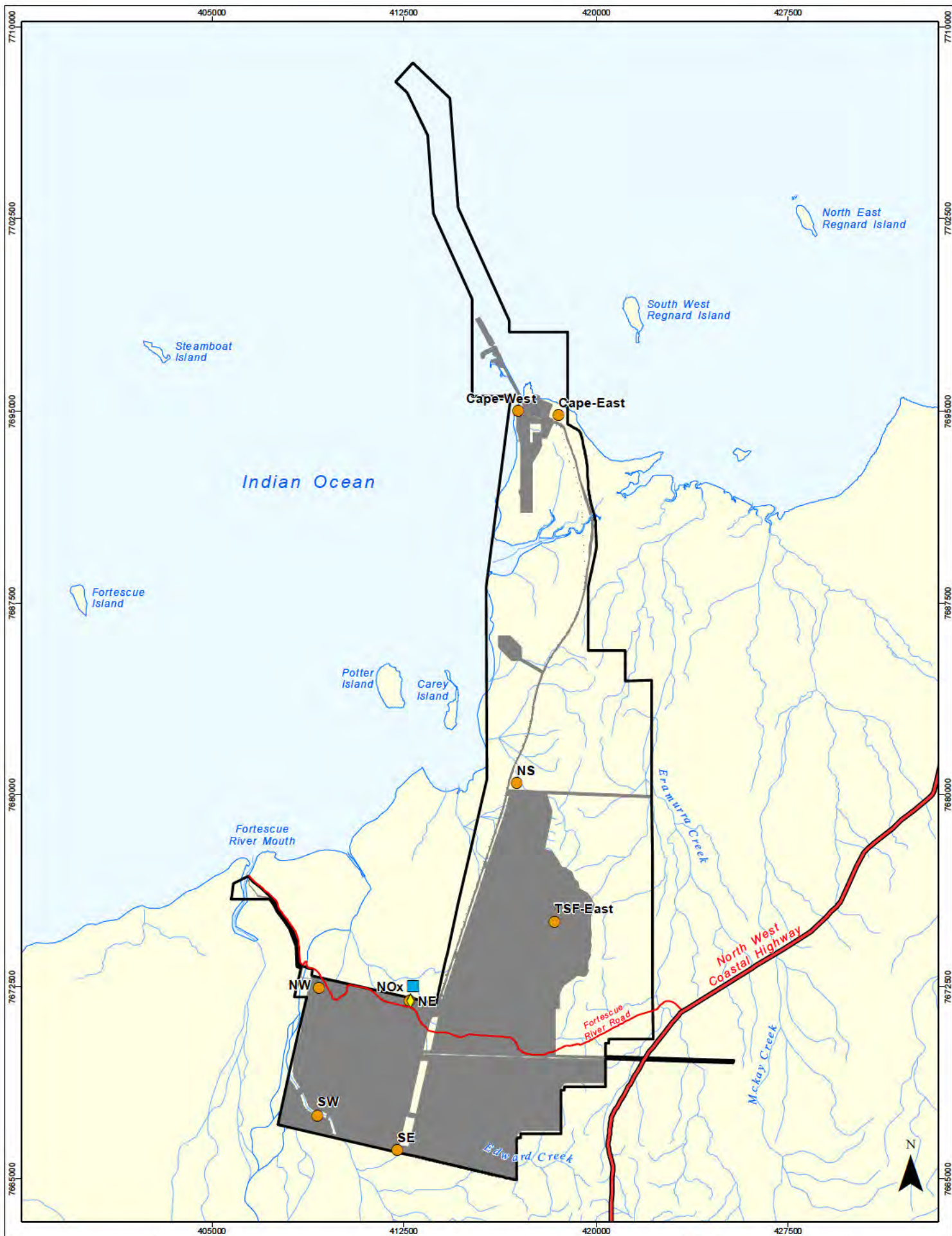
In addition to approval under the Part IV of the EP Act the operations are subject to three operational licences under Part V of the EP Act (*L8308/2008/2*, *L8758/2013/1* & *L8659/2012/2*). However, to avoid duplication Licences do not include limits or triggers that are already identified as a requirement of Statement 635 and are not considered further in this document.

10.4 Outcomes of existing monitoring

The OEMP specifies monitoring requirements for the existing operations related to:

- NO_x (as NO₂) (Section 10.4.1)
- Greenhouse Gas Emissions (Section 10.4.2)
- Dust (Section 10.4.3).

The FMMP monitoring is specified in Section 10.4.4. The location of air quality monitoring stations is shown in Figure 10-3.



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Mine Continuation Proposal

Figure 10-3
Air Quality Monitoring Locations

0 2.5 5
Kilometres
1:190,000
Datum: GDA94
Projection: MGA Zone 50

Department:	ENV	Date:	7/04/2017
Sheet Size:	A4	Status:	Final
Drawn by CF	Requested by BW	Internal Reference 4547_00_2017_APP	

- Weather
- ◆ NOx
- Dust PM₁₀
- Principal Road
- Major Road
- Major Creek/River
- Minor Creek/River
- Development Envelope
- Conceptual Footprint

10.4.1 Nitrogen oxides

Emissions from the power station are regulated by the Department of Environmental Regulation (DER) as under a Part V Licence. A continuous emissions monitoring system (CEMS) monitors power station stack nitrogen oxides ($\text{NO} + \text{NO}_2$) and oxygen when turbine units are operating.

Monitoring targets

The objective of the OEMP is to ensure nitrogen oxides emissions meet acceptable standards and the requirements of the DER Part V licence. The monitoring is undertaken of both Continuous Emissions Monitoring System (CEMS) and ambient monitoring. The CEMS monitors power station stack gas temperature, gas emission velocity, carbon monoxide, carbon dioxide, nitrogen oxides ($\text{NO} + \text{NO}_2$) and oxygen when turbines are operating. A monitoring station (shown in Figure 10-3) has been established to monitor ambient NO_x .

The Part V Licence identifies that by 30 June 2018 the Proponent must demonstrate "that the point source air emission levels from each turbine unit of the Power Station for oxides of nitrogen (NO_x) and carbon monoxide (CO) of <25 ppmv and <50 ppmv, respectively, have been met at full load."

Gaseous emission modelling was conducted prior to the operation of the power station as a requirement of Condition 10 of Statement 635. The air quality assessments indicated that in comparison to human health criteria NEPM Standard (National Environment Protection Council, 1998), the predicted gaseous emission ground level concentrations are all below their respective criteria.

The EPA objective for Project adopts the National Environmental Protection Measure (NEPM) for assessment of ambient NO_2 concentrations. The NEPM has a stated guideline for NO_2 , which is 0.12 ppm (1-hour average) and 0.03 ppm (annual average) for NO_2 .

Results of monitoring

Current CEMS data has been observed to be unreliable and has resulted in the Proponent replacing the CEMS. This new CEMS will be certified by the manufacturer as compliant for use in accordance with the CEMS Code for Stationary Source Air Emissions (DER 2016). This shall be operational by Quarter 2 2017. The Proponent will work to demonstrate that the power plant can meet the Licence requirements by 30 June 2018.

Results of ambient NO_2 monitoring against NEPM guideline are provided to the OEPA through existing compliance reporting requirements and are shown here for the period 2014 – 2016 in Table 10-1. Nil exceedances of the 1 hour average and annual average NO_2 NEPM were observed from the monitoring.

Table 10-1: Summary NEPM NO_2 guideline (concentrations in ppm)

Year	NEPM Guideline	2014	2015	2016
Maximum monthly average concentration	0.12	0.030	0.036	0.041
Annual average concentration	0.030	0.003	0.003	0.007
Number of exceedances of NEPM (1-hour average)		0	0	0

Summary of Nitrogen oxides monitoring

The gas turbine power station discharges NO_x emissions to atmosphere. Delay to the commissioning of this plant, combined with issues associated with the previous CEMS means that limited monitoring data is available for discussion.

The data indicates that ambient NO_2 concentrations are well below the NEPM, meeting the EPA objective for air quality.

10.4.2 Greenhouse Gas Emissions

A 480 MW combined-cycle gas fired power station is installed at the Project and is considered the primary source of greenhouse gas (GHG) emissions. It is approximately 40 per cent more energy efficient than an equivalent size open-cycle gas turbine power station. At full capacity it saves greenhouse gas emissions of 440,000 t CO₂-e per year. The power station is the first of its kind in the Pilbara and was recognised by the Energy Efficiency Council as the “Best Industrial Energy Efficiency Project” in 2012.

Other sources of GHG emissions include mobile equipment and fixed plant such as the mining fleet, ancillary mobile equipment and conveyors. These are lesser contributors to overall GHG emissions.

GHG emissions are reported on in accordance with *National Greenhouse and Energy Reporting Act 2007* (NGER Act). The NGER Act requires greenhouse gas emissions to be reviewed and reported annually. The Existing Mine is covered under the Safeguard Mechanism of the NGER Act, where tracking of emissions against a baseline target is required and calculation of emission intensity is part of submissions to the Clean Energy Regulator.

Results of monitoring

The greenhouse gas monitoring results for financial years 2013/14, 2014/15 and 2015/16 are shown in Figure 10-4. Natural gas combustion within the Power Plant made up the majority of emissions (81 to 85 %), with diesel combustion at 15 to 19% and other minor emission sources less than 0.5% for the NGER reporting data presented below.

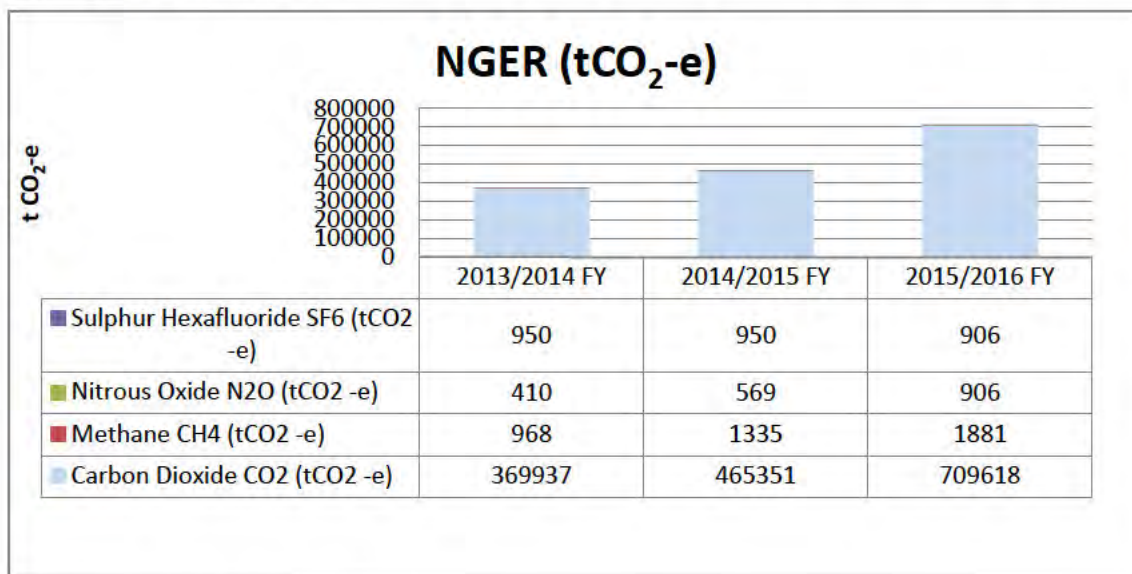


Figure 10-4: NGER monitoring results

The Project is characterised by a production ramp reflected in the increasing greenhouse gas emission profile as processing lines one to six were implemented. For example in 2013/14, Process Line 1 had commenced operations, in 2014/15 Process Line 2 operations commenced and by 2015/16 another two processing lines had begun commissioning. All lines are now commissioned and greenhouse gas emissions are expected to continue to increase over the coming years as peak production is reached. Optimisation of process lines is expected to be ongoing as the project works towards project design capacity.

A calculated emission baseline is to be submitted to the Clean Energy Regulator by CPM in October 2017. CPM as a responsible emitter will manage emissions according to a baseline issued by the Clean Energy Regulator under the Safeguard Mechanism. Greenhouse gas intensity per unit of product and electricity produced will be submitted to the Clean Energy Regulator in October 2017 as part of the calculated emission baseline application under the NGER Safeguard mechanism. This application will undergo an independent audit process to meet regulatory requirements.

Summary of greenhouse gas emissions

The mine continuation proposal does not seek to increase the capacity of the existing 480 MW power station nor seek an increase in its approved greenhouse gas emission profile.

The mine continuation changes are expected to be minimal, within the savings already made by implementing a Combined Cycle power Station and within currently approved amounts in the Greenhouse Gas Management Plan (approved in 2006).

10.4.3 Dust

Dust impacts as a result of the proposal, ore storage and transfer facilities are managed in accordance with the OEMP. The OEMP specifies the use of real time ambient monitoring to respond to elevated dust emissions associated with the project. The ambient dust monitoring program involves monitoring PM₁₀ dust level at eight locations across the mine site (refer to figure for location).

Monitoring targets

The targets services management objectives to ensure that environmental values are not adversely impacted by:

- complying with ambient dust concentration guidelines along premise boundary, and
- avoiding nuisance dust levels by minimising the probability of short-term dust events leading to exceedances of the daily target.

Internal PM₁₀ targets have been established and implemented through the Operations Dust Management Plan:

- an hourly average PM₁₀ concentration of less than 250 µg/m³ serves to avoid nuisance dust levels by minimising the probability of short-term dust events leading to exceedances of the daily target
- a daily average PM₁₀ concentration of less than 70 µg/m³ serves as a dust concentration guideline to be met at monitoring sites in proximity to the premise boundary.

Results of monitoring

Hourly average PM₁₀ concentrations

The most recent exceedances of the 250 µg/m³ hourly average PM₁₀ target concentration are shown in Table 10-2 for 2016.

Table 10-2: Exceedances of hourly average PM₁₀ target concentration

Sample Point	Sample date and time	PM ₁₀ concentration (µg/m ³ , 1-hour average)
EBAM 03 South East (SE)	17-02-2016 16:00	1350
EBAM 08 Cape West (CW)	17-02-2016 16:00	352
EBAM 04 South West (SW)	14-04-2016 10:00	259
EBAM 01 North West (NW)	11-05-2016 10:00	336
EBAM 04 South West (SW)	01-08-2016 19:00	326
EBAM 01 North West (NW)	06-08-2016 13:00	264

Sample Point	Sample date and time	PM ₁₀ concentration (µg/m ³ , 1-hour average)
EBAM 01 North West (NW)	06-08-2016 14:00	284
EBAM 04 South West (SW)	09-09-2016 10:00	275
EBAM 01 North West (NW)	16-09-2016 12:00	385
EBAM 01 North West (NW)	16-09-2016 13:00	434
EBAM 01 North West (NW)	16-09-2016 14:00	397
EBAM 07 Cape East (CE)	05-11-2016 14:00	260
EBAM 07 Cape East (CE)	05-11-2016 15:00	302
EBAM 06 TSF East (TSF-E)	13-12-2016 02:00	475
EBAM 02 North East (NE)	23-12-2016 11:00	1047
EBAM 04 South West (SW)	25-12-2016 14:00	299
EBAM 02 North East (NE)	28-12-2016 09:00	377
EBAM 02 North East (NE)	31-12-2016 09:00	333

The highest hourly average concentrations were associated with sudden wind shift associated with a thunderstorm event causing erosion of waste dump surface (17/2/2016), and a regional dust event on 23/12/2016 (further details provided in Table 10-3 below). CMP implemented various management responses across mining, stockpiling, processing and tailings operational areas (as described in the OEMP) to address these exceedances.

Daily average PM₁₀ concentrations

Daily average PM₁₀ concentrations for the 2014 to 2016 are presented for the two sites located near the port at the Cape Preston in Figure 10-5 (for 2014), Figure 10-6 (for 2015) and Figure 10-7 (for 2016), and at six sites around the mine in Figure 10-8 (for 2014), Figure 10-9 (2015) and Figure 10-10 (2016), the locations of the sites is shown in Figure 10-3). Exceedance of the daily average PM₁₀ guideline of 70 µg/m³ is recorded as an internal incident and investigated. This involves identifying the source, the proportion above background levels and the potential for additional dust control measures.

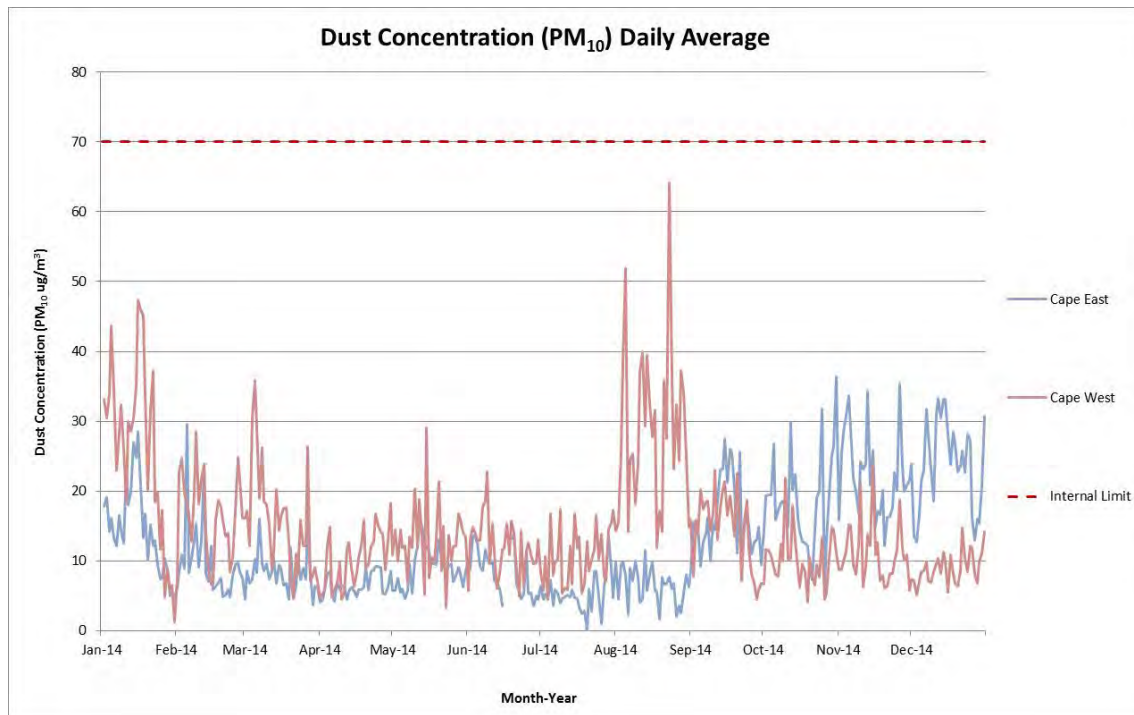
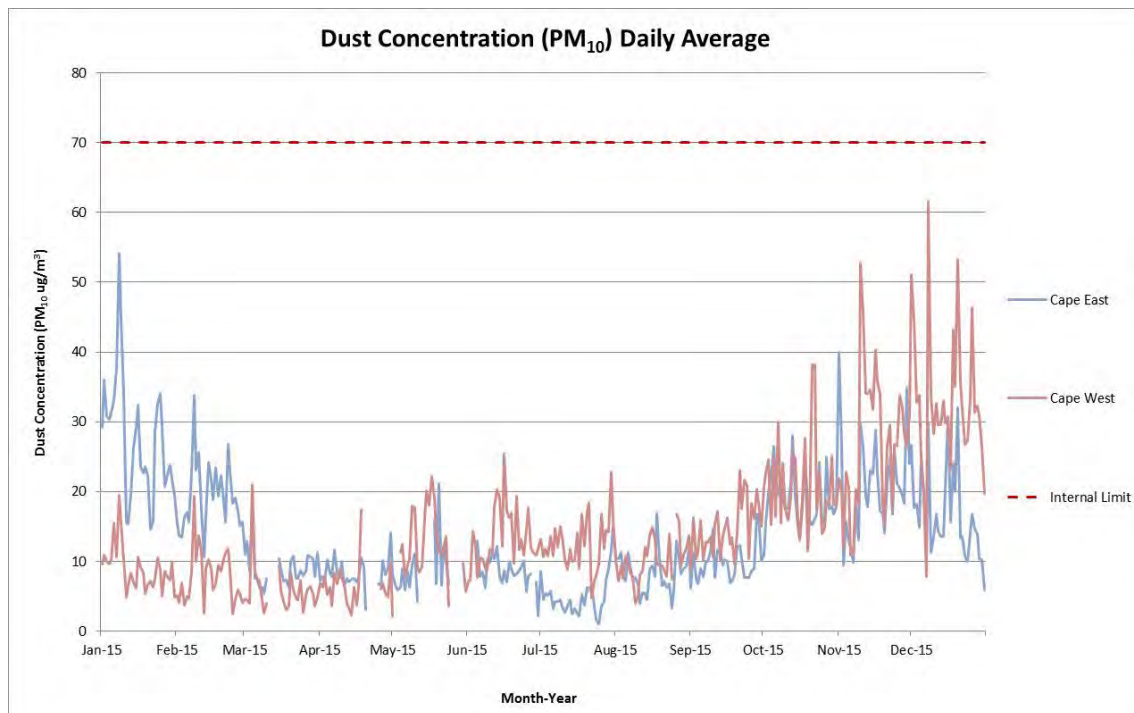
A summary of exceedances, outcomes from investigations and actions taken is presented in Table 10-3.

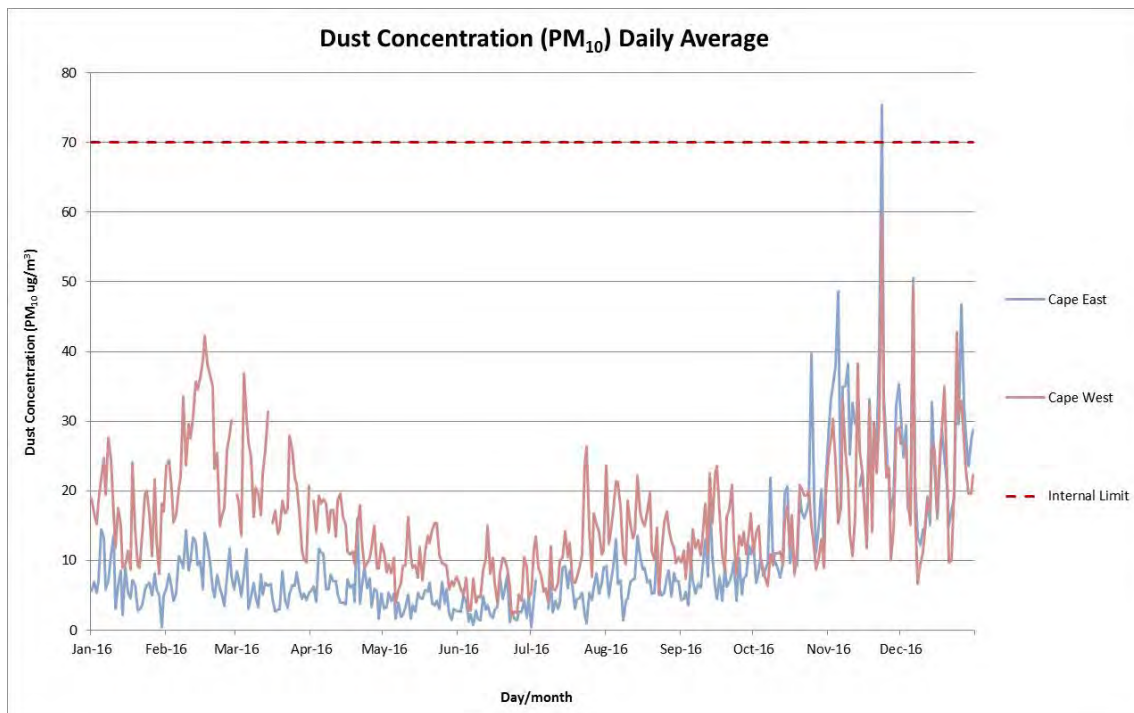
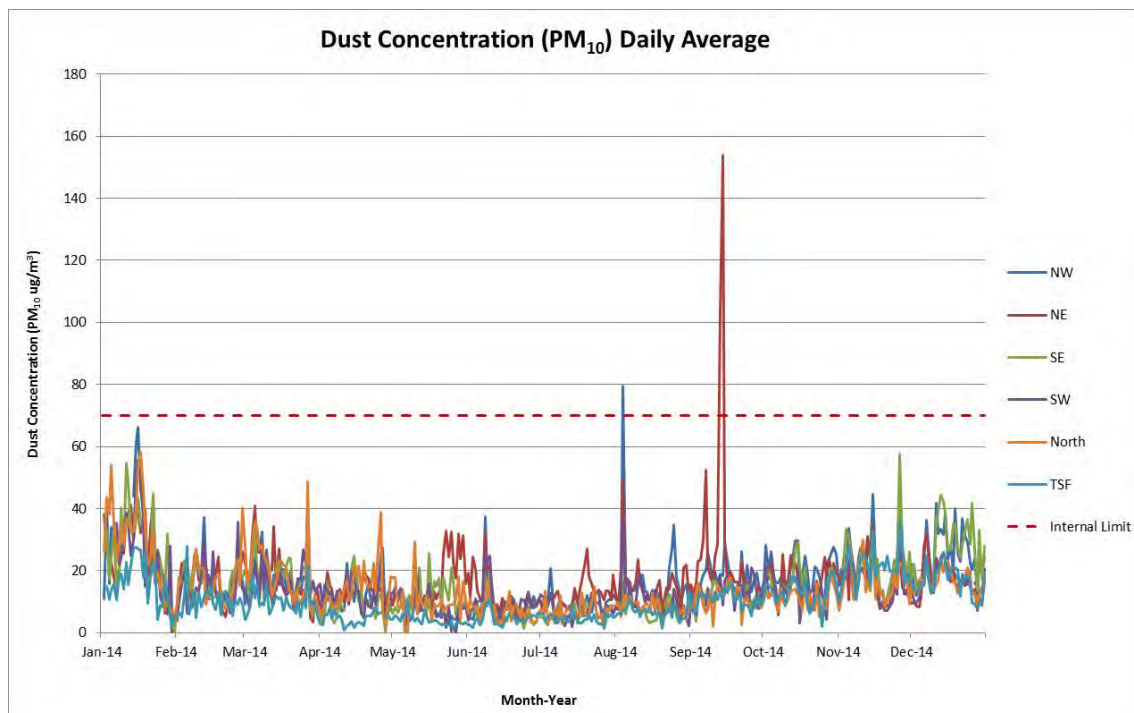
Table 10-3: Exceedances of daily average PM₁₀ limit

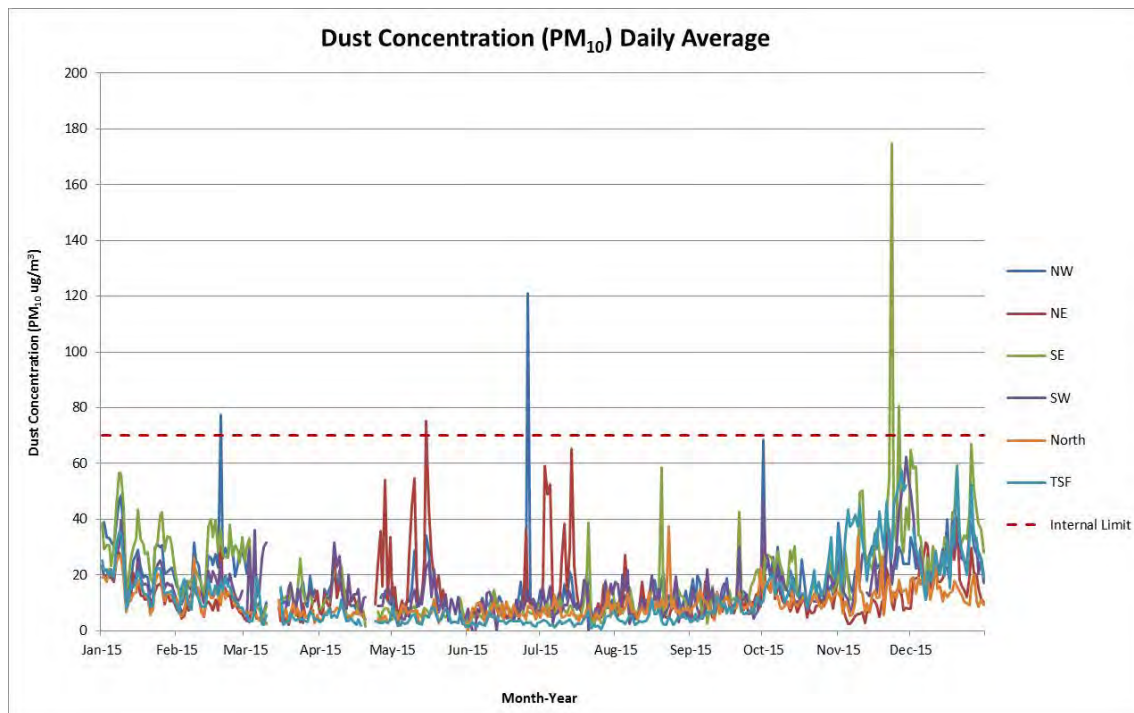
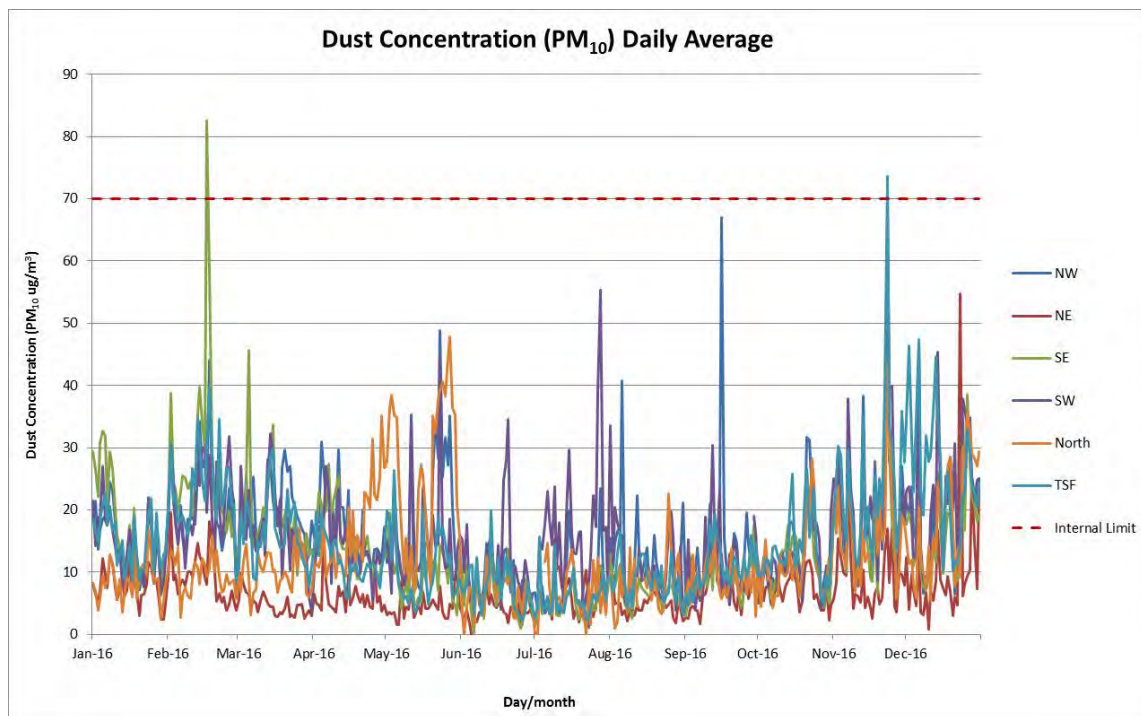
Incident date	Summary	Actions taken
4/08/2014	Dust exceedance at NW eBAM caused by strong winds creating dust storms.	Investigation finding was that exceedance caused by strong winds gusting to 22 m/s from the north east, raising dust from surrounding areas, possibly blowing dust from Fortescue River mouth road.
13/09/2014	Dust exceedance at NE eBAM (103.4 µg/m ³) caused by traffic on nearby Fortescue River Road.	Investigation findings were that high dust levels were recorded when the wind direction was from the south. No project activity on nearby north east waste dump, and wind speeds low to moderate. The conclusion that the source of dust was from traffic travelling on the Fortescue river mouth road.
14/09/2014	Dust exceedance at NE eBAM (154.6 µg/m ³) caused by traffic on nearby Fortescue River Road.	As above.
19/02/2015	Dust exceedance at NW eBAM due to strong easterly-north easterly winds raising dust across the project area.	Investigation conclusion was that strong winds associated with a sudden north easterly wind change due to thunderstorm activity was the cause of the elevated dust. The strong easterly winds raised dust associated with clearing activities at the TSF Stage 1B, and from disturbed and undisturbed areas across the project area.
15/05/2015	Dust exceedance at the NE eBam caused by strong easterly winds raising dust from topsoil stripping activities.	Investigation conclusion was that topsoil stripping activities together with strong easterly winds lead to elevated dust levels being recorded. Topsoil stripping activities will be shut down when strong winds are forecast, and where possible dust suppression methods will be employed.

Incident date	Summary	Actions taken
26/06/2015	Dust exceedance at the NW eBam caused by dust from vehicles travelling on the Fortescue river mouth road.	Investigation conclusion was that dust exceedance was caused by vehicles on nearby public Fortescue River mouth road. Recent grading of the road together with moderate northerly winds and heavy vehicle traffic had increased dust raised from this public road.
23/11/2015	Dust exceedance ($147.7 \mu\text{g}/\text{m}^3$) at SE eBAM due to clearing activity (disturbing topsoil for access road) within the SE Ebam location and prevailing wind conditions blowing dust directly over it.	Investigation conclusion was that during clearing activities (disturbing topsoil for access road) the prevailing wind conditions were such that the dust created was blown directly over the SE EBAM. Dust control was not possible as the area had not been cleared to bring water in nor is it effective on topsoil.
26/11/2015	Dust exceedance ($80.6 \mu\text{g}/\text{m}^3$) at SE eBAM due to moderate-strongly North Easterly winds flaring up dirt from recent clearing within the vicinity of the station.	Investigation concluded that the prevailing N/E winds caused dirt from recent clearing around the e-Bam site to flare up causing the elevated dust levels. Dust suppressant was applied to minimise the dust lift off and advised to develop dust governance.
26/12/2015	Dust exceedance ($81.2 \mu\text{g}/\text{m}^3$) at SE eBAM due to fluctuation in humidity and temperature.	Investigation concluded that elevated dust levels were caused by fluctuations in humidity and temperature affecting the e-Bam. All other parameters (wind speed & direction) did not indicate potential risk of dust event. Regular tracking of continuous data on Airodis/Envirosys systems and proactively attending to any potential trend of instrument fluctuation prior is paramount.
17/02/2016	Dust exceedance at SE eBAM ($82.6 \mu\text{g}/\text{m}^3$) due to strong wind speed/gusts raising dust across the project area.	Investigation conclusion was that strong winds associated with a sudden West South Westerly change due to thunderstorm activity were the cause of the elevated dust. The strong wind gusts raised dust associated with SE waste-dump and from disturbed and undisturbed areas across the project area.
23/11/2016	Dust exceedance at CE eBAM ($75.4 \mu\text{g}/\text{m}^3$) due to strong northerly winds blowing elevated regional dust across the project area.	Investigation conclusion was that high regional background dust levels and constant wind gust/speed (9.5 m/s) from Northerly direction experienced throughout the day across Sino Iron Project site caused the hourly PM_{10} dust levels to increase causing the 24-hour average to exceed ($73.39 \mu\text{g}/\text{m}^3$). All eight monitoring sites across the Sino Iron project recorded high PM_{10} levels. A dust haze was observed extending north east to Karratha indicating that the PM_{10} levels recorded across site were not project related.
23/11/2016	Dust exceedance at TSF East eBAM ($73.6 \mu\text{g}/\text{m}^3$) due to strong northerly wind blowing elevated regional dust across the project area.	Investigation conclusion was that high regional background dust levels and constant wind gust/speed (9.5 m/s) from Northerly direction experienced throughout the day across Sino Iron Project site caused the hourly PM_{10} dust levels to increase causing the 24-hour average to exceed ($73.39 \mu\text{g}/\text{m}^3$). All eight monitoring sites across the Sino Iron project recorded high PM_{10} levels. A dust haze was observed extending north east to Karratha indicating that the PM_{10} levels recorded across site were not project related.

The majority of exceedances were found to be due to either regional scale dust events (for example the event of 23/11/2016) and off-site vehicle movements on unsealed roads not related to the Project operations (for example the event of 26/6/2015). A number of exceedances were attributed to localised wind erosion events on the Project site, for example, the event of 17/2/2016 where waste dump dust emissions were generated from wind shift during thunderstorm activity. Land clearing activities also gave rise to exceedances, for example, the event of 15/5/2015.

Figure 10-5: Cape 24-hour Average Dust (PM₁₀) levels for 2014Figure 10-6: Cape 24-hour Average Dust (PM₁₀) levels for 2015

Figure 10-7: Cape 24-hour Average Dust (PM₁₀) levels for 2016Figure 10-8: Mine, Processing and TSF 24-hour Average Dust (PM₁₀) Levels for 2014

Figure 10-9: Mine, Processing and TSF 24-hour Average Dust (PM₁₀) Levels for 2015Figure 10-10: Mine, Processing and TSF 24-hour Average Dust (PM₁₀) Levels for 2016

Annual reports to OEPA provide a summary of the ambient monitoring program including the number of exceedances of the daily PM₁₀ guidelines together with a summation of the incident reports for each incident. The monthly average PM₁₀ trend (Figure 10-11) shows seasonal variations, with higher dust levels recorded when conditions are hot and windy (summer months before rainfall events) and lower dust levels when conditions are cooler (winter months May-July). Significant rainfall events reduce atmospheric dust levels and reduce the potential for dust to be generated from cleared areas and roads.

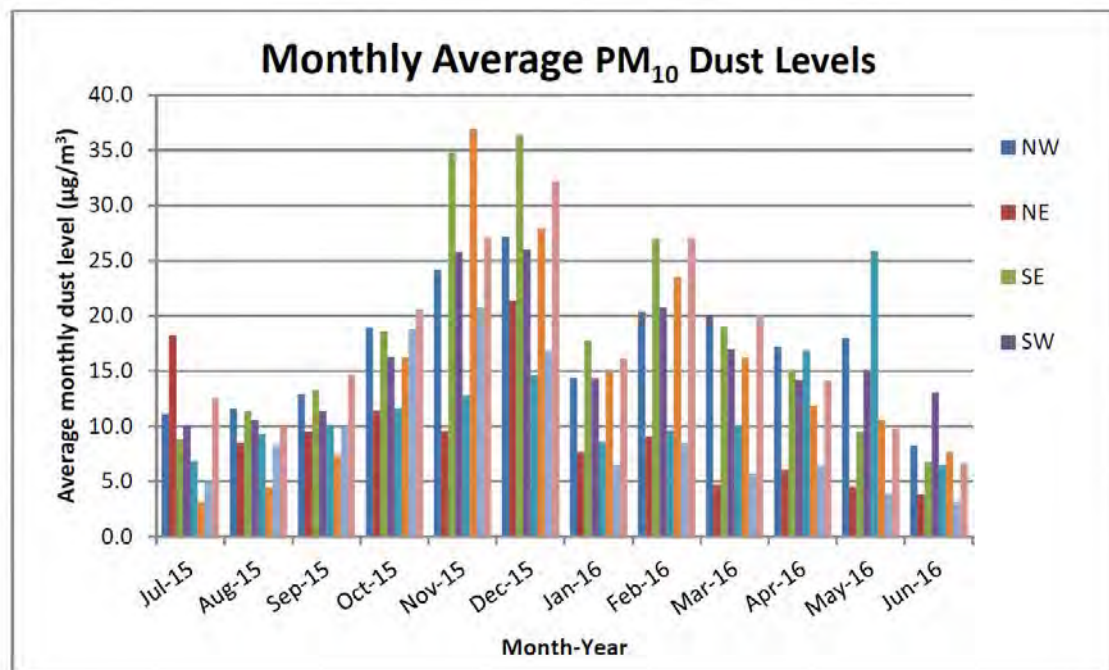


Figure 10-11: Monthly average dust levels

Summary of dust monitoring

Exceedance events of the hourly average PM₁₀ target are a trigger for various management responses across mining, stockpiling, processing and tailings operational areas. These are described in the OEMP. Review of the most recent data shows that 18 exceedance events of the hourly average PM₁₀ target occurred during 2016. Of these, three of the hourly average exceedance events corresponded with the three exceedance events of the daily average concentration targets. This indicates that in the remaining 15 instances, the exceedance of the hourly target did not manifest in an exceedance of the daily target. A review of the incident notes associated with the three daily target exceedances shows that those three events were characterised by strong wind conditions.

Monitoring shows that the targets and management measures are largely effective at maintaining ambient PM₁₀ concentrations below the daily target threshold. Exceedances of the threshold have occurred as a consequence of regional dust events, localised off-site vehicle movements and land clearing activities. As expected, higher PM₁₀ concentrations are observed across the hotter and dryer months of the year when the potential for wind erosion of exposed areas increases.

The relatively small number of Project related exceedances indicates the management measures specified in the ODMP are adequate for the continued management of operational dust emissions.

10.4.4 Fibrous minerals

Risks from Fibrous Mineral associated with mining, processing, ore storage and transfer facilities are managed in accordance with the FMMP. Section 10 of the Environmental Review considered the risks of Proposal to Terrestrial Environmental Quality, specifically related to exposure of fibrous minerals. In this report the risks of fibrous minerals to air quality is based on the potential for fibrous material to be spread as dust.

The predominant fibrous mineral encountered in the mining operations is massive (non-asbestiform) riebeckite. Although actinolite and tremolite may occur in trace amounts in transitional areas surrounding dolerite intrusions and, where encountered, are quarantined and transported to encapsulation cells within waste dumps. Massive riebeckite, is commonly encountered in all mining operations extracting ore in and around the Joffre and Dales Gorge Members and consists of densely packed acicular prismatic crystals. Crushing and milling of massive riebeckite can produce atmospheric concentrations of individual acicular crystals which meet the occupational health defined geometric criteria as a countable fibre.

While not meeting the formal definition of contaminant asbestos (under MSIA Regulation), based on precautionary principles CPM has chosen to include massive riebeckite in determining atmospheric fibre concentrations. Thus although the fibres are not asbestiform, CPM conservatively chooses to consider all fibres encountered on-site as having the potential to be asbestiform.

The primary sensitive receptors on-site are the workforce. CPM implements a comprehensive occupational hygiene monitoring program. A key component of the occupational hygiene monitoring program involves monitoring of personal sampling for fibrous mineral exposure. In addition to the personal exposure monitoring static or positional samples are also collected. Over a three year period from 2014 to 2016, 1204 personal and 2074 positional samples were collected and analysed for fibrous minerals.

Static atmospheric monitoring is undertaken to provide an indication of air quality and guide CPM's hierarchy of controls, including but not limited to:

- verify personal monitoring
- confirm location of designation PPE areas
- verify effectiveness of engineering controls.

Where elevated concentrations may be present, these areas are classified as designated areas where mandatory respiratory protection and decontamination is required. The static sampling is targeted in designated areas. Figure 10-12 and Figure 10-13 show the application of designated area at the Mine and concentrator and TSF, respectively.

Monitoring was undertaken at various locations around the operations including the mine, processing, tailings storage, village and port facilities.

Post closure requirements, as identified in the Mine Closure Plan require landforms with the potential to contain fibrous mineral (such as the tailings storage facility (TSF) and waste dumps) to be encapsulated. The Mine Closure Plan is required to conform to the requirements of the EPA and DMP for mine decommissioning, closure and rehabilitation.

Monitoring targets

The DoH (2013) *Guidance Note on Public Health Risk Management of Asbestiform Minerals Associated with Mining* identifies an occupational exposure standard and a limit for public exposure as follows:

- 0.1 f/mL standard for asbestos on a time weighted basis for occupational exposures
- 0.01 f/mL guideline limit for public exposure monitoring.

As the 0.1 f/mL exposure standard is for an average 8 hour day (and a 40 hour work week), this has been converted to a limit of 0.07 f/mL in accordance with the Department DMP guideline: *Management of fibrous minerals in Western Australian mining operations* for a 12 hour shift. In addition CPM apply a trigger to enact fibrous material controls in the workplace has been set at 0.04 – 0.06 f/mL. The 0.01 f/mL public exposure guideline limit is for limited duration activities (which DoH considers to be 6 months exposure).

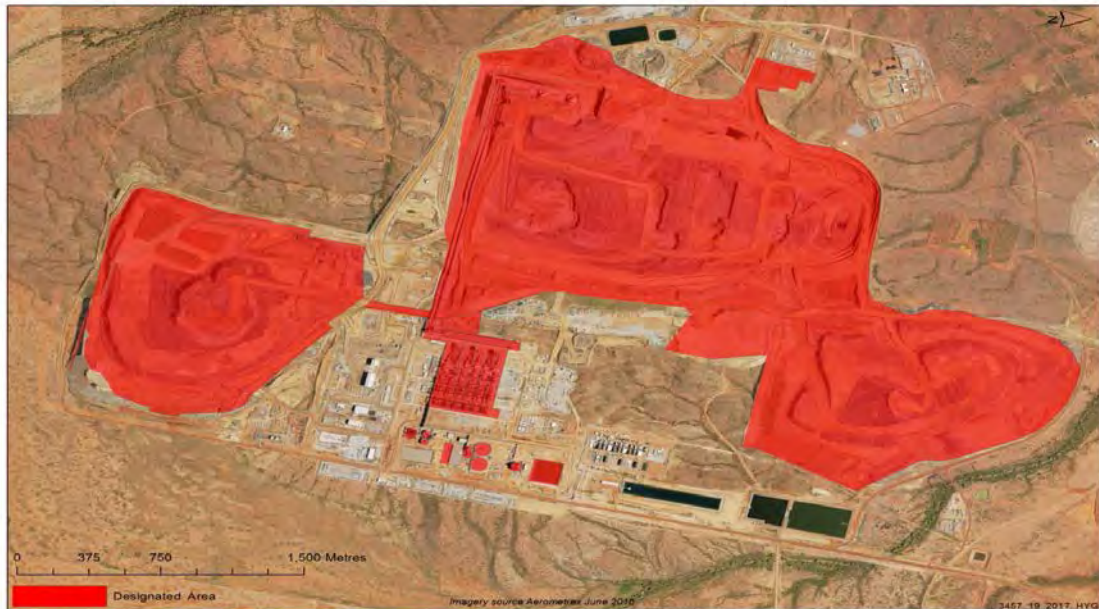


Figure 10-12: Designated area at Pit and Concentrator



Figure 10-13: Designated area at Tailings Storage Facility

Results of monitoring

Table 10-4 summarise the number of positional monitoring samples collected for the three year period from 2014 to 2016, categorised by project element. Over the three years of positional sampling (excluding voids) 1834 of the 1958 samples (93.6%) were below the 0.04 f/mL trigger level. The management trigger level of 0.04 f/mL was only exceeded in 94 samples (i.e. 4.8% of samples). The exposure limit of 0.07 f/mL limit was only exceeded on 31 occasions (i.e. 1.6% of samples).

The results of the positional monitoring samples demonstrates that even within the designated areas the potential exposure to fibres is low and that air quality parameters within the existing mine are well understood. The results also indicate that significant dilution of fibrous minerals occurs within a relatively short distance from point source emissions and are contained within areas that have been designated as being potentially hazardous.

Based on the location of the exceedances the key risk area is the processing facility, which recorded 26 of the 31 exceedances of the 0.07 f/mL limit (i.e. 83.9% of the exceedances) and 76 of the 94 exceedances of the 0.04 f/mL trigger level (i.e. 80.9% of the trigger level exceedances). The other key area that exceeded the trigger levels was the mine.

While the trigger levels at were exceeded at positional monitoring locations, employee safety was not at risk as these are restricted areas that require extensive PPE to protect employees. In addition, Scanning Electron Microscopy of atmospheric samples reveals that the predominant fibre released into the atmosphere is non-asbestiform, acicular, prismatic fibres of massive riebeckite.

Table 10-5 shows the results from positional monitoring conducted at the villages (i.e. workers camps within the mine leases). The guideline limit of 0.01 f/mL for public exposure has been applied at the mine villages. Of the 36 samples analysed from the villages 33 samples have been below the limit of 0.01 f/mL. One sample was recorded at the limit and two samples declared void. The sample at the limit was from the Fortescue Village, located approximately 25 km south of the mine operations. Advice from the technician who analysed that sample was that the fibres observed were **not an asbestiform mineral**.

Table 10-4: Positional monitoring sample results - operations

Location	< LOR	>LOR but <Trigger	>Trigger	>Limit	Void	Total
	<0.01 f/mL	0.01-0.03 f/mL	0.04-0.06 f/mL	>0.07 f/mL		
2014 sampling						
Mine	91	44	10	2	5	152
Processing	477	279	48	16	62	882
TSF	79	2	0	0	6	87
Port - Terrestrial	33	9	0	1	1	44
Port - Marine	4	3	0	0	2	9
General	3	2	0	0	1	6
Total	693	339	58	19	77	1186
2015 sampling						
Mine	16	35	5	0	1	57
Processing	66	97	11	7	3	184
TSF	25	8	0	0	2	35
Port - Terrestrial	57	11	0	0	0	68
Port - Marine	27	1	0	0	2	30
General	10	3	0	0	0	13
Total	222	157	14	7	8	408

Location	< LOR	>LOR but <Trigger	>Trigger	>Limit	Void	Total
	<0.01 f/mL	0.01-0.03 f/mL	0.04-0.06 f/mL	>0.07 f/mL		
2016 sampling						
Mine	67	15	4	0	6	92
Processing	91	131	17	3	18	260
TSF	48	8	0	2	2	60
Port - Terrestrial	15	3	0	0	0	18
Port - Marine	16	4	0	0	1	21
General	10	8	1	0	1	20
Total	253	169	22	5		479

Table 10-5: Positional monitoring sample results - villages

Monitoring year	< DoH guideline limit	>=DOH limit	Void	Total
	<0.01 f/mL	>=0.01 f/mL		
2014 sampling	6	0	0	6
2015 sampling	21	1	0	22
2016 sampling	6	0	2	8

Summary of fibrous mineral monitoring

Monitoring has identified that the main risk area for fibrous minerals is the processing facility, which requires extensive PPE and engineering controls. The Proponent has well established management practices to control this risk and ensure personnel are not exposed to fibrous minerals.

The current monitoring, management and reporting undertaken with respect to fibrous minerals is demonstrating risks and protecting employees.

10.5 Potential changes to emissions and impacts

As identified in Section 2.3 of the ERD, the Proposal involves an extension of existing activities. Specifically, the Proposal is for:

- increasing the area of the mine pit, WRD, TSF and associated infrastructure
- increasing the discharge of mine dewater into the Fortescue River mouth
- increasing the area of the product stockpile as well as the port infrastructure
- developing additional infrastructure corridors.

The Proposal does not change the production rate and does not introduce any new project elements. As the production will not increase the Proposal will not affect the output of operational elements. The demand on the power station will not change and as a consequence emissions associated with the operation of the power plant will not be affected. The Proposal provides potential for increase in dust emissions from the proposed increase in disturbance area.

In particular, the following sources of dust and fibrous material emissions have been identified which may increase with increase in area of mine pit, WRD, TSF and product stockpile from implementation of the Proposal:

- mining and construction activities have the potential to cause fibrous mineral to become airborne and affect air quality
- inappropriate management of potential asbestiform material (including post-closure storage, and mine pit wall exposures) has the potential to cause fibrous minerals to become airborne and affect air quality
- mining and construction activities have the potential to generate dust, which can affect air quality.

The primary air quality risks from the Proposal are therefore from human exposure to airborne PM₁₀ and fibrous materials.

10.6 Assessment of impacts

10.6.1 Potential for fibrous minerals to become airborne during mining and operational activities

Section 10 of the ERD assessed the potential impacts to Terrestrial Environmental Quality. Specifically, Section 10.3.1 of the ERD provided a summary of the potential for fibrous minerals to occur and concluded that:

1. The predominant fibrous mineral encountered in the mining operations (of the Joffre Member) is massive riebeckite, which is non-asbestiform.
2. The risks associated with fibrous minerals at the Project are similar to that experienced by other iron ore mining operations mining in and around banded iron formations within the Hamersley Group.

Section 10.3.2 of the ERD provided a summary of the occupational and public health considerations. Specifically, that section identified that while the fibrous minerals present are non-asbestiform, based on the fact that fibrous minerals are present, CPM have taken a conservative approach to the management of fibrous minerals by assessing all fibres as if they were contaminant asbestos. Therefore, on the basis of a potential hazard to human health a significant occupational hygiene monitoring program and the development of a comprehensive FMMP have been developed. Personal exposures to fibrous minerals are well controlled. Atmospheric concentrations of fibrous minerals recorded across the site are generally below the occupational exposure standard. Areas where elevated concentrations may be present (limited to mine pit, processing plant, TSF and parts of port operations) are classified as designated areas where engineering controls are included and mandatory respiratory protection and decontamination is required. Examples of the designated areas at the mine and concentrator and TSF are shown in Figure 10-12 and Figure 10-13, respectively.

Section 10.5.1 of the ERD assessed the risks of releasing fibres related to mining and processing to Terrestrial Environmental Quality. The objective for Terrestrial Environmental Quality is to “maintain the quality of land and soils so that environmental values are protected.” The assessment determined that the key measure in minimising risk of exposure to asbestiform minerals is to avoid known occurrences of asbestiform material where possible. Where asbestiform fibrous material is identified that cannot be avoided (transitional areas surrounding dolerite intrusion and Dales Gorge) this material is transported to designated encapsulation cells within WRDs.

Section 10.4.4 summarises the extensive ongoing occupational hygiene monitoring program that the existing project has undertaken to detect fibrous minerals. The Proponent will continue to implement this program to assist in protecting the health of employees on-site CPM. To date the monitoring program has been able to demonstrate that the fibrous minerals are contained in designated areas and that workers in the accommodation villages are protected from fibrous minerals.

Regular inspections and audits are conducted across site to ensure effectiveness of fibre controls is maintained.

As mentioned above, activities with the greatest risk of releasing fibres are related to mining and processing, and to a lesser extent activities at the port and marine operations. The FMMP has been developed by CPM to address these risks thereby ensuring fibrous minerals are appropriately managed on site.

This Proposal presents potential for increased risk to air quality associated with fibrous minerals. That risk will be managed by implementation of the FMMP such that the Proposal will continue to meet the EPA objective for Air Quality.

10.6.2 Potential for fibrous minerals to become airborne post-closure

Section 10.5.2 of the ERD assessed the risks of releasing fibres post-closure to Terrestrial Environmental Quality and identified that asbestiform mineral waste that is excavated from the mine is contained within designated encapsulation cell within waste rock landforms. The encapsulation cells are designed to include a minimum of 50 m of material along their sides and a 10 m deep capping layer of clean material on top.

The location of the cells within stable post-closure waste rock landforms will prevent the potential for fibrous minerals to affect air quality. The Proposal does not increase the risk to air quality associated with fibrous minerals from post-closure. By implementing the FMMP the Proposal will continue to meet the objective for Air Quality.

Potential exposure in final pit walls and TSF

The Project's pit design has minimised exposure of Dales Gorge member in the final pit shell. Based on the depth of the pit wall (i.e. ~400 m) it is very unlikely that any asbestiform material would leave the mine pit. The groundwater re-entering the pit void and forming a pit lake is expected to help mitigate the risk of any exposed material becoming airborne. Other management methods such as covering the exposures with clean fill or other material will be assessed to minimise the risk of exposing asbestiform material for long periods. In addition, the TSF will be encapsulated within a layer of clean material. For further information related to closure see the Conceptual Mine Closure Plan.

The Proposal does not increase the risk to air quality associated with fibrous minerals in the final pit walls and TSF. By implementing the FMMP the Proposal will continue to meet the objective for Air Quality.

10.6.3 Additional dust

Section 10.4.3 has demonstrated that the existing operations largely meet dust management requirements. Some exceedances of dust trigger levels have occurred from Project activities such as land clearing and operation of the waste dump. Other exceedances were due to significant weather events occurring in the Pilbara and not related to mine activities.

The Proposal will increase the life of the mine but not increase production rates. As the production rates will not increase, vehicle movements and operational activities are largely expected to remain similar. The Proposal will continue to apply existing dust measures and implement improvements where possible to the OEMP such that the Proposal will meet the EPA objective for Air Quality.

10.7 Mitigation

CPM's objective for air quality is to minimise impacts through the implementation of the hierarchical structure from the FMMP, as follows:

- prevention of fibre and related dust release as far as is practicable
- where prevention is not practicable, capture of emissions; if emissions cannot be captured, ensure as far as is practicable, suppressions of emissions when they do occur
- where prevention of fibre and related dust release is not practicable, prevention of worker exposure through use of other controls as provided for in the FMMP
- prevention of exposure to the public through use of controls as provided for in the FMMP
- prevention of environmental harm.

Specific actions proposed to achieve those outcomes are:

- mine planning that minimises the interaction with Dales Gorge material
- disposing of potentially asbestiform containing material in designated encapsulated cell within WRDs
- encapsulation and rehabilitation of TSF areas progressively when and where possible
- a rigorous program of preventing or suppressing fibre/dust release (e.g. by water spraying, misting and fogging, application of binders and surfactants, installation of extraction ventilation, etc.). Prevention and/or suppression methods will be used for drilling and blasting, loading, transfer of ore and waste, crusher operations and conveyor transport of ore, processing operations including management of tailings, stockpile management and transfer of concentrate through to transfer onto export vessels
- conducting workplace inspections and audits to ensure controls are maintained to a required standard.

As identified in Section 10.4 of the Sino Iron Mine Continuation Proposal Environmental Review the potential for public and occupants of the accommodation village to experience reduced air quality is minimised by:

- the isolation nature in terms of distance from populated areas
- security measures that prevents unauthorised access to the lease areas
- separation (including realignment) of public roads from processing and mining areas.

10.8 Predicted outcome

The ongoing implementation of existing management measures (described above) will ensure the Proposal will not result in any significant risk to Air Quality and impacts at sensitive receptors.

11. Terrestrial environmental quality

11.1 EPA objective

To maintain the quality of land and soils so that environmental values are protected.

11.2 Policy and guidance

The relevant guideline for Terrestrial environmental quality is:

- *Environmental Factor Guideline – Terrestrial Environmental Quality* (EPA 2016)
- *Management of fibrous minerals in Western Australian mining operations – guideline* (DMP 2015).

11.3 Receiving environment

11.3.1 Geology

The Hamersley Group contains one of the largest iron ore deposits in the world, covering more than 600 km from east to west. Numerous large scale operations mine haematite, goethite and limonite deposits found within the Brockman and Marra-Mamba Iron Formations situated within the Hamersley Group (Figure 11-1).

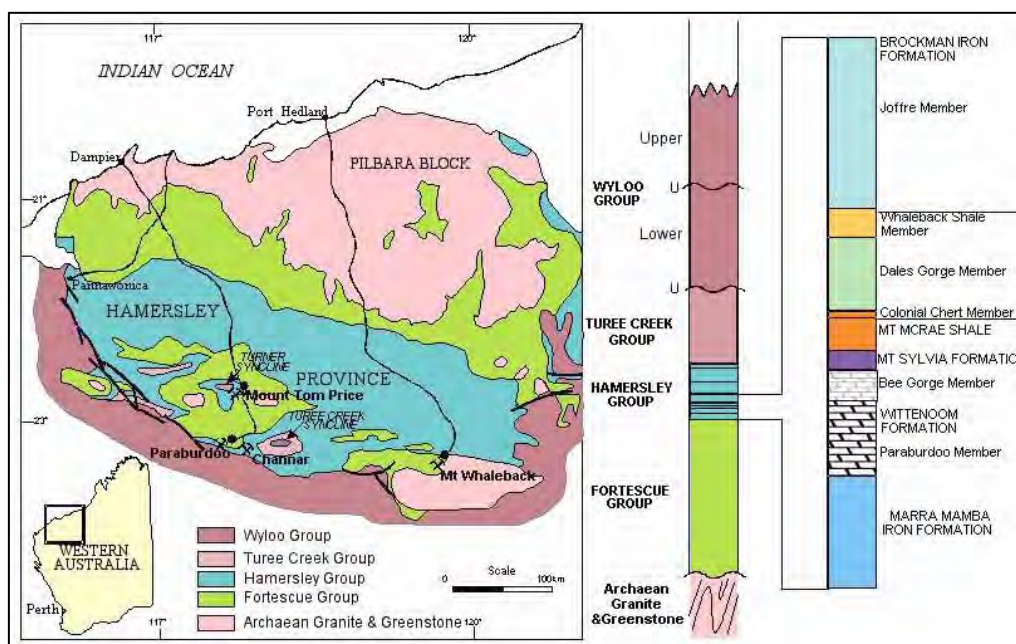


Figure 11-1: Regional geological context

The Joffre and Dales Gorge geological members of the Brockman Iron Formation as well as the Marra Mamba Iron Formation contain banded iron formations that typically consist of alternating sedimentary layers of chert matrix and iron rich bands. These members also contain massive reserves of iron as magnetite.

Fibrous minerals in the Hamersley Iron Group

Fibrous minerals including Actinolite, Tremolite and Riebeckite are ubiquitous throughout the Brockman and Marra-Mamba Iron Formations, each of which may occur in asbestiform and non-asbestiform habits.

While the Dales Gorge Member is known for its occurrence of asbestiform Riebeckite (otherwise known as Crocidolite or “Blue Asbestos”) particularly near the centre of the Hamersley Province, the Joffre Member is notable for its absence of crocidolite seams. However, instances of filiform sprays of crocidolite may be encountered in the chert matrix. Asbestiform Actinolite and Tremolite can also be found in the transitional areas around dolerite intrusions.

Fibrous minerals at Sino Iron Ore Operations

The predominant fibrous mineral encountered in the mining operations (of the Joffre Member) is, as would be expected, massive (non-asbestiform) riebeckite. Actinolite and tremolite may occur in trace amounts in transitional areas surrounding dolerite intrusions and, where encountered, are quarantined and transported to encapsulation cells within waste dumps.

The magnetite orebody being mined lies within the Joffre Member of the Brockman Iron Formation which in turn forms part of the Hamersley Group. The orebody overlies the Whaleback Shale and Dales Gorge Members. Dolerite intrusions are present in all geological units as indicated in Figure 11-2.

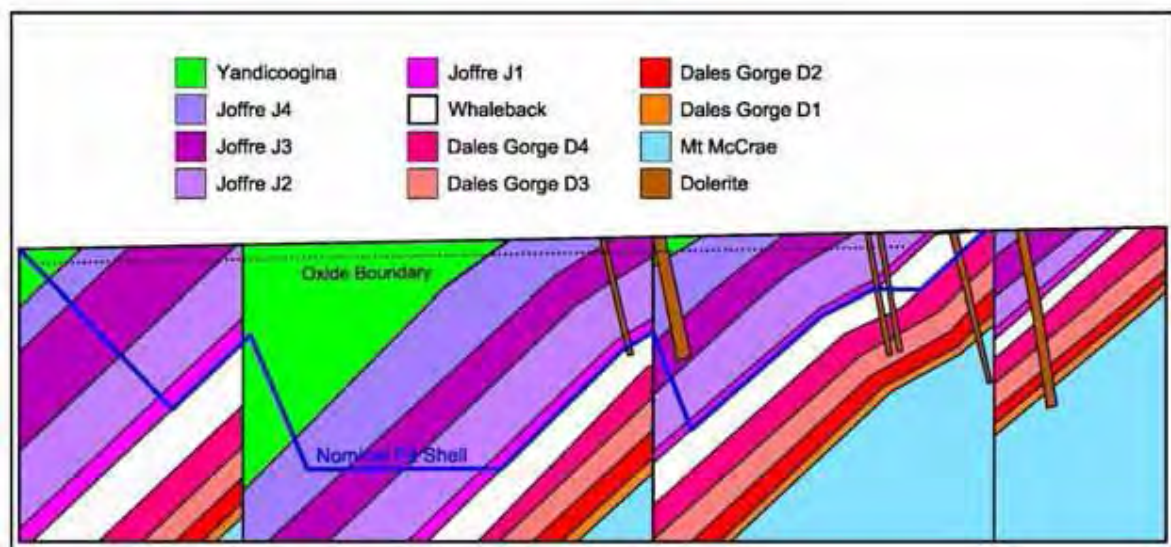


Figure 11-2: Indicative cross sectional view of the geological units within the mine plan.

Although the Dales Gorge does not form part of the target ore body, for economic as well geotechnical stability reasons, planned removal of this material involves quarantine and transport to waste (to be capped).

Massive (non-asbestiform) riebeckite

Massive riebeckite, is commonly encountered in all mining operations extracting ore in and around the Joffre and Dales Gorge Members and consists of densely packed acicular prismatic crystals. Crushing and milling of massive riebeckite can produce atmospheric concentrations of individual acicular crystals which meet the occupational health defined geometric criteria as a countable fibre. While not meeting the formal definition of contaminant asbestos (under MSIA Regulation), based on precautionary principles CPM has chosen to include massive riebeckite in determining atmospheric fibre concentrations.

Fibrous minerals and environmental health

The risks associated with fibrous minerals at the Project are similar to that experienced by other iron ore mining operations mining in and around banded iron formations within the Hamersley Group. The primary concern that arises is the potential effect on human health, both occupational and public.

Atmospheric monitoring for fibrous minerals at the Project indicates that significant dilution occurs within a relatively short distance from point source emissions within areas that have been designated as being potentially hazardous.

Scanning Electron Microscopy of atmospheric samples reveals that the predominant fibre released into the atmosphere is non-asbestiform, acicular, prismatic fibres of massive riebeckite.

11.3.2 Consultation with DMP

As outlined within Section 3 above, CPM has participated in a series of consultations with DMP on the management of this issue and ensuring the provision of a safe work environment is provided. DMP, as regulator for mine safety, has previously requested CPM to provide evidence to demonstrate the risks associated with fibrous material are being managed appropriately. Submissions made by CPM to the DMP has included copies of CPM's FMMP (Appendix 3) and data and information collected from CPM's ongoing monitoring and investigation of this matter. To date, DMP's Resources Safety Division has not raised any further issues since the submission of this material.

CPM met with DMP Resources Safety Division on 12 April 2017 to discuss the Proposal and CPM's ongoing approach to fibrous material management. DMP confirmed at this the meeting that the FMMP is appropriate for management of fibrous materials risks associated with the Proposal.

11.3.3 Summary

CPM's Sino Iron Ore operations extract and beneficiate magnetite from the banded iron formation of the Joffre Member of the Brockman Iron Formation.

The Joffre contains iron rich sedimentary layers as well as bands of chert and massive (non-asbestiform) riebeckite.

Crushing and milling of massive (non-asbestiform) riebeckite (as a small proportion of the ore processed) releases fibres into the atmosphere.

Scanning Electron Microscopy reveals that the predominant fibre released into the atmosphere is non-asbestiform, acicular, prismatic fibres of massive riebeckite.

Trace amounts of actinolite are encountered in transitional areas of dolerite intrusions, which is not processed as ore.

Unlike Dales Gorge Member encountered in central regions of the Hamersley Group, overall percentages of crocidolite observed at Cape Preston (at the periphery of the Group) are considerably lower.

The Dales Gorge Member is not mined for ore. However, for economic as well geotechnical stability reasons, any removal involves quarantine and transport to waste (to be capped).

CPM has taken a conservative approach to fibrous minerals by assessing all fibres as if they were contaminant asbestos. Accordingly, a comprehensive FMMP has been developed and implemented to reduce fibrous minerals emissions through the application of engineering controls and the protection from personal exposures.

An ongoing program of personal, and area monitoring for fibrous minerals is been implemented for the project.

Dedicated management plans for the closure and rehabilitation of the TSF and WRD (Appendix 3).

11.4 Potential impacts

The following impacts have been identified:

- mining activities have the potential to cause fibrous mineral to become airborne
- inappropriate management of potential asbestiform material (including post-closure storage, and mine pit wall exposures) has the potential to cause fibrous minerals to become airborne
- potential for occupational and public health exposures
- potential long term contamination of land.

Public exposure to fibrous minerals is minimised by:

- the isolation nature in terms of distance from populated areas
- security measures that prevents unauthorised access to the lease areas
- separation (including realignment) of public roads from processing and mining areas.

Public exposure to fibrous minerals outside of the lease area is limited to contact with potentially contaminated vehicles, plant and equipment. CPM mitigate these risks by requiring:

- inspections and, if necessary, decontamination of vehicles, plant and equipment leaving designated areas
- a requirement to inspect and, if necessary, decontaminate vehicles, plant and equipment leaving site
- provision of decontamination facilities for both personnel and plant operating in designated areas
- atmospheric monitoring for fibrous minerals at the project and Eramurra Village and the application of additional controls if required.

11.5 Assessment of impacts

11.5.1 Mining and operational activities

As mentioned above, activities with the greatest risk of releasing fibres are related to mining and processing, and to a lesser extent activities at the port and marine operations. The FMMP has been developed by CPM to address these risks thereby ensuring fibrous minerals are appropriately managed on site.

The key measure in minimising risk of exposure to asbestiform minerals is to avoid known occurrences of asbestiform material where possible. Where asbestiform fibrous material is identified that cannot be avoided (transitional areas surrounding dolerite intrusion and Dales Gorge) this material is transported to designated encapsulation cells within WRDs.

The existing project has a rigorous ongoing occupational hygiene monitoring program to detect fibrous minerals. To assist in protecting the health of employees on-site CPM has implemented a substantial occupational hygiene monitoring program since the commencement of mining operations.

Regular inspections and audits are conducted across site to ensure effectiveness of fibre controls is maintained.

11.5.2 Post-closure

Asbestiform mineral waste that is excavated from the mine (e.g. dolerite intrusions and any Dales Gorge overburden) is contained within designated encapsulation cell within waste rock landforms. The encapsulation cells are designed to include a minimum of 50 m of material along their sides and a 10 m deep capping layer of clean material on top (as shown in Figure 11-3).

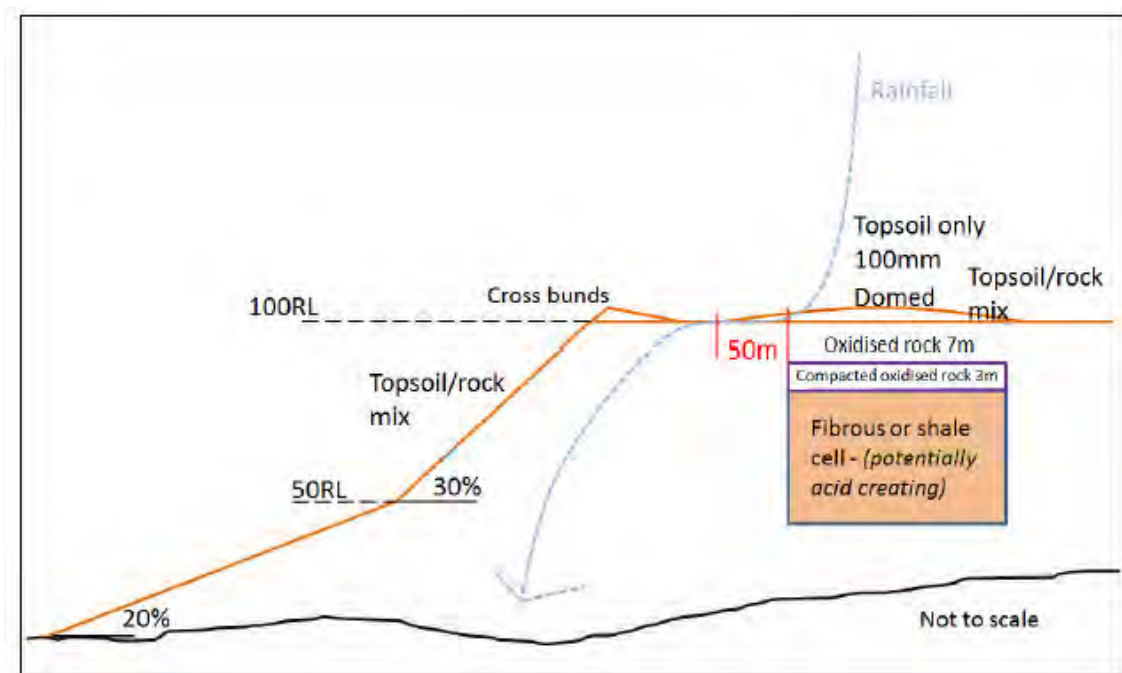


Figure 11-3: Schematic cross-section of encapsulation cell within a waste rock landform

Potential exposure in final pit walls and TSF

The Project's pit design has minimised exposure of Dales Gorge member in the final pit shell. Figure 11-4 presents the areas where the Dales Gorge member will be exposed.

Based on the depth of the pit wall (i.e. ~400 m) it is very unlikely that any asbestiform material would leave the mine pit. The groundwater re-entering the pit void and forming a pit lake is expected to help mitigate the risk of any exposed material becoming airborne. Other management methods such as covering the exposures with clean fill or other material will be assessed to minimise the risk of exposing asbestiform material for long periods. In addition, the TSF will be encapsulated within a layer of clean material. The low erosion potential of the closure landforms following the proposed surface treatment and rehabilitation trials further reduce the risk. For further information related to closure see the Conceptual Mine Closure Plan at Appendix 3.

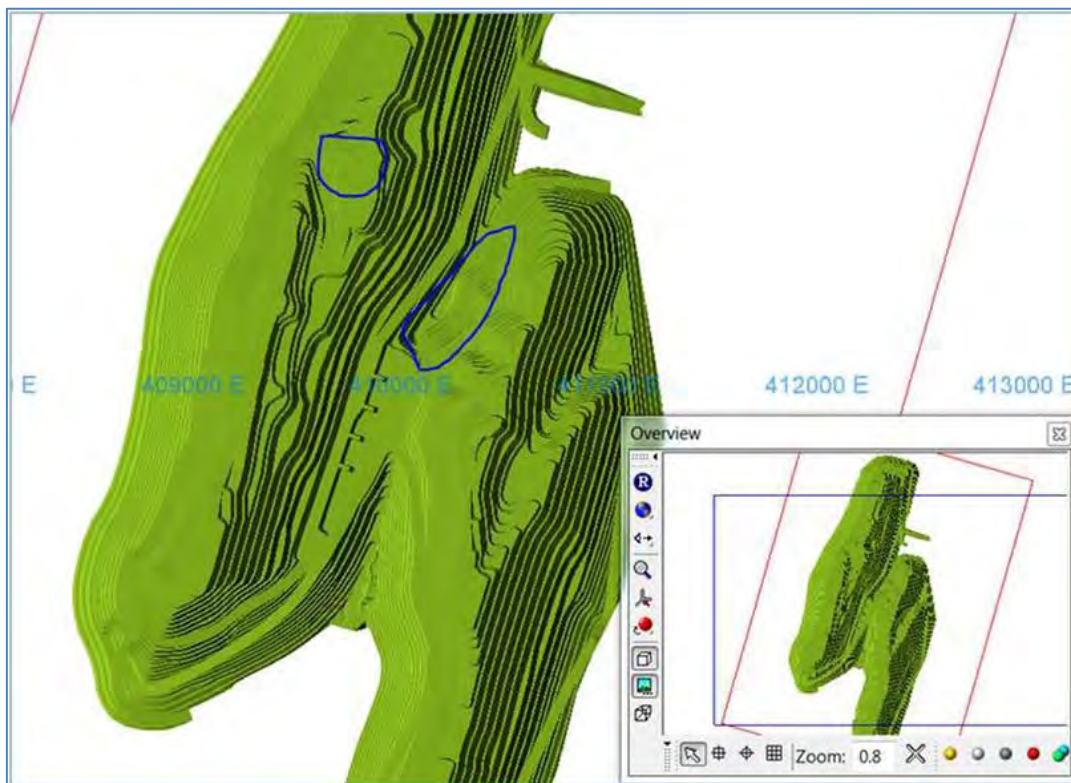


Figure 11-4: Final pit shell and location of potential fibrous material exposure associated with the Dales Gorge member

11.6 Mitigation

As discussed in Section 10, CPM's objective for air quality is to minimise impacts through the implementation of the hierarchical structure from the FMMP, as follows:

- prevention of fibre and related dust release as far as is practicable
- where prevention is not practicable, capture of emissions; if emissions cannot be captured, ensure as far as is practicable, suppressions of emissions when they do occur
- where prevention of fibre and related dust release is not practicable, prevention of worker exposure through use of other controls as provided for in the FMMP
- prevention of exposure to the public through use of controls as provided for in the FMMP
- prevention of environmental harm

Specific actions proposed to achieve those outcomes are:

- mine planning that minimises the interaction with Dales Gorge material
- disposing of potentially asbestiform containing material in designated encapsulated cell within WRDs
- encapsulation and rehabilitation of TSF areas progressively when and where possible
- a rigorous program of preventing or suppressing fibre/dust release (e.g. by water spraying, misting and fogging, application of binders and surfactants, installation of extraction ventilation, etc.). Prevention and/or suppression methods will be used for drilling and blasting, loading, transfer of ore and waste, crusher operations and conveyor transport of ore, processing operations including management of tailings, stockpile management and transfer of concentrate through to transfer onto export vessels
- conducting workplace inspections and audits to ensure controls are maintained to a required standard.

As mentioned in Section 11.4 the risk for public and occupants of the accommodation village from air quality impacts is minimised by:

- the large separation distance from populated areas
- security measures that prevents unauthorised access to the lease areas
- separation (including realignment) of public roads from processing and mining areas.

11.6.1 Occupational health

The presence of fibrous minerals and the potential hazard to human health has resulted in a significant occupational hygiene monitoring program from which evidence based statements of risk can be made and from which a comprehensive management plan has emerged (see Fibrous Minerals Management Plan (FMMP) in Appendix 3). The FMMP has been developed by CPM using DMP's guideline: Management of Fibrous Minerals in the Western Australian Mining Industry.

Key areas within the FMMP that address occupational health risks include:

- mine planning that limits mining of Dales Gorge material
- Dales Gorge and transitional areas surrounding dolerite intrusions encountered are quarantined from processing and transported to encapsulation cells within waste dumps
- the delineation of designated areas where respiratory protection and decontamination is mandated
- provision of in-pit dust control and suppression
- crushing and conveyor transport dust suppression systems
- restricting (and recording) access to designated areas to essential personnel
- fitting HEPA systems to heavy plant and buildings
- decontamination facilities for personnel and equipment
- unprecedented respiratory protection program (including fit testing)
- fibrous minerals training and awareness sessions for all personnel
- ongoing occupational hygiene monitoring for fibrous minerals including assessment of similar exposure groups through representative sampling and ongoing revision of the program as required.

Personal (occupational) exposures to fibrous minerals are well controlled. Atmospheric concentrations of fibrous minerals recorded across the site are generally below the occupational exposure standard. Areas where elevated concentrations may be present (limited to mine pit, processing plant, TSF and parts of port operations) are classified as designated areas where mandatory respiratory protection and decontamination is required.

11.6.2 Public health

The presence of controls that reduce dust and fibre emissions, coupled with the dispersion of emissions with distance from sources ensures that the greater risk from fibrous minerals occurs within designated operational areas. The Eramurra accommodation village is considered a sensitive location where public health standards apply to ensure there are no additional exposures to mine workers as well as ensuring the protection of the non-mining workforce. Area and personal monitoring is regularly carried out at the village; results from 2014-2016 were at or below the DoH guideline limit of 0.01 f/mL with the exception of one result from the Fortescue Village, which is located approximately 25 km south of the mine operations. Anecdotal evidence from the technician who analysed that sample was that the fibres observed were not an asbestiform mineral. The monitoring results suggest that the controls implemented and the dispersion of residual emissions with increasing distance from the sources effectively manage the risks from fibrous material emissions.

11.7 Predicted outcome

The ongoing implementation of existing management measures (described above) will ensure the Proposal will not result in any significant impact to terrestrial environmental quality.

12. Other environmental factors

The EPA Scoping Guideline identified 'other' environmental factors that have the potential to be affected by the proposal. These include:

- subterranean fauna
- social surroundings
- human health.

Due to the low level of impact, application of industry standard controls and other regulatory mechanisms, these factors are not expected to be required to be assessed in detail by the EPA. Table 12-1 provides a summary of the impacts, mitigations and outcomes for these factors.

Table 12-1: Other environmental factors

Element	Description
Subterranean fauna	
EPA objective	<i>To protect subterranean fauna so that biological diversity and ecological integrity are maintained.</i>
Policy and guidance	Environmental Factor Guideline – Subterranean Fauna (2016m). Technical Guidance – Subterranean Fauna survey (2016n).
Potential impacts	Potential impacts to subterranean fauna through removal of habitat.
Mitigation	Avoid: The troglofauna community at Cape Preston will be protected through the retention of the majority of the existing troglofauna habitat in the area. Minimise: Dewatering to drain the subterranean environment above the dewatered zone to field capacity, therefore not changing the relative humidity within the soil matrix.
Outcomes	Residual Impact: Groundwater drawdown resulting from the Proposal will not significantly affect stygofauna as the amount of habitat lost will be insignificant in relation to each species' distribution. The troglofauna community at the Development Envelope will be protected through the retention of the majority of the existing troglofauna habitat in the area. The relative humidity in the soil matrix above the watertable is not expected to change as a result of dewatering and, therefore, troglofauna at the Development Envelope appear unlikely to be affected by dewatering.
Social surroundings	
EPA objective	<i>To protect social surroundings from significant harm.</i>
Policy and guidance	Environmental Factor Guideline – Social surroundings (EPA 2016o).
Potential impacts	Potential impacts to Aboriginal Heritage Sites.
Mitigation	Avoid: Heritage sites are avoided or salvaged where possible, and consultation with traditional owners is ongoing. Minimise: Indigenous Land Use Agreements (ILUAs) have been entered into with three Traditional Owner Groups, being the Yaburara & Mardudhunera People (YM), the Kuruma Marthudunera People (KM) and the Wong-Goo-Tt-Oo People (WGTO). Since these ILUAs were agreed: • the native title claim made by WGTO was dismissed by the Federal Court of Australia and removed from the National Native Title Tribunal's register of Native Title Claims; and • KM amended the boundaries of its native title claim so that its claim no longer overlaps with the area the subject of the Approved Proposals or this Proposal. Pursuant to the current YM ILUA, YM recognises, acknowledges and agrees that the existing and any future mining tenements and titles granted for the purposes of this Proposal are valid, effective and enforceable under the Native Title Act, the IOPAA and otherwise at law. The Proponents will continue to liaise with Traditional Owner Groups regarding interaction with Aboriginal heritage sites.

Element	Description
Outcomes	Residual Impact: The Proposal will not significantly affect the values associated with Social surrounds factor and will continue to meet the objective for this factor.
Human health	
EPA objective	<i>To ensure that human health is not adversely affected.</i>
Policy and guidance	Environmental Factor Guideline – Human Health (2016p).
Potential impacts	Potential impacts of elevated noise levels and potential occurrence of fibrous material on human health.
Mitigation	Avoid: Human health will not be affected from noise associated Proposal because of the distance separating sites of public use from the Proposal. Guidance Statement 3 has been considered and no sensitive receptors identified. Minimise: The potential occurrence of fibrous material is managed in accordance with a FMMP, which has been submitted to DMP.
Outcomes	Residual Impact: The Proposal will not significantly affect the values associated with Human health factor and will continue to meet the objective for this factor.

13. Holistic impact assessment

Avoidance has been a key approach for CPM in managing the potential environmental impacts associated with the Proposal. Numerous studies within Cape Preston have been utilised in understanding the potential impacts of the Proposal and mitigation measures have been formulated to prevent potentially significant impacts. The Proposal activities within the port area have been designed to avoid the critical Northern Quoll habitat adjacent to the Proposal footprint.

For significant flora species, vegetation or habitat that is unable to be completely avoided, disturbance will be minimised through the implementation of management measures. These are outlined in the Draft OEMP and include restriction of access and retention of vegetation along creek lines (Appendix 3).

CPM has undertaken stakeholder consultation throughout planning for the Proposal (see Section 3). Consultation will continue to develop as the Proposal progresses into the detailed design, construction and operational phases of the project.

'Key' and 'other' environmental factors have been considered against EPA objectives and relevant guidelines. The key environmental factors, impacts of the Proposal and mitigation actions to address potential residual impacts are summarised in Table 13-1. Based on the mitigation measures proposed and the continuation of existing management measures, the Proposal is considered to meet the EPAs objective for each environmental factor.

The proposed Approval Statement is included in Appendix 4.

Table 13-1: Assessment of preliminary key environmental factors

Description and potential impacts	Environmental aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
Hydrological processes - <i>To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.</i>				
Context The hydrological regime at the mouth of the Fortescue River includes: - high variability in natural flow volumes - strong tidal flows and high tidal range - high velocities and rate of flushing and well mixed circulation. Key survey findings Modelling of the extent of groundwater drawdown was conducted for the Proposal. Modelling indicated that at the completion of mining the vertical profile of the groundwater drawdown will change from a steep-sided deep profile to a shallower profile. The extent of deeper drawdown contours (more than 10 m) will contract closer to the mine pit but it will result in a minor increase in the extent of the shallower 1.0 m contour. At the end of mining, the depth to groundwater will not be substantially different throughout the extent of the model with the exception of the mine pit. The recovery of groundwater is expected to result in a pit lake of 250 m in the west pit and 20 m in the east pit. The regional groundwater levels are not expected to be substantially affected. During mining the predicted inflows that will need to be dewatered are 7.5 GLpa. The Proposal includes the discharge of up to 8.0 GLpa and will not substantially affect flows of the Fortescue River as the natural flows are large, highly variable and have a strong tidal influence. The development of a Waste Dump adjacent to Du Boulay Creek is not expected to increase the velocity of flow. Potential impacts: - groundwater drawdown from dewatering has potential to modify groundwater and surface water flows - discharge of groundwater has potential to modify surface water flows in the Fortescue River - diversion of Edwards Creek will modify surface water flows - construction of physical elements will alter surface water flows.	Mine construction Groundwater drawdown	Avoidance: - incorporate flood modelling data and surface flow data into the design of the Proposal to avoid impacts to hydrological processes. Minimisation: - discharging groundwater to the Fortescue River on outgoing tides to minimise changes to hydrological processes - a naturally vegetated buffer will be maintained between the bunds around the Proposal elements and floodplain channels to limit increases in flood levels and velocities, and minimise erosion - monitoring will be undertaken to continue to assess potential impacts to nearby creeklines - an Operating Strategy shall detail the monitoring and adaptive management measures for of the groundwater drawdown aspects - realignment of the southern branch of Edwards Creek into two sections to enable the minimisation of the disturbance area of the infrastructure.	A requirement to maintain an approved Environmental Management Plan (EMP). This EMP will specify the methods, procedures and management to avoid and minimise the impacts on hydrological processes. Groundwater abstraction and discharge licence (RIWI Act).	Outcomes: - the areal extent of the 0.5 m, 5.0 m and 10.0 m drawdown contours will decrease relative to the existing project - the recovery of groundwater is expected to result in a pit lake of approximately 250 m deep in the west pit and 20 m deep in the east pit - the regional groundwater levels are not expected to be significantly affected - no permanent pools will be significantly affected - the cumulative development of all mines on Cape Preston would not substantially increase the areal extent of groundwater drawdown - although highly unlikely to occur the inclusion of additional mines to assess cumulative impacts to hydrological processes do not significantly affect groundwater levels; however, Balmoral South borefield will increase the extent of the 1.0 m drawdown contour - during mining the predicted mine pit inflows that will need to be dewatered are 8.0 GLpa - the discharge of 8.0 GLpa will not substantially affect flows or values of the Fortescue River - the development of a Waste Dump adjacent to Du Boulay Creek is not expected to affect volumes or surface water

Description and potential impacts	Environmental aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
				significantly increase flow velocities. <u>Assessment against EPA objective</u> The Proposal has been designed and would be managed to avoid or minimise impacts on hydrological processes. The Proposal can be managed to meet the EPA's objective for Hydrological processes subject to existing licences. The abstraction of groundwater is licensed under s 5C of the Rights in Water and Irrigation Act 1914 (GWL167151, GWL167891, GWL171149, GWL167324 and GWL168819). Given the hydrological regime and contribution of water at the mouth of the Fortescue River, the Proposal is unlikely to affect the stream flow characteristics of any water course.
Inland waters environmental quality - To maintain the quality of groundwater and surface water, sediment and biota so that the environmental values are protected.				
<u>Context</u> The Fortescue River system is highly dynamic. Salinity at the mouth of the Fortescue River fluctuates depending on season and the tide and river conditions. <u>Key survey findings</u> The southern branch of Edwards Creek will be realigned in two sections, enabling the disturbance area of the infrastructure to be minimised. The two diversions have been designed to accommodate the 5 – 10 year ARI flood flow, which maintains the natural design of the creek therefore the hydrological properties of the creek is not expected to change. During mining the rate of flow into the pit is approximately 8 GLpa. As groundwater levels recover, the numerical model estimates pit inflows to increase to approximately 14 GLpa. The quality of groundwater flowing into the pit lake has been estimated to vary with the distance from the coast.	Discharge of groundwater from groundwater drawdown	<u>Avoidance:</u> - maintain the same length and natural design (8 – 10 m bed width) for the diversion of Edwards Creek <u>Minimisation:</u> - pass all runoff from disturbed areas through sediment traps prior to discharging downstream (during both construction and operation) - collect seepage from the tailing dam and use it on the mine site for ore-processing, dust control purposes and road-making - remove sediment from sediment basins prior to the wet season to the extent needed to maintain capacity. As required dispose of sediments to bio-remediation facility - monitoring will be undertaken including visual inspection of water quality and quantity in major creeklines and Fortescue River pools.	A requirement to maintain an approved Environmental Management Plan (EMP). This EMP will specify the methods, procedures and management to avoid and minimise the impacts on inland waters environmental quality.	<u>Outcomes:</u> - diversion of Edwards Creek will not significantly alter either flow or velocity within the creek and therefore is not expected to affect water quality of either Edwards Creek or Fortescue River downstream - collection of surface runoff in sedimentation ponds will prevent surface water contamination - pit lake will act as a terminal sink and likely become hypersaline over time although surrounding groundwater quality will not be adversely affected. <u>Assessment against EPA objective</u> The Proposal has been designed and would be managed to avoid or

Description and potential impacts	Environmental aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
<u>Potential impacts</u> - diversion of Edwards Creek has the potential to increase stream velocity, which may affect water quality - physical development of the site and use of infrastructure will generate runoff which has the potential to affect surface water quality - following the formation of a pit lake after closure, evaporation and groundwater flow into the pit has the potential to affect water quality within the pit lake and surrounding environmental values.		<u>Rehabilitate:</u> contain and cleanup any spill in accordance with DR017219 Hydrocarbons - Hazardous Materials Spill Response Procedure - Land.	Groundwater abstraction licence (RIWI Act).	minimise impacts on inland waters environmental quality. The Proposal can be managed to meet the EPA's objective for Hydrological processes subject to existing licences. The abstraction of groundwater is licensed under s 5C of the <i>Rights in Water and Irrigation Act 1914</i> (GWL167151, GWL167891, GWL171149, GWL167324 and GWL168819). The diversions of the creek are not expected to alter either the flow or velocity of the creek. By maintaining the flow velocity and volume of the creek, it is not expected that the water quality of either Edwards Creek or the Fortescue River downstream will be affected.
Marine environmental quality - To maintain the quality of water, sediment and biota so that the environmental values are protected.				
<u>Context</u> The lower Fortescue River estuary is a delta which experiences strong tidal influence, with low sediment trapping efficiency, generating naturally high turbidity with well mixed waters. The area contains a well-developed and structurally complex mangrove system that fringes the major tidal creek with extensive cyanobacterial mats occurring on the tidal flats. <u>Key survey findings</u> Prior to discharge, the groundwater to be discharged is equivalent to that of the Fortescue River estuary for TSS, pH and metals. The groundwater has elevated nitrogen levels, but the receiving environment has nitrogen-fixing algal mats and the low phosphorus levels in the groundwater means that the system is phosphorus limiting and unlikely to generate algal blooms. On this basis the only key parameter that may affect the marine environmental quality is the salinity (TDS). The groundwater quality to be dewatered ranges from brackish within the south of the deposit to saline and hypersaline at the north, which associated with the naturally occurring saline seawater wedge.	Discharge of groundwater from groundwater drawdown	<u>Avoidance:</u> - undertake monitoring in accordance with DER discharge licence to ensure the groundwater salt, metal and nutrient concentrations are consistent with discharge licence requirements. <u>Minimisation:</u> - discharging groundwater on outgoing tides to ensure discharge water is rapidly diluted to achieve the target dilution - discharging via a diffuser in accordance with dilution modelling (RPS APASA 2017) - to ensure the integrity of infrastructure any debris or other blockages will be cleared as required. - implement DR017219 Hydrocarbons - Hazardous Materials Spill Response Procedure - Land.	A condition requiring the preparation of an approved Environmental Management Plan (EMP). This EMP will specify the methods, procedures and management to avoid and minimise the impacts on marine environmental quality.	<u>Outcomes:</u> - target dilution for salinity (TDS) is a dilution level of 27 times, which will be achieved throughout the model for both a median and 80th percentile assessment of an 8 GLpa discharge - an 8 GLpa discharge is rapidly diluted on the falling tide and modelling shows no sign of build-up of salinity. <u>Assessment against EPA objective</u> The Proposal has been designed and would be managed to avoid or minimise impacts on marine environmental quality. The Proposal can be managed to meet the EPA's objective for Marine environmental quality subject to:

Description and potential impacts	Environmental aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
<u>Potential impacts</u> discharge of groundwater has the potential to affect the water quality of the Fortescue River estuary.				implementation of the EMP The Proposal is not expected to result in significant changes to marine environmental quality and is expected to meet the EPA objective for this factor.
Flora and vegetation - To protect flora and vegetation so that biological diversity and ecological integrity are maintained.				
<u>Context</u> The Development Envelope is within an active pastoral station that has historically been adversely affected by weed invasion and grazing by stock. The condition of the vegetation within the Cape Preston area ranges from Completely Degraded to Very Good. The majority of the Development Envelope contains vegetation communities of moderate local conservation significance (3035 ha) within the well-represented Newman, Paraburdoo, Rocklea and Horseflats land systems. <u>Key Survey Findings</u> Extensive flora and vegetation surveys of the Cape Preston area have been conducted over approximately 53 000 ha. No Threatened Flora species as listed under the WC Act are known from within 15 km of the Development Envelope. Thirteen Priority Flora species listed by Parks and Wildlife have the potential to occur within the broader Cape Preston area, with one, <i>Goodenia pallida</i> (P1) having the potential to occur within the Development Envelope. No Priority Flora species were recorded by vegetation surveys within the Development Envelope. Thirteen groundwater dependent vegetation communities have been mapped to the west of the Development Envelope, ranging from high to low dependence on groundwater. <u>Potential impacts</u> - clearing of native vegetation has potential to affect regional representation of vegetation communities and flora species - clearing has potential to introduce/spread weeds - groundwater drawdown from dewatering has potential to affect groundwater dependent ecosystems.	Clearing of native vegetation Introduced weeds Groundwater drawdown	<u>Avoidance:</u> - inspection of the site for the presence of Mesquite or Parkinsonia prior to any machinery being moved to a site - maintenance of adequate fire breaks across the mine site and around working areas. <u>Minimisation:</u> - restricting clearing to approved areas through the implementation of an internal ground disturbance permit system - restricting all vehicles and equipment to within designated tracks and parking areas - restricting all earthworks and movements of machinery and vehicles to within marked clearing or disturbance boundaries - requirements for all earthmoving machinery to be inspected as clean and free of weed and seed prior to entry and exit from a site - monitoring of GDE vegetation as outlined in the GDVMP (Astron 2015) will be conducted and contingency responses activated when trigger levels are exceeded. <u>Rehabilitate:</u> - progressive rehabilitation of any disturbed areas not required for other future mining activities, sourcing topsoil for rehabilitation from areas of lowest weed infestation where possible.	A requirement to maintain an approved Environmental Management Plan (EMP). This EMP will specify the methods, procedures and management to avoid and minimise the impacts on vegetation and flora.	<u>Outcomes:</u> - approximately 7366 ha of vegetation will be cleared by the Proposal with the majority of this occurring in habitat of low to moderate conservation significance and well represented in the region - loss of 121.51 ha of vegetation from the Horseflat Land System, a Priority 3iii Ecological Community although this will not result in a significant reduction in the extent of this community with total clearing in the Roebourne Subregion less than 0.5% - no Threatened Flora species listed under either the WC Act or EPBC Act will be affected by the Proposal - no Priority Flora species as listed by Parks and Wildlife will be affected by the Proposal - no change to GDE health is predicted with implementation of the GDE the monitoring plan and related adaptive management actions; and as a result of minimal changes to of groundwater levels (0.5 m) - the Proposal will not conflict with the WC Act as no flora species will significantly affected or have its conservation status affected by the Proposal's

Description and potential impacts	Environmental aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
				implementation. <u>Assessment against EPA objective:</u> The Proposal has been designed and would be managed to avoid or minimise impacts on vegetation and flora. The Proposal can be managed to meet the EPA's objective for Vegetation and Flora subject to: • implementation of the EMP Given the mitigation measures together with the widespread vegetation types, low percentage of vegetation types affected and lack of conservation significant species identified within the Development Envelope, it is considered likely that the residual impacts of the Proposal will meet the EPA objective for this factor.
Terrestrial fauna - <i>To protect terrestrial fauna so that biological diversity and ecological integrity are maintained</i>				
<u>Context</u> The Cape Preston area contains broad terrestrial habitat types including cracking clays, dunes, hilltop/hill slopes/rocky outcrops, mangrove/beach, samphire, stony spinifex plain with or without low shrub and woodland drainage areas. The majority of habitat within the Development Envelope is of moderate conservation significance consisting of cracking clay and major drainage line / creekline habitats. <u>Key survey findings</u> Potential habitat for Northern Quolls (<i>Dasyurus hallucatus</i>) listed as Endangered (EPBC Act, WC Act) identified within the Development Envelope. No Northern Quolls were recorded within the Proposal footprint. One short range endemic (SRE) species (<i>Bdelloidea</i> sp.) has been recorded in the Development Envelope. This species is at low regional risk.		<u>Avoidance:</u> • the Proposal footprint will avoid drainage line habitat alongside Edward and Du Boulay creeks • maintaining a buffer alongside the Edward and Du Boulay creeks to allow potential movement of fauna • preventing unauthorised access to Northern Quoll habitat • record Northern Quoll habitats to ensure baiting exclusion zones to reduce risk of secondary or accidental poisoning. <u>Minimisation:</u> • informing the workforce of the fauna present and preventing direct and inadvertent feeding of feral animals • implementing and signposting speed limits for both mining equipment and light vehicles in the Development Envelope and on access roads • undertake baiting outside of Northern Quoll	A requirement to maintain an approved Environmental Management Plan (EMP). This EMP will specify the methods, procedures and management to avoid and minimise the impacts on fauna.	<u>Outcomes:</u> • the majority of the disturbance (approximately 5100 ha of the 7366 ha Proposal) occurs in the Low conservation significance Stony Spinifex plain with or without low shrub and Hilltop/hill slopes/rocky outcrops habitat types • disturbance of habitats of Moderate or High local conservation significance occurs in habitats that have been degraded as a result of historical pastoral activities, such as drainage lines and cracking clay units; disturbance within other habitat types (i.e. dunes, samphire and mangrove) is limited

Description and potential impacts	Environmental aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
<u>Potential impacts</u> - clearing has the potential to reduce the extent of fauna habitat - clearing has the potential to disrupt localised fauna linkages for native fauna - clearing of Northern Quoll habitat has the potential to affect habitat availability for this species - development has the potential to introduce/attract feral animals - mining development has the potential to reduce habitat quality or result in the death or injury of terrestrial fauna.	Clearing of native vegetation	breeding season, outside of known habitat and bury baits to prevent non-target species locating the baits. <u>Rehabilitate:</u> undertaking feral animal control.		- clearing of Northern Quoll habitat is limited to 0.12 ha and impact on Northern Quoll populations is unlikely as they were not found to utilise the potential habitat within the Proposal footprint during the reconnaissance and targeted surveys - the Proposal will not conflict with the WC Act as no fauna species will be made extinct or have its conservation status affected as the result of the implementation of the Proposal - no species listed as Endangered or Vulnerable under either the WC Act or EPBC Act will be affected by the Proposal. <u>Assessment against EPA objective</u> The Proposal has been designed and would be managed to avoid or minimise impacts on fauna. The Proposal can be managed to meet the EPA's objective for Fauna subject to: - implementation of the EMP. Given the low to moderate significance of the fauna habitat affected and the lack of critical population of conservation significant species within the Development Envelope, the residual impacts of the Proposal are expected to meet the EPA objective for this factor.

Description and potential impacts	Environmental aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
Terrestrial environmental quality - <i>To maintain the quality of land and soils so that environmental values are protected</i>				
Context CPM's Sino Iron Ore operations extract and beneficiate magnetite from the banded iron formation of the Joffre Member of the Brockman Iron Formation The Joffre contains iron rich sedimentary layers as well as bands of chert and massive (non-asbestiform) riebeckite. Crushing and milling of massive (non-asbestiform) riebeckite (as a small proportion of the ore processed) releases fibres into the atmosphere. Scanning Electron Microscopy reveals that the predominant fibre released into the atmosphere is non-asbestiform, acicular, prismatic fibres of massive riebeckite Trace amounts of actinolite are encountered in transitional areas of dolerite intrusions, which is not processed as ore. Unlike Dales Gorge Member encountered in central regions of the Hamersley Group, overall percentages of crocidolite observed at Cape Preston (at the periphery of the Group) are considerably less. The Dales Gorge Member is not mined for ore. However, for economic as well geotechnical stability reasons, any removal involves quarantine and transport to waste (to be capped). The majority of fibrous minerals are not released into the atmosphere but delivered to the TSF where they are bound in the matrix of the tailings. CPM has taken a conservative approach to fibrous minerals by assessing all fibres as if they were contaminant asbestos. Accordingly, a comprehensive fibrous minerals management plan has been developed and implemented to reduce fibrous minerals emissions through the application of engineering controls and the protection of personal exposures. An ongoing program of personal, and area monitoring for fibrous minerals. Dedicated management plans for the closure and rehabilitation of the TSF and WRD (Appendix 3). Potential impacts - mining activities have the potential to cause fibrous minerals to become airborne - inappropriate management of potential asbestiform material (including post-closure storage, and mine pit wall exposures) has the potential to cause fibrous minerals to become airborne.	Mining and operational activities Post-closure	Minimisation: - mine planning that minimises the interaction with Dales Gorge material - disposing of potentially asbestiform containing material in designated encapsulated cell within WRDs - encapsulation and rehabilitation of TSF areas progressively when and where possible - a rigorous program of preventing or suppressing fibre/dust release (e.g. by water spraying, misting and fogging, application of binders and surfactants, installation of extraction ventilation, etc.). Prevention and/or suppression methods will be used for drilling and blasting, loading, transfer of ore and waste, crusher operations and conveyor transport of ore, processing operations including management of tailings, stockpile management and transfer of concentrate through to transfer onto export vessels - conducting workplace inspections and audits to ensure controls are maintained to a required standard.	A requirement to maintain an approved Fibrous Minerals Management Plan (FMMP). This FMMP will specify the methods, procedures and management to prevent and control the presence of fibrous minerals.	Outcomes: The ongoing implementation of existing management measures (described above) will ensure the Proposal will not result in any significant impact to terrestrial environmental quality <u>Assessment against the EPA objective.</u> The Proposal has been designed and would be managed to prevent and control the presence of fibrous minerals. The Proposal can be managed to meet the EPA's objective for Terrestrial environmental quality subject to: implementation of the FMMP. Given the mitigation measures, it is considered likely that the residual impacts of the Proposal will meet the EPA objective for this factor.

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Appendix 1

Supporting investigations

Appendix 2
Matters of National Environmental
Significance report

Appendix 3

Management Plans

Appendix 4
Proposed Approval Statement

