ENTERPRISE PASTE PLANT WORKS APPROVAL APPLICATION

PADDINGTON GOLD PTY LTD

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Prepared for:

Department of Water and Environmental Regulation
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1.0 PREMISES DETAILS

1.1 Occupier of Premises

Name of Occupier:
Paddington Gold Pty Ltd
(ACN 008 585 886)

Address of Occupier:
Paddington Gold Pty Ltd
35 km NE Menzies HWY
PO Box 1653
Kalgoorlie WA 6430

Contact Details of Occupier
Paddington Gold Pty Ltd
PO Box 1653
Kalgoorlie WA 6430
Phone: (08) 9080 6800
Fax: (08) 9080 6893

Australian Business Number (ABN)
98 008 585 886

1.2 General Company Description

Paddington Gold Pty Ltd is a wholly owned subsidiary of Norton Gold Fields Limited (Norton). The Paddington Mill is located 33 km north-northwest of the City of Kalgoorlie-Boulder, has a planned capacity of more than 170,000 ounces of gold annually from 3.7 million tonnes of ore, and is one of the larger gold mining and processing operations in the region.

All of the ore produced from Norton's Paddington Operations is processed through the Paddington Mill. Tailings from the Paddington Mill are deposited into the adjacent Paddington In-pit Tailings Facility.

The Paddington Mill is operated under the Environmental Protection (Gold Extraction Operations) Exemption Order of 1993.

1.3 DWER Environmental Operating Licences

Norton Gold Fields currently holds DWER Operating Licence L8692/2012/1 for dewatering and discharge from Enterprise open cut mine to Gimlet South open cut mine. This licence is due to expire in August 2028. It is anticipated that upon approval of this works approval, Norton will apply for an amendment of L8692/2012/1 to incorporate paste fill plant and additional discharge point.

1.4 Name and Location of Premises

Premises Name
Enterprise Mine Site

Tenements
Tenements relevant to this application include M24/29 and M24/170. Within tenement M24/29 is the Ora Banda town site and the associated gazetted Ora Banda town site boundary, as outlined in Figure 2. Given the location of the town site boundary and the size of these tenements relative to the prescribed activities within, Norton proposes that the prescribed premises be a portion of those tenements as outlined in Figure 2.

Location
The Enterprise site is located within the Ora Banda project area, approximately 65 km north-west of the City of Kalgoorlie-Boulder. A regional location map is included as Figure 1.

The proposed paste fill plant will be constructed to the west of the existing Enterprise open pit and utilise dry stack tailings from the nearby Ora Banda TSF2 to create paste (Figure 3).

The premises for dewatering discharge is the Enterprise and Gimlet South open cut pits, and paste plant storage tanks. Enterprise and Gimlet South pits are located within 2.5 km distance of each other (Figure 4).

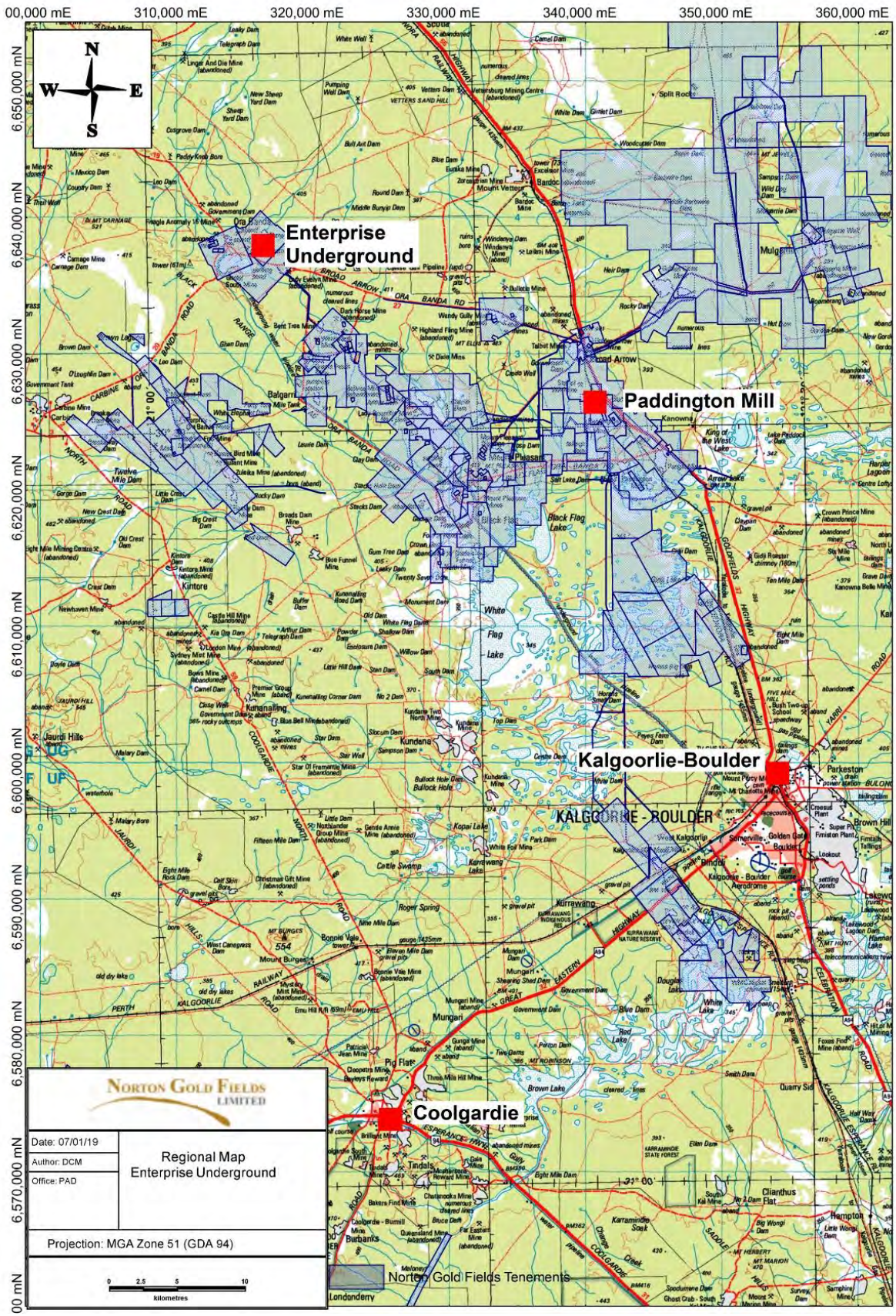

Figure 1 - Enterprise Underground regional location map

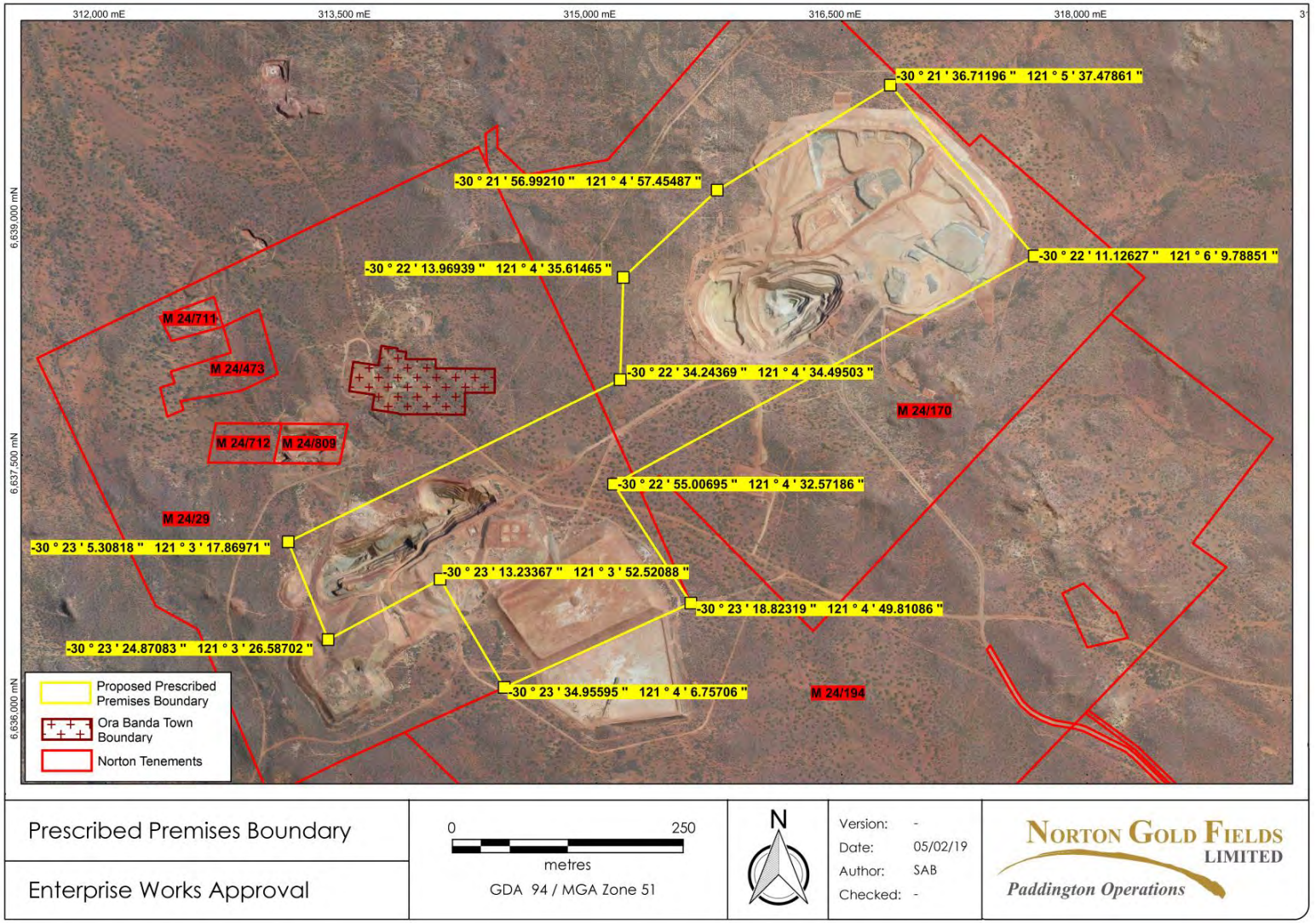

Figure 2 - Proposed Prescribed Premises Boundary

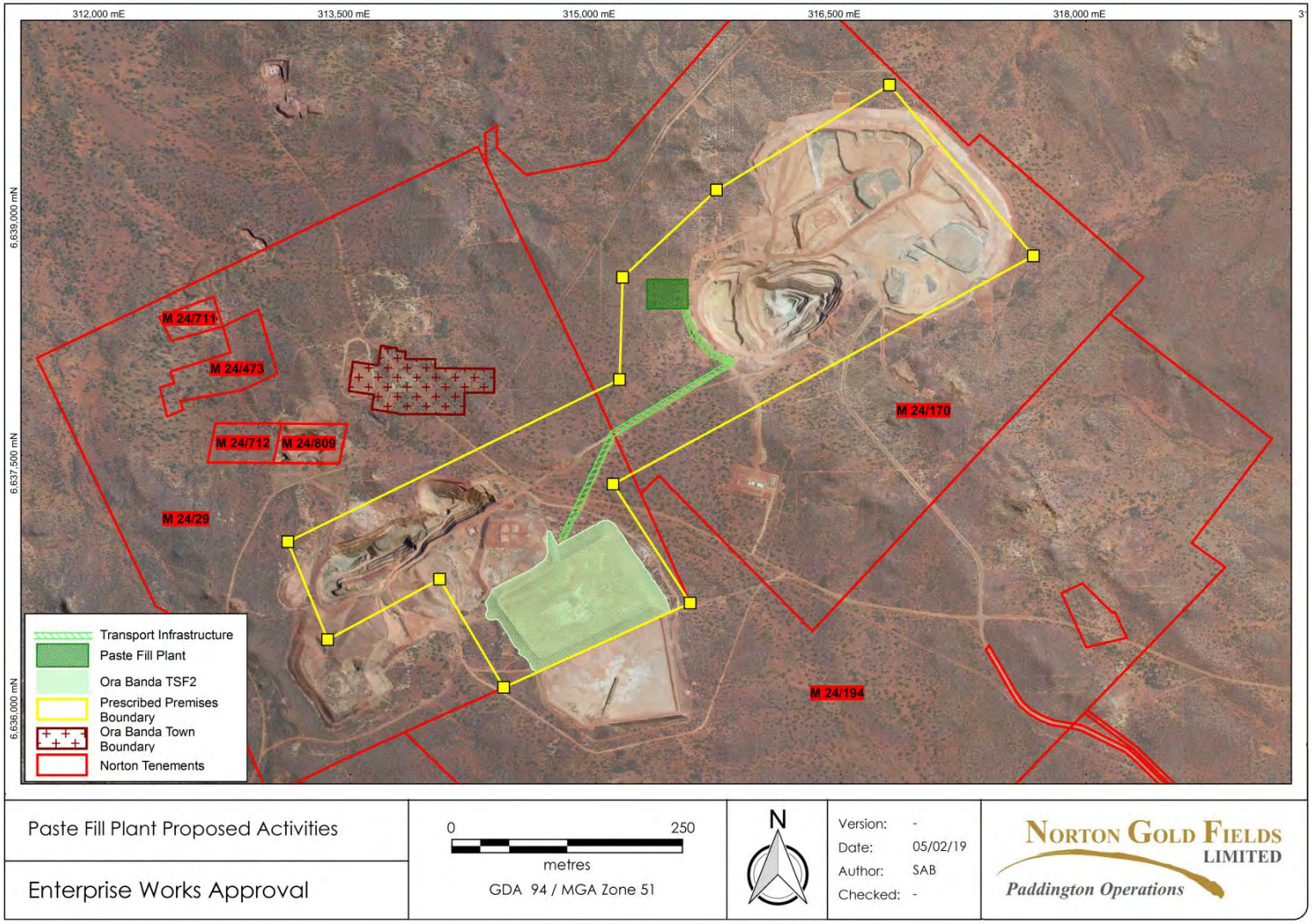

Figure 3 - Enterprise Underground Paste Plant Proposed Activities / Infrastructure

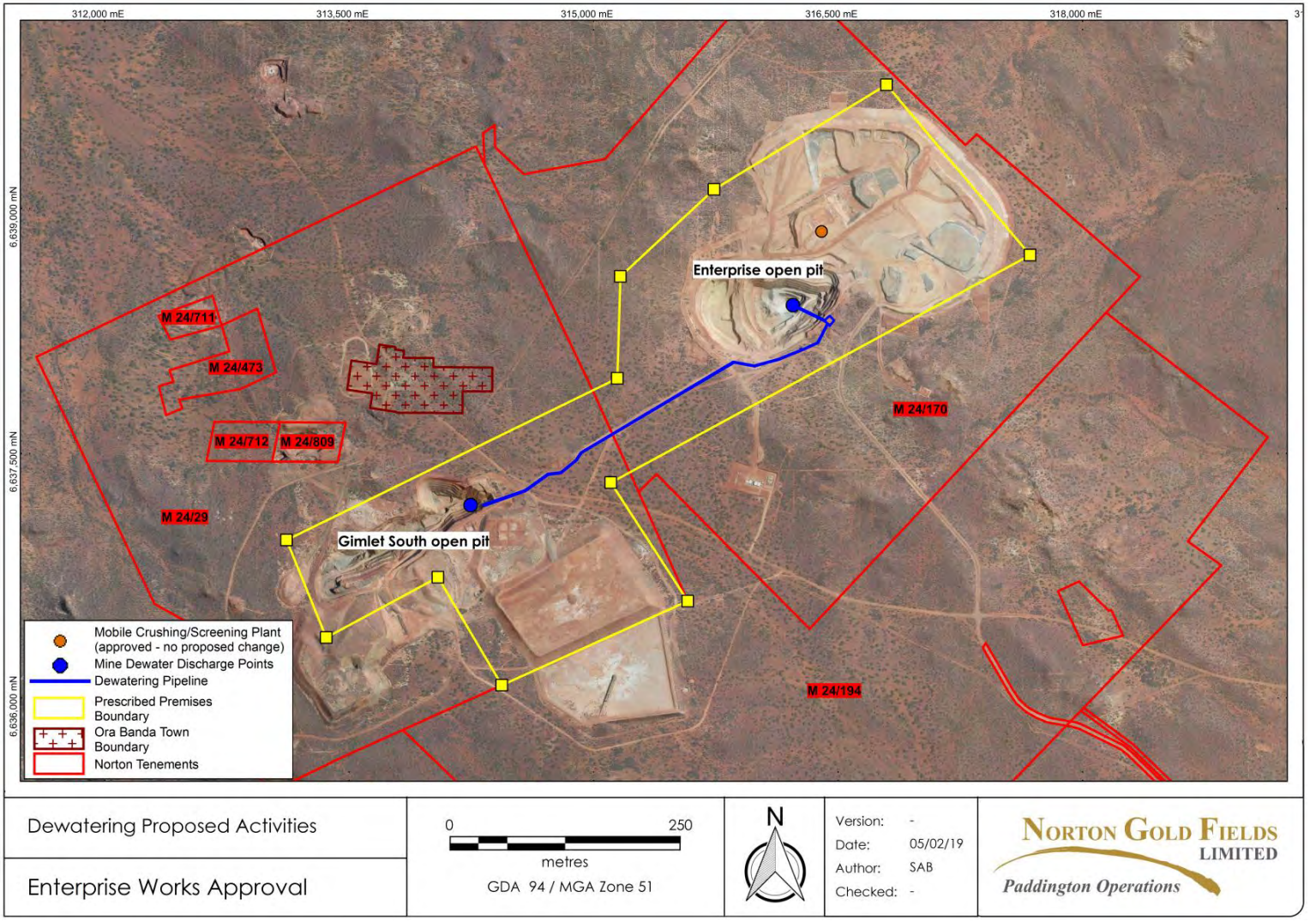

Figure 4 - Enterprise Underground Dewatering Proposed Activities / Infrastructure

2.0 PRESCRIBED PREMISES CATEGORY

Table 1 - Prescribed Premises Category Details

Activity	Category Number	Category Production or Design Capacity	Nominated Rate of Throughput	New/ Existing
Processing or beneficiation of metallic or non-metallic ore: premises on which – (b) tailings from metallic or non-metallic ore are reprocessed.	5	1,500,000 tonnes per annum	650,000 tonnes per annum	New
Mine Dewatering: premises on which water is extracted and discharged into the environment to allow mining of ore.	6	650,000 tonnes per annum	500,000 tonnes per annum	Existing with modifications

3.0 DESCRIPTION OF ACTIVITY

3.1 Existing Activities

Dewatering activities:

Norton currently operates the Enterprise Open Cut Mine Project as per the "Enterprise Stage 4 Mining Proposal – Version 3" (REG ID 68588) submitted to the Department of Mines, Industry Regulation and Safety (DMIRS) in September 2017. The below activities occur under approved DWER Environmental Operating Licence 8692/2012/1.

Norton has dewatered the Enterprise open pit as required into a HDPE lined 1,500 m^3 surface dam (turkey's nest) adjacent to the southeast crest of the pit. Water is pumped from a staging sump within the Enterprise pit, via a 200 mm diameter, 270 m long HDPE pipeline to the surface dam.

The option exists for excess water to be discharged via gravity, from the dam through a 2.4 km long, 200 mm diameter HDPE pipeline, into the Gimlet South open pit. However, water sourced from Gimlet South pit is currently pumped into the surface dam and supplements dust suppression and water requirements for the Enterprise operations.

When outside the Enterprise pit and Gimlet South pit crests the pipeline is within bunded pipeline corridors. This bunded pipeline corridor runs adjacent to the existing access road between Enterprise and Gimlet South.

A standpipe is located adjacent to the surface dam and used for dust suppression around the mine site and on existing haul roads in the area.

Groundwater Licence GWL160697(3) is retained for abstraction in the Ora Banda project area, expiring December 2022 and included in Appendix 1. Table 2 below details total abstraction volumes in relation to total abstraction allocation for GWL160697(3) in 2017 and 2018.

Table 2 - Total abstraction volumes in relation to total abstraction allocation for GWL160697(3)

Year (Jan – Dec)	Abstraction allocation GWL160697(3) - kL	Total abstraction - kL	Percentage of total allocation
2017	400, 000	153,480	38 %
2018	400, 000	147,649	37 %

Intermittent mobile crushing and screening:
There are no proposed changes to the mobile crushing and screening plant. Refer to the document "Enterprise Works Approval and Licence Application Dewatering and Mobile Crushing Application" dated September 2012 for details on existing infrastructure and DWER Operating Licence 8692/2012/1 for conditions.

3.2 Proposal Description

3.2.1 Enterprise Underground Dewatering – Discharge into Enterprise and Gimlet South open cut pits

The existing infrastructure described in Section 3.1 above for dewatering and discharge from Enterprise open cut pit into Gimlet South open cut pit will continue to be utilised.

Norton proposes to add two additional discharge points, including the paste plant water storage tanks and the Enterprise pit.

A discharge point will be located at the paste plant which will be comprised of a series of storage tanks. A 200-315 mm pipeline will be installed from the Enterprise turkeys nest to the paste plant tanks. The pipeline will be installed in a v-drain and a pump will be required to feed water to the paste plant as the head pressure is not sufficient based on gravity feeding.

An additional discharge point will be located in the base of the Enterprise pit to allow for dewatering during the underground mining operations (see Figure 4). Water will be pumped from the underground mine into the Enterprise pit for temporary storage, before being pumped via an existing pipeline to the Enterprise turkeys nest. Water from the turkeys nest is fed to a standpipe, and supplies the filling of water carts used for dust suppression within the project area. This configuration relies on a gravity feed and does not require a pump or power supply.

A schematic showing the underground water cycle is shown in Figure 5 below.

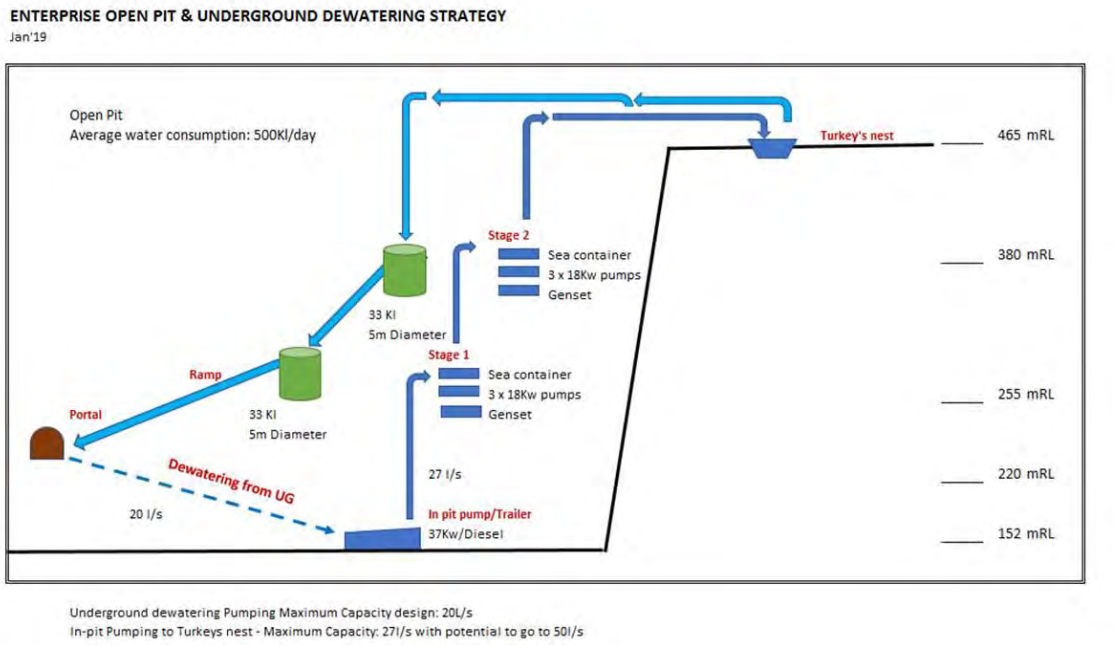

Figure 5 - Enterprise underground dewatering strategy

The current Enterprise pit floor is at 250 m RL, with the final pit floor to be located at 152.5 m RL. The portal will be located at the 220 m RL, leaving a catchment volume of 774 ML between the portal and the pit floor. This is sufficient volume to store the 1:100 ARI rainfall event with a 15 m freeboard. Current water level in the Enterprise pit is at 255 m RL, 199 m below the lowest point of the pit edge.

A hydrological assessment of the aquifer undertaken by RPS in 2011 indicated an approximate maximum yield of 12L/s. However observations since mining of the open pit have seen much lower yields than this eventuate.

An assessment of groundwater inflow risks for the Enterprise Underground mine was undertaken by AQ2 in 2019 to determine dewatering requirements. This updated assessment based on 6 years data from the Enterprise open pit determined future groundwater inflows will most likely be in the range of 1-2 L/s (AQ2 2019). The AQ2 report is attached in Appendix 2.

Given the small rates of groundwater inflow (between 1-2 L/s) the planned dewatering infrastructure capacity of 20 L/s from the Underground operations will be sufficient. Dewatering will continue from the Gimlet South open pit at a rate of approximately 15 L/s (peak rate of 50 L/s).

The Gimlet South pit and associated underground workings have a storage capacity of 10.5 GL and are approximately 2.5 km to the south-west and therefore it is unlikely that there will be any seepage back into the Enterprise open pit or underground mine.

Given the current storage capacity of the existing pits and anticipated dewatering requirements, it is expected that the storage capacity will be sufficient over the life of the project.

Standard dewatering pipeline used by Norton has been previously constructed of PE100 PN16 HDPE piping that meets:

- AS/NZS 2033:2008: Installation of polyethylene pipe systems;
- AS/NZS 4129:2008 Fittings for polyethylene (PE) pipes for pressure applications;
- AS/NZS 4130:2009 Polyethylene (PE) pipes for pressure applications; and
- *AS/NZS 4131:2010* Polyethylene (PE) compounds for pressure pipes and fittings.

The general principles mentioned below will be followed to ensure compliance to license conditions and to ensure Norton maintain a high standard of environmental practices during dewatering activities:

- Service and maintenance of pumps, breathers, isolation values and flow meters;
- Bund & sump maintenance and upgrades when required;
- 12 hourly pipeline inspections;
- Site training and induction of all personnel working in the area; and
- Dust suppression used on haul roads and as applicable access tracks.

Norton implements a Mine Dewatering Procedure (PGM-ENV-PRO-06-002) to ensure compliance with the above matters, available as Appendix 3.

3.2.2 Enterprise Paste Fill Plant

The proposed paste fill plant will be located at the western end of the existing Enterprise open pit directly over the underground workings (Figure 6). It will utilise a combination of fixed and mobile components for its future relocation to other operations. An indicative paste fill plant design is shown in Figure 7.

The preparation of the paste is facilitated through a dedicated weighing/batching system mixing harvested dry tailings with the addition of relatively small amount of Portland cement (3% to 7% in a dry weight blend) and mine dewater. To ensure mixing creates a homogenous paste material and the tailings combine thoroughly with the cement, a shaft batch mixer will move the materials in an uninterrupted spiral motion at a low speed.

The paste fill plant will be controlled by a PLC software & instrumentation system to determine accurately the specifications and moisture of the mix as well as to prevent plugged pipelines and excessive pressures on the line. Infrastructure required for the paste fill includes:

- The paste fill plant incorporates a screw conveyor cement silo, a mobile hopper and dry tailings feeder system, a paste batch mixer, water and compressed air storage tanks, QAQC lab, a sump and dry tailings stockpile/storage area;
- Operator support infrastructure (including a crib room, control room, ablution block, safety shower);

- Process water line from existing Enterprise surface dam and Gimlet South pipeline to paste plant;
- Connections to Western Power grid or generators (to be determined); and
- Paste delivery system to Enterprise Underground consisting of a bore hole from the surface containing steel conduit with HDPE 250 mm pipeline fed through.

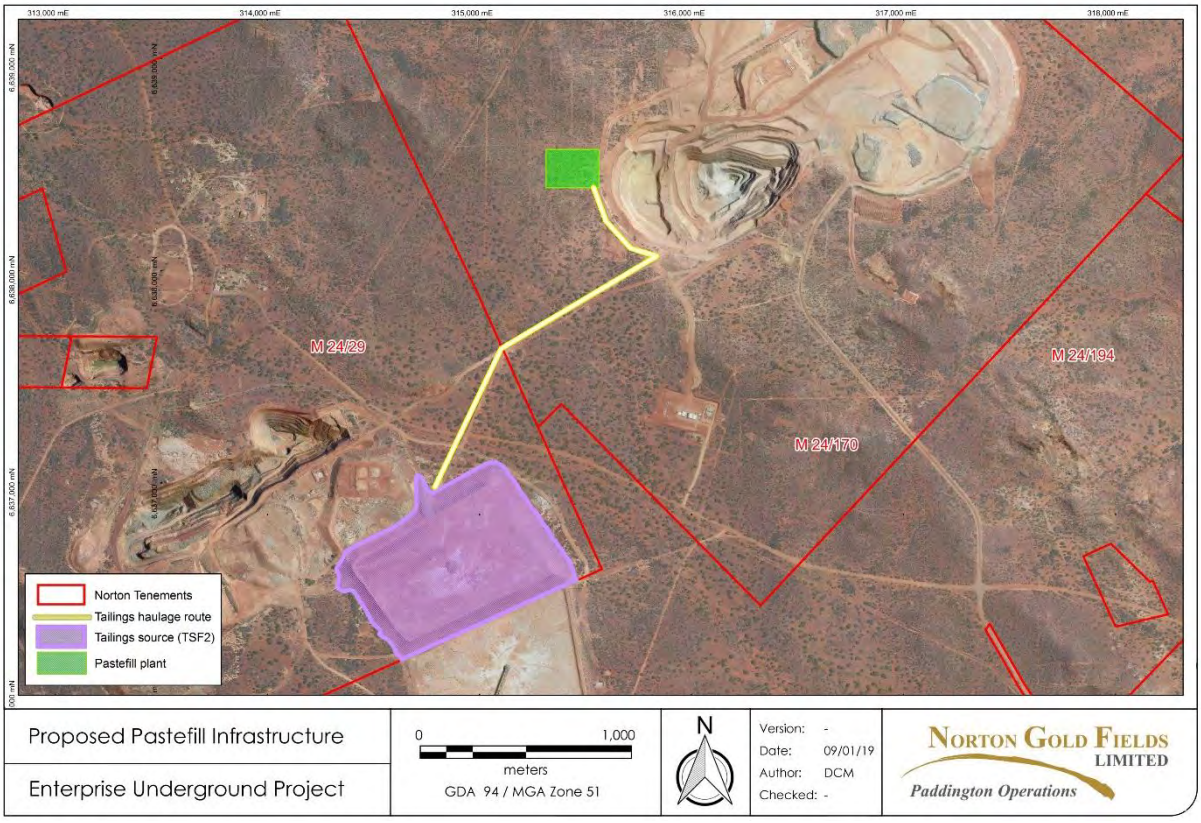

Figure 6 - Proposed Paste Fill Infrastructure

3.2.3 Tailings sourcing

Paste fill will be created through a mixture of dry tailings, water and cement. Dry tailings will be sourced from the Ora Banda TSF2. This TSF2 covers an area of 54 ha and was commissioned in 1988 and ceased operation in 1997. TSF2 was capped in 2006 and rehabilitated, but vegetation establishment has not been optimal.

Dry tailings were sampled for acid mine drainage test work (n = 4). Tailings showed a low total sulphur content of between 0.10 -0.90%. Acid neutralising capacity to theoretical acid production potential is an average of 791% (± 296%). Consequently it is not expected that the tailings are acid forming.

Dry tailings will be extracted by excavator and hauled by truck or road train to the paste fill plant where they will be stored in stockpiles in the tailings storage area close to the paste fill plant. During the transport of tailings, haulage will briefly cross the Broad Arrow – Ora Banda public road and otherwise use existing

Norton haulage roads. The City of Kalgoorlie-Boulder will be consulted about the road crossing prior to use.

Tailings will be stored in a tailings storage areas via stockpiles. Tailings will be fed into the paste plant hopper by a loader. Samples of the tailings show an average water content of 14.3 – 22.7%, meaning that dust is unlikely to be a significant issue. In the event that dust is an issue, dust will be supressed by water cart as required.

Water will be sourced from the Gimlet South pipeline, or from the Enterprise surface dam. Approximately 300 kL of water is required per day to prepare around 25,000 m^3/month of paste material. A water pipeline will be constructed from the surface dam to the paste fill plant.

Paste fill will be created by use of a batching system with an estimated production of 120-150 m^3/h while operating at full capacity. Paste will be gravity fed via borehole to backfill mined out stopes.

While paste fill will be the primary backfilling method, cemented rock fill may be used as the auxiliary backfilling method for some small and medium marginal stopes.

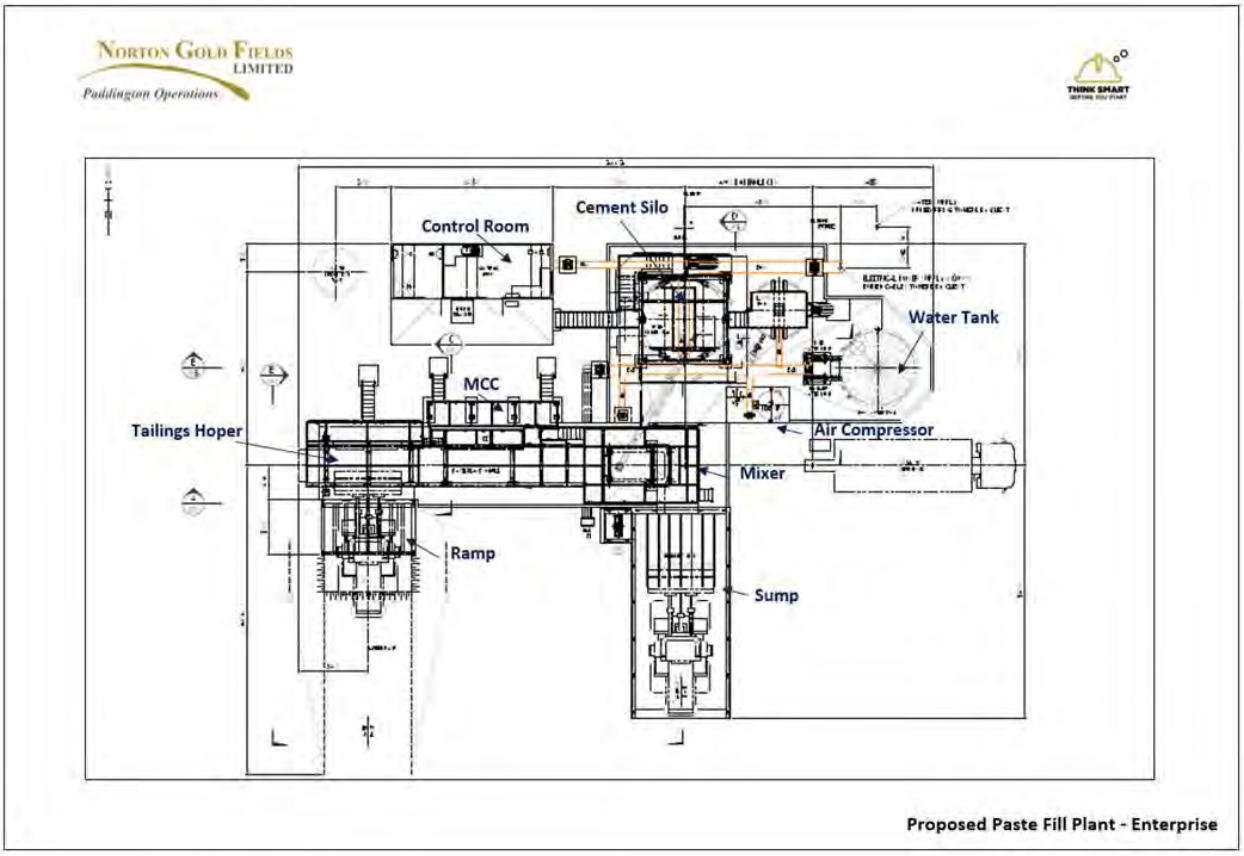

Figure 7 - Indicative paste fill plant design

Norton proposes to undertake a commissioning phase once the paste fill plant is constructed. Details of this proposal are outlined in Appendix 4.

Following commissioning, Norton intends to apply for an amendment to L8692/2012/1 to incorporate the paste fill plant and additional discharge point as described in Section 3.2.1 above.

3.2.4 Ora-Banda Road Crossing

Haulage will briefly cross the Broad Arrow – Ora Banda public road and otherwise use existing Norton haulage roads. The brief crossing of the public road will trigger controlled waste tracking requirements. Given that the road crossing is an unintentional consequence of traversing through continuous tenure, Norton considers that the transport of dry stack tailings should be exempt from controlled waste tracking requirements. Discussions with Danielle Eyre from DWER on 21 November 2018 indicated that Norton should be able to seek exemption under r49 of the Controlled Waste Regulations if the entire site is a prescribed premises. Closure outcomes are seen as favourable as the tailings are being removed from the surface and being placed back underground, reducing future environmental risks.

3.3 Premises Boundary

Figures 2 to 4 provide locations of the tenements, the proposed prescribed boundary and prescribed activity. The proposed prescribed boundary incorporates Ora Banda TSF2, access to which is required for operation of the paste fill plant. Norton intends to apply for an amendment to L8692/2012/1 to incorporate this change to the prescribed premises boundary and activities described in Section 3.2 above.

Figure 4 identifies the proposed discharge points into the various pits, and Figure 3 identifies the location of the paste fill plant and Ora Banda TSF2.

GPS co-ordinates (latitude, longitude) for the proposed prescribed premises boundary, starting from north eastern corner and moving clockwise are as follows:

Latitude	Longitude
-30 ° 21 ' 36.71196 "	121 ° 5 ' 37.47861 "
-30 ° 22 ' 11.12627 "	121 ° 6 ' 9.78851 "
-30 ° 22 ' 55.00695 "	121 ° 4 ' 32.57186 "
-30 ° 23 ' 18.82319 "	121 ° 4 ' 49.81086 "
-30 ° 23 ' 34.95595 "	121 ° 4 ' 6.75706 "
-30 ° 23 ' 13.23367 "	121 ° 3 ' 52.52088 "
-30 ° 23 ' 24.87083 "	121 ° 3 ' 26.58702 "
-30 ° 23 ' 5.30818 "	121 ° 3 ' 17.86971 "
-30 ° 22 ' 34.24369 "	121 ° 4 ' 34.49503 "
-30 ° 22 ' 13.96939 "	121 ° 4 ' 35.61465 "
-30 ° 21 ' 56.99210 "	121 ° 4 ' 57.45487 "

4.0 OTHER APPROVALS

4.1 Environmental Impact Assessment

This discharge of mine dewater and paste fill plant are considered a low risk and an Environmental Impact Assessment or referral to Office of Environmental Protection Authority is not required.

4.2 Other Decision Making Authorities

Norton Gold Fields has attained approval for ''Enterprise Underground Mining Proposal – Version 1'' (REG ID 78366) on 3 May 2019.

4.3 Other Legislation and Guidance Material

Norton Gold Fields will comply with the provisions in applicable Acts and Regulations which include the following, but may not be restricted to:

- Aboriginal Heritage Act 1972;
- Biodiversity Conservation Act 2016;
- Conservation and Land Management Act 1984;
- Environmental Protection Act 1986;
- Environmental Protection Regulations 1987;
- Environmental Protection (Noise) Regulations 1997;
- Environmental Protection (Clearing of Native Vegetation) Regulations 2004;
- Environmental Protection (Controlled Waste) Regulations 2001;
- Environmental Protection (Unauthorised Discharge) Regulations 2004;
- Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth);
- Explosives and Dangerous Goods Act 1961;
- Heritage of Western Australia Act 1990;
- Land Administration Act 1997;
- Land Drainage Act 1925;
- Local Government Act 1995;
- Local Government (Miscellaneous Provisions) Act 1960;
- Mining Act 1978 and Regulations 1981;
- Mines Safety and Inspection Act 1994, Mines Safety and Inspection Regulations 1995;
- Native Title Act 1973 (Commonwealth);
- Occupation Safety and Health Act 1984; and
- Rights in Water and Irrigation Act 1914.

5.0 DESCRIPTION OF THE ENVIRONMENT

5.1 Climate

Table 3 - Climate data for the Enterprise Underground project

	Average Temperature (°C)		9am Conditions			3pm Conditions		
	Min	Max	Temp	Humidity (%)	Wind Speed (km/hr)	Temp	Humidity (%)	Wind Speed (km/hr)
Jan	18	34	24	45	17	32	24	15
Feb	18	32	23	51	16	31	30	15
Mar	16	29	21	54	16	29	32	14
Apr	13	25	18	60	14	24	38	14
May	9	21	14	67	12	20	44	14
Jun	6	18	11	74	12	17	48	16
Jul	5	17	10	73	12	16	46	17
Aug	6	19	12	65	14	18	39	17
Sept	8	22	15	54	16	21	31	18
Oct	11	26	18	47	17	25	27	18
Nov	14	29	21	45	17	28	25	17
Dec	17	32	23	43	16	31	24	16
Annual	12	25	17	57	15	24	34	16

Sourced from BOM, 2018 weather station location #12038 Kalgoorlie-Boulder Airport

5.1.1 Temperature

Kalgoorlie-Boulder falls within the semi-arid region of WA, characterised by hot summers and mild winters. Mean annual maximum temperature is 25.2°C and mean annual minimum is 11.6°C. The coldest month is July and diurnal temperature variations are commonly high throughout the year.

5.1.2 Rainfall

The area is arid and the annual average rainfall at Kalgoorlie-Boulder is 268.4mm. Most of the rain falls between February and July, and this amount varies greatly both seasonally and annually.

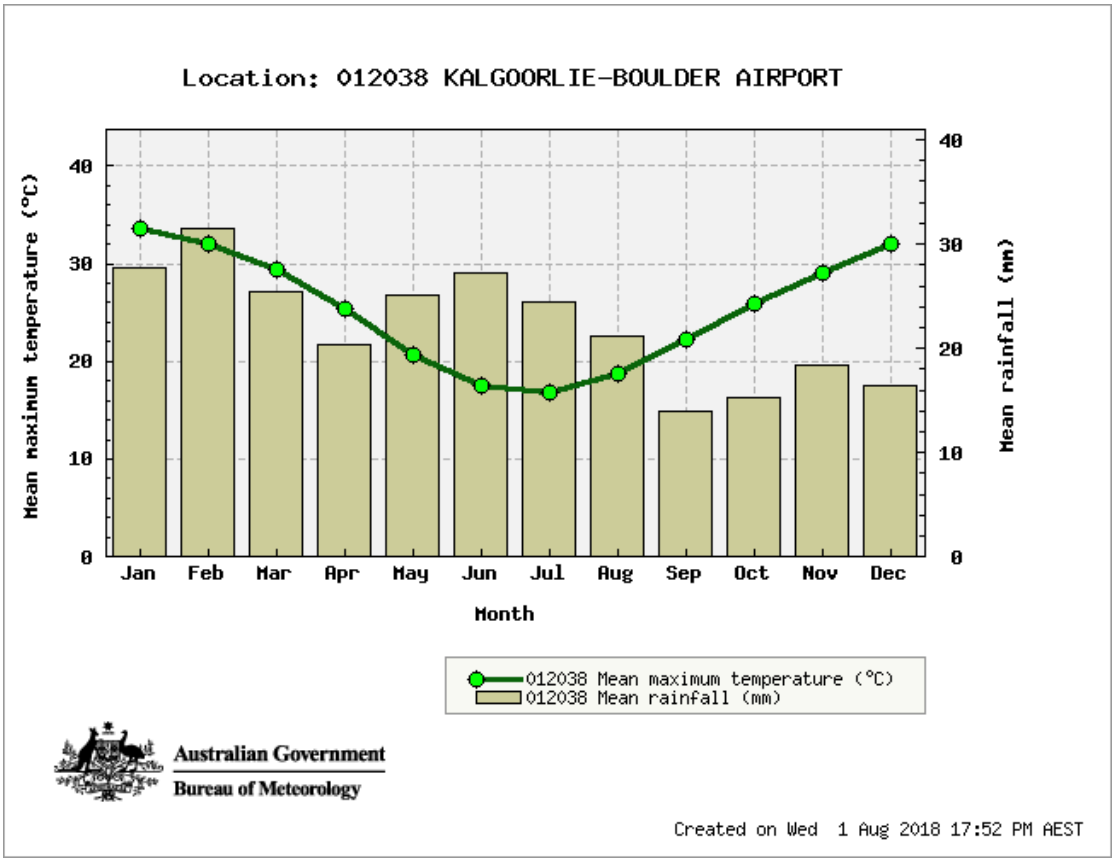

Figure 8 - Mean monthly maximum temperature and rainfall at weather station
Sourced from BoM, 2018

5.1.3 Winds

The average wind speeds at Kalgoorlie-Boulder vary throughout the year from 11.8 – 17.2 km/h in the morning to 13.7 – 17.8 km/h in the afternoon.

5.1.4 Evaporation

Annual potential evaporation is approximately ten times higher than rainfall, and evaporation greatly exceeds average rainfall during each month of the year. The annual evaporation rate is approximately 2,628 mm (BOM, 2018), compared to the annual rainfall of 267 mm. Figure 9 shows the average annual evaporation rate ranges throughout Australia.

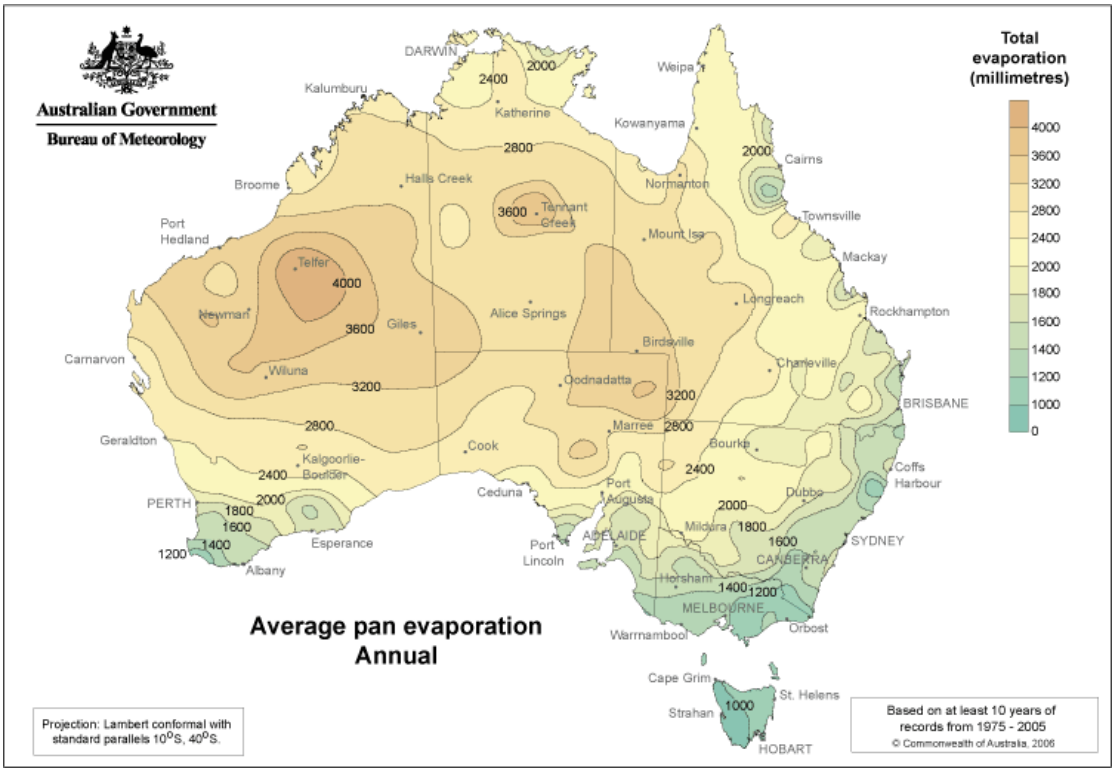

Figure 9 - Annual average evaporation

Sourced from BoM, 2018

5.2 Geology

5.2.1 Regional Geology

The Enterprise gold deposit is hosted within the Ora Banda district on the eastern limb of the Kurrawang Syncline. The Kurrawang Syncline is a major regional fold structure in the Norseman-Wiluna Greenstone Belt of the Eastern Goldfields Province.

The geology of the Ora Banda district is dominated by the Ora Banda mafic sequence, a moderately southwest dipping sequence of late Archaean age rock. Ultramafic rocks form the base with the Siberia Komatiite overlain by the Big Dick Basalt, Cashmans Sedimentary Horizon, Bent Tree and Victorious Basalts and the Black Flag Sediments.

The Enterprise Dolerite intrudes the Cashman's Sedimentary Horizon at the contact between the Big Dick Basalt and Bent Tree Basalt, and the Mount Pleasant Sill intrudes the sequence between the Cashman's Sedimentary Horizon and the Bent Tree Basalt. The Ora Banda sill intrudes the sequence at the base of the Black Flag Group. The Lone Hand Monzogranite intrudes the eastern end of the Ora Banda domain and several large porphyry dykes are associated with the emplacement of the granitoid. Quartz-feldspar porphyry dykes intrude the Enterprise Dolerite and Cashman's Sedimentary Horizon.

5.2.2 Local Geology

The gross geometry of the ore body is that of a 1.3km elongate zone that plunges approximately 30° towards a 260° strike, and dips steeply north to sub-vertical. Gold mineralisation is characterised by multiple fault orientations, with the major ore envelope controlled by the intersection of a series of steep 080° to 090° trending faults (Enterprise Fault Zone or EFZ) with the Cashman's Sedimentary Horizon and the Enterprise Dolerite.

The primary host rock for the deposit is the Enterprise Dolerite, a layered mafic sill that trends 120°/44° southwest. The layering and phase variations within the unit have been mapped in detail as part of a thesis entitled "The Geochemistry and Petrology of the Enterprise Dolerite, Ora Banda, WA" (M. Gregory 1998). Eight layers have been identified within the sill.

The ore body is constrained to the south by the South Enterprise Fault (SEF) and to the north by the North Enterprise Fault Zone (NEFZ); together these form the Enterprise Fault Zone. High grade gold zones are concentrated in steeply plunging linear zones that coincide with these brittle-ductile faults, and large areas of relatively lower grade mineralisation fill the gaps between the faults. The ore bearing structures are typically foliated in contrast to the breccia fabrics that dominate Gimlet South-style deposits. The brittle-ductile faults along with N-S, NE-SW and NW-SE striking shear zones were the conduits of fluid-flow during the gold mineralisation event that formed the Enterprise deposit.

5.3 Landforms

The project area lies in the Coolgardie bioregion within the Eastern Goldfields subregion, which lies on the Yilgarn Craton's 'Eastern Goldfields Terrains'. The relief is subdued and comprised of gently undulating plains interrupted in the west with low hills and ridges of Archaean greenstones and in the east by a horst of Proterozoic basic granulite.

The general underlying geology of the Coolgardie Bioregion is of gneisses and granites eroded into a flat plane covered with tertiary soils and with scattered exposures of bedrock. Calcareous earths are the dominant soil group and cover much of the plains and greenstone areas. A series of large playa lakes in the western half are the remnants of an ancient major drainage line.

5.4 Hydrology

5.4.1 Surface Hydrology

Surface water is scarce to non-existent throughout the area for most of the year. Drainage is internal, terminating in salt lakes and clay pans. Surface drainage is only significant immediately following rainfall. Local flooding may occur, especially following cyclonic thunderstorms.

During construction and operations, unconsolidated surfaces such as overburden storages, stockpiles, embankment faces and unsealed roads may contribute to sediment loads in the runoff water.

5.4.2 Groundwater Hydrology

5.4.2.1 Aquifers

In 2011 Aquaterra completed a desktop study of potential inflows into the Enterprise Mine. The report showed that aquifer potential of basement rocks in which the pit will be further developed is dependent on secondary permeability and porosity associated with rock fractures, shear zones and mineralisation. Groundwater inflows will occur as the pit intersects these structural features with the rate and cumulative volumes of inflows dependent on the degree of openness and interconnection of the fractures/shears. It is also expected that permeability will reduce with depth as overburden pressure increases. Given the heterogeneous and anisotropic nature of the basement rocks and structural features, precise inflows (spatially and temporally) are difficult to predict accurately and will vary over the mine site. Modelling and hydrological studies indicated maximum yields of 12L/s, however observations since mining of the open pit have seen much lower yields than this eventuate.

5.4.2.2 Groundwater flow direction

Groundwater flow is towards the major palaeodrainages and modern playa lakes where the water-table is at or near the surface. Groundwater discharge occurs mainly by evaporation from playa lakes, with comparatively small volumes discharged through palaeochannels. The groundwater level is encountered 78 m below ground surface. The regional groundwater flow direction is not well understood but is expected to be towards the southwest due to the water table being lower in the Gimlet South open pit. Aquifer recharge is from direct infiltration of rainfall and runoff and is therefore very low. Recharge is likely to occur as episodic events following discreet high rainfall events.

An assessment of groundwater inflow risks for the Enterprise Underground mine was undertaken by AQ2 in 2019 to determine dewatering requirements. This updated assessment based on 6 years data from the Enterprise open pit determined future groundwater inflows will most likely be in the range of 1-2 L/s (AQ2 2019). The AQ2 report is attached in Appendix 2.

5.4.2.3 Groundwater chemistry

Groundwater from the region is drawn from the Rebecca Paleochannel System. The groundwater salinity in the Tertiary sediments of the paleochannels in the Rebecca Palaeochannel increases steadily downstream from approximately 30,000 mg/L TDS in the upper parts of the Palaeodrainage systems to approximately 200,000 mg/L TDS in the lower reaches, near playa lakes.

The most recent groundwater quality analysis (pH, TDS and EC) in the Enterprise and Gimlet South open pits are outlined in Table 4. Water quality results indicate saline water quality and slightly alkaline to acidic groundwater within the project area. Comparatively low field pH measurements were recorded at Gimlet South pit in June (pH 5.7) and September (pH 5.7) 2017, although laboratory results from June 2017 sampling indicate slightly alkaline groundwater (pH 7.1) (Table 4). This data is derived from quarterly sampling and water quality analysis that was conducted in 2017/2018 in accordance with the monitoring schedule outlined in Norton's Groundwater Operating Strategy.

The major ionic composition of the groundwater is salts of sodium and chloride with minor levels of sulphate, magnesium and calcium present. Most other ions are by comparison in low total concentrations. Given the saline nature of the groundwater, it is considered to have uses suitable for the mining industry only.

Table 4 - Water Parameters of Ora Banda Pits

Name	Year	Variable		
		pH (pH Units)	Total Dissolved Solids (mg/L)	Electrical Conductivity (mS/cm)
Gimlet South	2017	7.1	26,000	34
	2018	7.2	25,000	33
Enterprise	2017	7.8	28,000	35
	2018	No access to water due to Stage 4 cutback		

5.5 Vegetation and Flora

The Enterprise project is situated within the Eastern Goldfields subregion, which is part of the Coolgardie bioregion (as delineated under the Interim Biogeographic Regionalisation for Australia (IBRA) system). The Eastern Goldfields sub-region is characterised as supporting diverse Eucalypt woodlands on low greenstone hills, valley floors, broad plains and salt lake surrounds; samphire shrublands on saline valley floors; and Mallees, Acacia thickets and shrub-heaths on sand plains, playas, laterite areas and granite outcrops.

Vegetation of the project area is also likely to be influenced by the East Murchison sub-region which lies less than 5km to the north-east. The East Murchison sub-region is characterised by elevated red desert sand plains, internal drainage and salt lake systems. Mulga woodlands (often with a rich ephemeral understorey), hummock grasslands, saltbush shrublands and samphire shrublands comprise the dominant vegetation units.

Refer to Appendix 5 for the 2016 Enterprise Flora and Vegetation survey conducted by Botanica Consulting.

5.6 Fauna

In 2009 GHD undertook a Flora and Fauna assessment of the Enterprise area, a copy of this survey can be found in Appendix 6.

Three broad habitats were identified in the survey area:

- Mixed woodland over mixed shrubs – provides a medium level of habitat value to fauna;
- Acacia dominated shrublands – provides a medium level of habitat value to fauna (although with lower species diversity than the mixed woodland); and

- Pits and cleared area – highly disturbed and devoid of vegetation, with little habitat value for fauna.

GHD reported that no fauna habitats were recorded within the study area that are considered to be significant. All habitats observed are widespread within the region.

A total of twenty nine bird species, five mammal species and three reptile species were recorded within the survey area. No significant species were recorded during the survey (excluding malleefowl).

Terrestrial Ecosystems conducted a Targeted Malleefowl Survey in the Enterprise project area in 2017 and 2018.

The November 2018 survey found 12 Malleefowl mounds in the Enterprise project area, none of which were active. One mound, which was recently active in February 2018 was no longer active. Activities associated with this proposal are not within 100 m of recently active mounds and therefore will not be impacted.

The 2018 Annual Malleefowl Report is attached as Appendix 7.

Norton maintains a Malleefowl Management Plan and Fauna Management Plan to ensure that all reasonable steps are taken to prevent harm to Malleefowl. These management plans are available on request.

5.7 Aboriginal heritage

The Aboriginal Heritage Inquiry System maintained by the Department of Indigenous Affairs does not contain any previously registered sites within the proposed prescribed premises (Aboriginal Heritage Inquiry System, April 2019).

An archaeological and ethnographic survey was undertaken in 2010 by Deep Woods Surveys, with and on behalf of the Widji Group. A heritage survey was also undertaken in 2012 by Central West, Central East Maduwongga and Guburn Aboriginal Groups. Both survey groups have verified that the Enterprise project will not be impacting on any Aboriginal Heritage Sites.

Consultation with the relevant Native Title Groups; Central West, Gubrun, Maduwongga and Widji is ongoing to ensure that mining operations do not disturb any significant sites.

5.8 European heritage

There are no State Heritage sites within the proposed prescribed premises as detailed in this works approval application.

5.9 Sensitive Receptors

The nearest residential community is the Ora Banda community, a small community with approximately 10 permanent residents. The Enterprise open cut mine is positioned approximately 2.5 km east of the historic Ora Banda Inn with

portions of the project being located within 2 km of the gazetted Ora Banda town site boundary (Figure 2). The paste fill plant will be located to the west of the existing Enterprise open pit and utilise dry stack tailings from the nearby Ora Banda TSF2 (Figure 3).

When active dust suppression is being utilised there could be some minor water runoff from back into the sump at the base of Enterprise. This sump will act as a retention basin and prevent emissions of suspended solids from site. There will be no other significant air, odour or light emissions from the paste fill plant or dewatering activities.

6.0 ASSESSMENT OF ENVIRONMENTAL RISKS FROM EMISSIONS

6.1 Risk Identification

From the risk identification process, the below potential emissions were identified associated with the dewatering discharge into Enterprise or Gimlet South open pits and the Enterprise paste fill plant. The likelihood of an event happening where the emissions affect the environment is detailed in Section 6.4 Risk Management.

6.2 Potential emissions:

- Saline water (spill into dewatering system, breach of pipeline or overtopping of any pit);
- Hydrocarbon spill (spill from water pump, failing storage tank or transfer from service truck to fuel tank);
- Noise (from engines, paste fill plant infrastructure or vehicle movements from inspections);
- Dust (from discharge points or vehicle movements from inspections);
- Tailings dust (from movement and storage of tailings for the paste fill plant);
- Diesel emissions (from generators to power paste plant if required); and
- Cement (paste fill plant).

6.3 Risk Assessment

To identify the risks associated with dewatering discharge into open pits and the paste fill plant, each component of the process flow chart was assessed to identify any risk that may occur within each component. Risks that were identified are summarised below.

Hypersaline water spill has the potential to occur and is considered a high risk without management measures and a moderate risk after management measures are put in place. The consequences would be a loss of vegetation and/or habitat from contaminating the soil and water.

Hydrocarbon contamination is possible but considered a low risk. The consequences would be water and soil contamination which would lead to vegetation deaths and habitat decline. Only a small amount of fuel will be stored within the day tanks of the dewatering pump, therefore any hydrocarbon contamination will not be sizeable.

Noise impacts are unlikely and not expected. The consequence of residential disturbance would not occur as there are no residents within the immediate vicinity. There is also risk of impact on local fauna populations. It is highlighted that neither of these are likely to be greater than noise impacts from mining operations (excavators, dump trucks, dozers, graders, service trucks, drill rigs and rock breakers).

Dust accumulation is possible and considered a low risk. Again, the impact from paste fill plant, discharge points and vehicle movements is not likely to be greater than the mining operations.

Wet paste discharge from tailings, cement and saline water into the environment is likely with a moderate consequence without controls. The consequences would be water and soil contamination which would lead to vegetation deaths and habitat decline. This risk will be reduced through appropriate use of a concrete sump located in the paste plant as well as maintenance and monitoring of correctly designed infrastructure.

6.4 Risk Management

Table 5 - Risk identification, Analysis and Management

Risk Identification				Risk Analysis			Risk Management	Residual Risk Analysis		
Issue	Event/Incident	Potential Impact	Causes	Consequence	Likelihood	Risk Ranking	Management/ Control Measures	Consequence	Likelihood	Risk Ranking
Hypersaline water	Release of hypersaline water into the environment	Soil, surface water contamination . Vegetation deaths	Pipeline failure Lack of appropriate containment facilities	3	B	High	12 hourly Pipeline inspections Pipeline maintenance Sufficient containment bunds	2	C	Moderate
Hypersaline water - Water holding capacity of the pit	Exceed the water holding capacity of the pit	Soil, surface water contamination . Vegetation deaths.	Lack of inspections Lack of water volume monitoring Large rainfall event	3	C	Moderate	Mine Dewatering procedure Monthly water volume monitoring Monthly surveying of water level in pits Installation of markers at 6m below crest level. Develop groundwater management plan should water levels get within 6m of the pit crest	3	D	Low - Moderate

Hydrocarbons	Release of hydrocarbons into the environment Release of hydrocarbons into dewatering network	Soil, surface water contamination Vegetation deaths	Lack of appropriate containment facilities Lack of fuel/oils storage and handling procedures Lack of adherence to existing fuel/oil storage and handling procedures	2	B	Moderate	Appropriately designed and maintained service truck Waste management plan Hydrocarbon management and spill procedure Collection of waste oil and grease Hydrocarbon Spill Kits Toolbox presentations to employees and information posters	1	C	Low
Noise – pumps & engines	Noise – impact on local fauna	Disturbance to habitats	Inappropriate positioning of pump	2	D	Low	If required place noise barrier around pumps & engines	2	E	Low
Dust	Dust accumulation on vegetation	Vegetation decline Nuisance	Heavy use of vehicles on track to check pipeline	2	C	Moderate	Use appropriate dust suppression techniques on the track Daily observations on dust within work area and additional measures implemented if required	2	D	Low
Tailings dust	Dust accumulation on vegetation Dust across public road or town site	Vegetation decline Nuisance Potential health effects	Movement of dry tailings from TSF to paste plant Lack of dust suppression	2	C	Moderate	Use appropriate dust suppression techniques on stockpiles Daily observations on dust within work area and additional measures implemented if required	2	D	Low

Wet paste from tailings, cement and saline water	Release of wet paste into the environment Release of wet paste into dewatering network	Soil, surface water contamination Vegetation deaths	Lack of appropriate containment facilities Blockage in system resulting in failure of pipe	2	B	Moderate	Appropriately designed and maintained paste fill plant infrastructure Monitoring of facility and training of staff Tailings management plan Toolbox presentations to employees	1	C	Low

Refer to Appendix 8 for Norton Gold Fields Risk Rating Matrix.

7.0 ENVIRONMENTAL PERFORMANCE OBJECTIVES, STANDARDS AND MEASUREMENT CRITERIA

7.1 Objectives and Standards

Table 6 - Environmental Performance Objectives and Standards

Environmental Performance Objectives	Standards	Measurement Criteria
Saline water emissions: ensure all saline water is contained within the pipeline bund, open pits and scour pits	- Environmental Protection Act Regulations 1986 - Mine Dewatering Procedure	- Pipeline inspection carried out on 12 hourly basis - Mine Dewatering Procedure - Pipeline logbook and inspection sheets - Isolation and breather valves - Monthly surveys of water level in pits - When water level approaches 6m from the surface of any pit implement development of groundwater management plan to ensure water levels remain less than 6m below surface at nearest natural vegetation
Dewatering: ensure groundwater abstraction is not exceeded	- Groundwater Abstraction Licence 160697(3) - Groundwater Operating Strategy - Water and Irrigation Regulations 1914 - Environmental Protection Act Regulations 1986 - Mine Dewatering Procedure	- Flow meters installed and measured monthly - Annual Groundwater Monitoring Summary
Hydrocarbon emissions: ensure hydrocarbons do not leak into the environment	- Hydrocarbon Spill and Bioremediation Procedure - Groundwater Operating Strategy	- Small quantities stored on active machinery - System in place to immediately deal with a hydrocarbon spill - Hydrocarbon spill kit located nearby - Annual water quality monitoring - Hydrocarbons not stored in fuel tanks will be bunded
Noise emissions: ensure noise is kept at a suitable level to avoid fauna disturbance and residential communities.	- Environmental Protection (Noise) Regulations 1997 - Biodiversity Conservation Act 2016	- Fauna observations in the area, in particular that travel patterns are not changing - Communication with Ora Banda Community - Adhere to Noise Management Plan
Dust accumulation: ensure dust is managed so it does not affect vegetation and the public.	- Dust Suppression Procedure - Environmental Protection Act Regulations 1986	- Follow Dust Suppression Procedure - Monitor dust in the area including active dust monitors within Ora Banda - Communication with Ora Banda community - Adhere to Dust Management Plan

Norton's Mine Dewatering Procedure and Dust Suppression Procedure are attached as Appendix 3 and Appendix 9, respectively.

8.0 IMPLEMENTATION STRATEGY

8.1 Commissioning

Norton proposes to undertake a commissioning phase once the paste fill plant is constructed. During this time Norton intends to apply for an amendment to existing L8692/2012/1 to include the paste fill plant, additional discharge point and update of premises boundary. Details of this proposal are outlined in Appendix 4.

The paste fill plant will be constructed by contractor staff once approvals are in place.

Estimated costs for the paste fill plant and associated infrastructure are shown below in Table 7.

Table 7 - Estimated Costs paste fill plant

Activity	Estimated Cost
Dry tailings stockpile and storage area setup	$175,000
Paste Plant earthworks	$175,000
Paste plant facility	$5,250,000
Paste fill delivery infrastructure	$525,000
HV power supply from main grid	$455,000
Water supply infrastructure (pipeline, pumps, tanks)	$655,000
Total	$7,235,000

8.2 Clearing

No additional clearing will be required to discharge mine dewater into Enterprise open pit.

The proposed paste fill plant and associated infrastructure will require 29.75 ha of clearing. This will include construction of a v-drain and access tracks for the pipeline from the existing Enterprise surface dam to the paste fill plant, as well as laydown area, powerline corridor and reload facility. All additional disturbance will be located on tenement M24/170.

Clearing will be managed in accordance with permit CPS 3560/5.

8.3 Monitoring

- Monitoring of the pipeline occurs every twelve hours following current practices;
- The pipeline flow meter will be monitored on a monthly basis;
- Monthly water level survey of Ora Banda pits;
- The water quality will be monitored annually and will include pH, EC, TDS and heavy metals analysis;
- Noise will be monitored on as required basis – given it is a work area triggered by OHS standards; and

- Dust observations will be carried out regularly.

8.4 Rehabilitation

The pipeline and paste fill plant will be rehabilitated and revegetated with local species once they are no longer required in accordance with DMIRS requirements.

Rehabilitation is guided by the following principles:

- Ensure that vegetation clearing is kept to a minimum;
- Collect and correctly stockpile vegetative material and available topsoil for later use at selected sites;
- Strip topsoil for immediate re-use on prepared surfaces where possible;
- Progressively rehabilitate completed areas as soon as practicable;
- Only use local native plant species for seeding; and
- Undertake decommissioning and closure of the site to industry leading practice principles and to statutory requirements.

To assist with ongoing review of the rehabilitation and environmental management within the Ora Banda project area, Norton submit an Annual Environmental Report (AER) to DMIRS in March each year.

8.5 Contingencies

8.5.1 *Hypersaline spill*

In an event of a hypersaline spill, bunding will assist to contain the spill and the isolation valves will be turned on by the person inspecting the pipeline. Repairs will be carried out on the pipeline and any bunding that may have been damaged will be reconstructed to standard by the service crew. Earthmoving equipment will be used by the service crew to remove contaminated soil. Soil sampling will be carried out by the Environment Department to assess the extent of the contamination. Reports provided in accordance with Section 72 of the *Environmental Protection Act 1986*. Rehabilitation of the affected area will be carried out by Environmental Department if required.

8.5.2 *Hydrocarbon Spill*

In an event of a hydrocarbon spill the source will be stopped immediately and the spill will be contained with additional bunding from the spill kit that will be in the vicinity. All personnel are responsible for containing a spill. Any contaminated soil will be removed and disposed of appropriately by the service crew. Soil and water sampling will be carried out by the Environment Department to assess the extent of the contamination. Reports provided in accordance with Section 72 of the *Environmental Protection Act 1986*. Rehabilitation of the affected area will be carried out by Environmental Department if required.

8.5.3 Dewatering

To ensure the pit volume is not exceeded, monthly water volumes deposited in to the Ora Banda pits will be collected by the pipeline service crew. In addition, surveyors will measure the water levels in the Ora Banda pits on a monthly basis to ensure the water holding capacity is not exceeded. The Environment Department will check this data on a monthly basis and examine any inconsistencies or unusual readings.

If dewatering volumes exceed the allowed amount, relevant authorities will be notified by the Environmental Department and pumping volumes will be reduced to prevent exceedance of the allowed limit.

8.6 Records

The records that are maintained at Norton to ensure systems, practices and procedures are in place are listed below:

- Groundwater well licence reports;
- Groundwater Operating Procedure;
- Pipeline inspection log book;
- Flow meter log book;
- Groundwater monitoring database;
- Environmental Incident report form;
- Environmental Incident log book; and
- Shift logs.

8.7 Management Responsibilities

Management responsibilities are detailed below to ensure the Environmental Management System (EMS) is established, implemented and maintained throughout the operation. These are in line with Norton Gold Fields Environment and Community Policy, attached as Appendix 10.

8.7.1 Chief Executive Officer

- Provides resources to implement maintain and improve the EMS; and
- Appoints and supports the Environment, Community and Security Superintendent who is responsible for the EMS.

8.7.2 Underground Manager and Superintendent

- Ensures that sufficient personnel and resources have been engaged to implement the plans and procedures within the EMS as applicable to the Enterprise Underground project.

8.7.3 Environment, Community and Security Superintendent

- Ensures that the EMS is established, implemented, reviewed and maintained throughout the year in accordance with progress and changes that occur; and
- Reports to Supervisor on the performance of the system.

8.7.4 Operator

- Carries out relevant requirements of the EMS such as the plans and procedures to aim for a minimal incident operation;
- Reports all environmental incidents and opportunities for improvement on the current practices; and
- Report and record all carried out inspections.

8.8 Competence, Training and Awareness

- All of the workforce, both Norton staff and contractors, are given a wide ranging safety, occupational health and environmental management induction on arrival at the site;
- Pipeline inspectors are trained on the Mine Dewatering Procedure (attached as Appendix 3) to ensure inspectors have a full understanding of their responsibilities;
- Water cart operators are trained on the Dust Suppression Procedure (attached as Appendix 9) to ensure minimum impact on the vegetation; and
- Continuous staff training will involve environmental input at "tool-box" meetings and specific environmental courses as required.

8.9 Communication

Daily meeting with Department Managers are held to ensure communications are effectively passed through the system. In addition all policies and procedures are available to all personnel through the Environmental Department. Weekly meetings are conducted with the Technical Services Department to discuss any matter that may need addressing.

9.0 CONSULTATION

Table 8 - Consultation Register

Organisation/ Individual	Contact Person	Initial Contact	Topic Discussed	Outcome
Department of Water and Environment Regulation	Danielle Eyre	21/11/2018	Discussion with DEWR about approval requirements for Enterprise underground in particular paste fill plant. Should be able to seek exemption under R49 of the Controlled Waste if the site is a prescribed premises. Closure outcomes are seen as preferential with the tailings material fixated and placed back underground	Whilst likely to be a preferential method for final tailings disposal some materials characterisation needed to occur to verify NAF (or that cement product would make it NAF)

10.0 COMMITMENTS

Norton's Paddington Operations has made a number of specific commitments within this works approval. See page numbers to reference back to relevant page/s:

Table 9 - Summary of Commitments

Issue	Commitment	Page Number
Water Monitoring	- Monthly water volumes will be undertaken during dewatering - Annual water quality will be undertaken during dewatering	29 - 30
Hypersaline Spill Control	- 12 hour pipeline monitoring will occur while dewatering - V-drain and pipeline bunding is maintained - Monthly water level monitoring within Ora Banda open pits - Report all incidents internally and externally as required by Section 72 of EP Act	29
Rehabilitation	- The pipeline and paste fill plant infrastructure will be rehabilitated and revegetated with local species once the pipeline is no longer required in accordance with DMIRS requirements	31
Hydrocarbons	- Hydrocarbons not within fuel tanks for engines will be stored in bunded areas - Hydrocarbons and hydrocarbon contaminated material will be collected and sent offsite for treatment and disposal - Spill kits will be available near each machine	27 - 29
Dust (including dust from dry tailings)	- Dust generating activities will be monitored to ensure that vegetation and workers are not impacted - Dust generating equipment will be assessed and a range of measures implemented including water carts, restricting access, increased wind breaks, change to nozzle parameters - Any action being implemented will be reviewed to ensure that it is (a) effective and (b) not having other adverse impacts	27 - 29
Noise	- Operations will adhere to *Environmental Protection (Noise) Regulations 1997*	27, 29

These commitments will ensure the project is managed in an environmentally sound manner, consistent with the statutory requirements, the company's objectives and conditions imposed by DWER.

Appendix 1

Groundwater Well Licence: GWL160697(3)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Paddington Gold Pty Ltd		
Description of Water Resource	Goldfields Palaeochannel - Fractured Rock	**Annual Water Entitlement**	400000 kL
Location of Water Source	M24/170, M24/29, M24/809, M24/473, M24/711, M24/712 & M24/194 - Ora Banda		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Dewatering for mining purposes Dust Suppression for mining purposes	M24/170, M24/29, M24/809, M24/473, M24/711, M24/712 & M24/194 - Ora Banda
Duration of Licence	From 18 December 2012 to 18 December 2022	

This Licence is subject to the following terms, conditions and restrictions:

1 The licensee must install a cumulative water meter of a type approved under the Rights in Water and Irrigation (Approved Meters) Order 2009 to each water draw point under this licence.

2 The meter(s) must be installed in accordance with the provisions of the document entitled "Guidelines for Water Meter Installation 2009" by no later than sixty days after the issue of date of this licence.

3 The licensee must ensure the installed meter(s) accuracy is maintained to within plus or minus 5% of the volume metered, in field conditions.

4 The annual water year for water taken under this licence is defined as 12:00 pm at 31 December to 12:00 pm at 31 December twelve months later.

5 The licensee must not, in any water year, take more water than the annual water entitlement specified in this licence.

6 The licensee must take and record the reading from each meter required under this licence at the beginning and another at the end of the water year defined on this licence.

7 The licensee shall comply with the commitments or requirements of the operating strategy, as prepared by the licensee and approved by the Department of Water on 18 December 2012 including any modifications to the strategy as approved during the term of the licence.

8 Every year the licensee must submit a groundwater monitoring summary prepared by a groundwater professional in accordance with Operational policy 5.12 - `Hydrogeological reporting associated with a groundwater well licence.' The report is due 31 March each year. The groundwater monitoring summary is to contain a summary of all monthly data and analysis of impacts from abstraction.

9 The licensee shall provide a Groundwater Monitoring Review to the Department of Water by 31 March 2013, and every third year thereafter. A Groundwater Monitoring Summary need not be submitted in a year in which a Groundwater Monitoring Review is due.

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

This Licence is subject to the following terms, conditions and restrictions:

10 Should the monitoring at any time indicate a need for prompt action to prevent or reduce the effect of the licensee's draw on the underground resource, the licensee shall immediately report this to the Department of Water and advise the corrective measures proposed.

End of terms, conditions and restrictions

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Paddington Gold Pty Ltd		
Description of Water Resource	Goldfields Palaeochannel - Fractured Rock	**Annual Water Entitlement**	400000 kL
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4 The annual water year for water taken under this licence is defined as 12:00 pm at 31 December to 12:00 pm at 31 December twelve months later.

5 The licensee must not, in any water year, take more water than the annual water entitlement specified in this licence.

6 The licensee must take and record the reading from each meter required under this licence at the beginning and another at the end of the water year defined on this licence.

7 The licensee shall comply with the commitments or requirements of the operating strategy, as prepared by the licensee and approved by the Department of Water on 18 December 2012 including any modifications to the strategy as approved during the term of the licence.

8 Every year the licensee must submit a groundwater monitoring summary prepared by a groundwater professional in accordance with Operational policy 5.12 - `Hydrogeological reporting associated with a groundwater well licence.' The report is due 31 March each year. The groundwater monitoring summary is to contain a summary of all monthly data and analysis of impacts from abstraction.

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End of terms, conditions and restrictions

Appendix 2

2019 Memorandum: Assessment of Inflow Risks Enterprise Underground Mine, AQ2

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AQ2 Pty Ltd
ABN 38 164 858 075

Memo

To	Dylan Martini and Wayne Astill	Company	Norton Gold Fields – Paddington Operations
From	Jon Hall	Job No.	234-B1
Date	23 January 2019	Doc No.	003a
Subject	Assessment of Inflows Risks – Enterprise Underground Mine		

Hi Dylan/Wayne,

We have completed our assessment of the likely groundwater inflows to the proposed Enterprise underground mine. It should be noted that there was only limited available data (covering the full 37-year history of mining and dewatering at Enterprise) and only indicative mine plans/schedules and our assessment should be considered a high-level risk assessment, rather than a precise prediction of mine inflows.

Notwithstanding the data limitations, there is sufficient information to confirm that the groundwater inflow risks are low and that inflows will most likely be in the order of 1 to 2 L/s (average), possibly as high as around 10L/s under extreme conditions. Such inflows could be managed with a simple in-mine dewatering system comprising staged single mono-pump stations.

1. MINING, DEWATERING AND INVESTIGATION HISTORY

From information provided to us, the following investigation and dewatering history was derived:

- Pre-mining water table was around 60m below ground (around 400mRL).
- Enterprise pit was first mined from 1985 to 1993 (by BHP Gold/Newcrest), with minor dewatering achieved by sump pumping.
- Advanced dewatering using two bores was initiated ahead of planned mining in 1995. It is reported that pumping at 300 to 400KL/d was sufficient to maintain a dry pit, but it is not clear whether the pit was actually mined or for how long.
- One bore and a pit sump were later used (by Centaur) to provide process water to Ora Banda and Mt Pleasant. Average pumping in 1999-2000 was 30KL/d, with some peak monthly flows as high as 130KL/d.
- A dewatering assessment (by Aquaterra in 1999) based on available data at the time, indicated potential inflows to an underground mine of around 400 to 600KL/d.
- A later assessment (by RPS Aquaterra in 2011 for Norton Gold Fields) based on similar data indicated potential inflows to an expanded pit ranging from 700 to 1,200KL/d.
- The pit water level had recovered to 376mRL in 2008 (recorded by Norton Gold Fields) and continued to recover slowly to 377.3m in 2013 ahead of renewed mining.
- Norton Gold Fields commenced pit expansion mining in 2013. The pit has been developed to a base at 220mRL and is planned to be mined down to 150mRL. Average pumping rates required to maintain a dewatered pit are reported to have been:

- 2014 and 2015 – 207KL/d and 210KL/d, although site personnel believe that the flow meter data are suspect and that these numbers are incorrect (too high).
- 2016 and 2017 (to June) – 70KL/d
- Post June 2017 – the pit sumps were not pumped (mining was a cutback at a higher level and the lower pit was allows to slowly fill with water (to 255mRL).

2. CURRENT INVESTIGATION

2.1 Background

Norton Gold Fields plan to develop an underground mine to further develop ore to the west of the planned final pit, once open pit mining has been completed. From screen shots of the preliminary mine plan, it would appear that the underground mine will extend around 100 to 200m along strike from around 200mRL down to 70mRL (and possibly deeper). Access will be via a portal from the pit at 220mRL.

AQ2 were commissioned to undertake an assessment of the likely ground inflows and inflow risks. Three specific potential risks identified in discussion with Norton Gold Fields are:

1. General groundwater inflow from surrounding aquifers.
2. Flow from the Gimlet South pit and underground (which may be used to store water) along geological structures.
3. Flow from any water ponded in the base of the Enterprise pit (below the portal).

2.2 Approach to Assessment

The following approaches were adopted to assess the above inflow risks:

- Risk 1 (General Inflows) - A simple analytical groundwater flow model (using the same model equations as were used in the earlier Aquaterra and RPS Aquaterra assessments) was used to assess the potential bulk average groundwater inflows from the surrounding aquifers.
- Risk 2 (Flows from Gimlet South) – A simple Darcy model was used to assess potential inflows along a specific structure connecting Gimlet South and Enterprise Short *(assuming such connection exists).
- Risk 3 (Flooding from Enterprise pit base) – this is an obvious risk and no quantitative assessment of potential inflows has been undertaken. Rather, we recommend that water is not allowed to pond at the pit base.

2.3 Risk 1 – General Inflows

2.3.1 Model Set-up and Calibration

The model used is a two-dimensional analytical model based on the Theim and Dupuit-Forchheimer equations for flow to a large diameter well. The pit (and underground) is represented by an "equivalent well" with a radius that best approximates the dimensions of the mine (below water table), and the model predicts the flow rates to the "equivalent well" when water levels are maintained at/below the base of the mine. Like all models, this approach makes a number of simplifying assumptions (principally that the aquifer system is homogeneous and isotropic) and model predictions cannot be considered to be precise. However, this approach does allow for the broad estimation of pit inflows based on limited data and has historically proven to be very close to observed inflows. The approach is considered to be appropriate for this assessment.

The model was initially used to simulate inflows to the current pit shape and reported dewatering conditions. Due to uncertainties about some of the mining and dewatering history, the model was set up to simulate inflows (in recent years) to a pit that has been open (and experiencing inflows or dewatering of some sort) since 1985. This approach is considered valid given the very low observed dewatering pumping rates and could also be considered a pseudo-steady state approach (due to the long time-frame).

Based on advice from Norton Gold Fields personnel that reported dewatering data for 2014-15 was suspect, the base case model was calibrated to data from 2016-17. The calibration indicates a bulk aquifer permeability of 3 x 10^{-4}m/d. This is very low, but not unexpected given the very low reported pumping rates (around 70KL/d) to keep the pit dry.

When using the reported 2014-15 data, the calibration indicates a permeability of 1.3 x10^{-3}m/d. It is noted that the 2011 RPS Aquaterra assessment derived a permeability of 1.5 x 10^{-2}m/d but this was based on limited data from the test pumping of dewatering bores and early dewatering of a much smaller pit in 1995-96. The more recent Norton Gold Fields dewatering data are considered to provide much better indication of future general inflows.

2.3.2 Model Predictions

The model was then modified to include the planned underground mine (assuming the pit was also maintained dry) and run to simulate groundwater inflows to the full underground mine workings (with a base at 70mRL).

The base case model run uses the calibrated aquifer parameters and are considered the most reliable based on available calibration data. Uncertainty cases were also run to assess the potential impacts of:

- Higher dewatering rates than adopted (i.e. using 204-15 data); and
- Higher aquifer permeability (than indicated during calibration).

The results are listed in Table 1 below

Table 1: Predicted Inflows from General Aquifer.

Run	Description	Bulk Aquifer Permeability (m/d)	Predicted Inflow (L/s)
Base Case	Based on calibration to 2016-17 data	3 x 10^{-4}	<1
UC1	Based on calibration to 2014-15 data	1.2 x 10^{-3}	1
UC2	Permeability 10 x UC1	1.2 x 10^{-2}	7
UC3	Permeability as per RPS Aquaterra, 2011	1.5 x 10^{-2}	9

Given that there are model calibration data (at least for 2014-17) and even allowing for some doubt as to the 2014-15 data, the model indicates that general inflows from the surrounding aquifer will most likely be around 1L/s or less. At worst, assuming the underground mine intersects ground with a bulk aquifer permeability one order of magnitude higher than the calibrated permeability, the model indicates inflows of less than 10L/s.

2.4 Risk 2 – Flows from Gimlet South

A simple Darcy model was set up to predict flows from the easternmost part of the Gimlet South underground mine workings to the Enterprise underground mine assuming:

- There is a connecting structure that has a permeability higher than the bulk permeabilities adopted in Section 2.3 (general aquifer inflow modelling). The base case adopts 0.3m/d (which is two orders of magnitude higher than the calibrated bulk permeability)
- Various effective widths of the connecting structure (width of hydraulic conduit). The base case and most uncertainty cases adopt 1m.
- Various pit water levels in Gimlet South – which will be used to store water. The base case adopts 300mRL. Some uncertainty cases adopt 400mRL.

There are no available calibration data, other than the pumping data used in the general aquifer inflow modelling which, in any case, do not suggest that such a connection exists. As such, predictions using his model should be considered "what if" scenarios.

The results are listed in table 2 below.

Table 2: Predicted Inflows from Gimlet South along Connecting Structure

Run	Permeability of Structure (m/d)	Width of Structure (m)	Gimley South Pit Water Level (mRL)	Predicted Inflow (L/s)
Base Case	0.3	1	300	<1
UC1	3	1	300	2
UC2	0.3	1	300	<1
UC3	3	1	400	3
UC4	0.3	10	400	3

Even the highest predicted inflows (for extreme conditions) are low, at around 3L/s. This is an easily managed risk any such inflows could be accommodated by the in-mine dewatering system.

2.5 Flow from Enterprise Pit Base

This is difficult to quantify. Under "normal" conditions, any such flows would be controlled by the water level in the pit base and the bulk permeability of the aquifer between the pit and the underground. However, what cannot be quantified (now) and what presents the key risk, is the potential for enhanced hydraulic connection to the pit base as a result of:

- Ground deformation and unravelling of structures around the pit and underground.
- Accidental breakthrough by drilling or mining.

Either could result in a burst inflow (safety risk) and subsequent inundation of part of the underground mine (production risk). Given that, if breakthrough does occur (or even if inflows are only steady), this water will need to be pumped from the underground.

We strongly recommend that the pit base is maintained dry, or at least pit water levels are maintained as low as possible. This will require sump pumping system to be maintained. Given that groundwater inflows to the pit (predicted and observed) are so low, the sump pumping system should be sized to accommodate storm runoff.

We trust this brief report is enough for your immediate needs. If you have any question, please do not hesitate to contact us.

Regards

Jon

Consulting Hydrogeologist

Author: JWH (23/01/19)
Reviewed: DGS (23/01/19)

Appendix 3

Norton Gold Fields Mine Dewatering Procedure

NORTON GOLD FIELDS LIMITED

Paddington Operations

MINE DEWATERING PROCEDURE

Document No: PGM-ENV-PRO-06-002

Revision:	A	B		
Prepared by:	Anna Dyer Environmental Advisor	Tari Pawlyk Environmental Advisor		
Reviewed by:	Wayne Astill Environmental Superintendent	Wayne Astill ECS Superintendent		
Approved by:	Brian Sowden Manager HSE	Albert Schaus Acting General Manager - Operations		

SUMMARY OF DOCUMENT REVISIONS			
Rev. No.	Date Revised	Section Revised	Revision Description
A	18/10/2012		Initial Document
B	24/04/2017	All	Revision and update

1. PURPOSE

The purpose of this procedure is to provide guidance to Norton Gold Fields (NGF) employees and contractors on the process of mine dewatering out of open cut and underground mines with discharge primarily into inactive open cut voids, or via other means into the environment.

2. SCOPE

This procedure applies to all sites within the NGF Operations.

3. DEFINITIONS AND ACRONYMS

Definitions

- Mine dewatering is the extraction of water from an underground or open cut mine and discharge of it into another open cut void or into the environment via other means, such as into a salt lake other water body.
- Monthly measurements are to be taken more than 15 days apart across two separate months, but not more than 45 days apart, as per operating license conditions.

Acronyms

- DER – Department of Environment Regulation
- DoW – Department of Water
- GWL – Groundwater Well License

4. ROLES AND RESPONSIBILITIES

General Manager

- Responsible for ensuring sufficient resources are available to implement this Procedure.

Environmental Superintendent

- Responsible for an annual discussion/biennial review of this Procedure with Area Superintendents and other responsible departments; and
- Responsible for maintaining records of open cut and underground mine dewatering volumes, pit water levels and pit water parameters, as required by the relevant DER Works Approval and Licences, and DoW GWLs.

Area Superintendents

- Responsible for ensuring that staff adhere to procedure and are made available to carry out inspections as required by relevant licences;
- Informing the NGF Environmental Section of any issues identified during dewatering inspections; and

- Ensuring logbooks/inspection books are filled out as required by license conditions and when completed, provided to the Environmental Superintendent, or made available to view when requested for inspection purposes.

Surveyors

- Surveyors are responsible for ensuring that water levels within the discharge pit are surveyed on a monthly basis or more frequently as required by the relevant licences; and
- Responsible for surveying extent of any environmental harm resulting from incidents of hypersaline water discharge.

Dewatering

- The Dewatering Section is responsible for ensuring all flow metre readings are recorded on a monthly basis for all pits registered on active GWLs and DER Environmental Operating Licenses.

5. TRAINING

NGF will ensure that training is provided to appropriate responsible site personnel and will include as a minimum the understanding of:

- Requirements for dewatering mines as per the relevant licences; and
- The requirements of this Procedure.

6. PROCEDURE

Dewatering is required during the operation of a mine where groundwater is infiltrating into an underground or open cut mine at a rate in which it cannot be reutilised for purposes such as dust suppression. In these circumstances, water is collected in either a sump or dam and pumped via a pipeline to a discharge location such as an inactive open cut void with sufficient storage capacity.

Considerations for the discharge location must be investigated prior to requesting government agency approval and include; water quality, storage capacity, geotechnical stability, safe access and groundwater flow direction.

In instances where a salt lake is considered as a potential discharge location, archaeological, hydrological and ecological studies may also be required prior to application to ensure impacts to the environment are minimised.

6.1 REQUIREMENTS FOR NEW DEWATERING POINTS

Government Approval

Prior to undertaking the construction or operation of a dewatering network, approvals are required from DER when design capacity of the discharge could exceed 50,000 t

per year (if pipeline infrastructure were to be operated at maximum capacity 24hrs/day for 365 days per year).

The application for Works Approvals and Environmental Operating Licences will be made via the Environment Section after an appropriate discharge receiving location has been identified and risk assessed.

Pipeline

Pipelines are to be constructed of HDPE piping that meets Australian Standards:

- AS/NZS 2033:2008: Installation of polyethylene pipe systems;
- AS/NZS 4129:2008 Fittings for polyethylene (PE) pipes for pressure applications;
- AS/NZS 4130:2009 Polyethylene (PE) pipes for pressure applications; and
- *AS/NZS 4131:2010* Polyethylene (PE) compounds for pressure pipes and fittings.

All pipelines are to be fitted with isolation and breather valves, as dewatering pipeline networks do not generally have telemetry systems installed. Additionally, a flow meter is required to be installed with monthly readings to be reported and made available to the Environment Section to ensure compliance with relevant licences.

Pipeline Bunding

As water in the Goldfields is brackish to hypersaline, an uncontrolled release of water can have a detrimental effect on the surrounding environment. Therefore, all pipelines on the surface must be contained within an earthen bund or v-drain that directs water either to a mining void or catchment pit. The bund must be constructed in such a way that if a pipeline were to fail, the bunding would sufficiently contain the volume of discharge from the pipeline and prevent the release of water into the surrounding environment.

Pumping

All pumps using fuel are required to have a hydrocarbon spill kit nearby to ensure that any hydrocarbon spills are managed appropriately. Each department is responsible for ensuring their spill kits are stocked and in good order. Where it is identified there is inadequate spill response equipment available, the Environment Section shall be contacted to supply a new or refurbished spill kit for the area.

6.2 Monitoring

Monitoring is required whilst dewatering activities are undertaken to ensure that risks identified by dewatering are controlled/managed (these are generally licence conditions also). Dewatering monitoring includes but is not limited to:

12 hourly inspections

Whilst dewatering is occurring, 12 hourly inspections shall be carried out and recorded in the pipeline inspection logbook held within the Area Superintendent's office. The recommended schedule for 12 hourly inspections should include the following:

- Inspection of the pipeline network for leaks and to check that all pipelines, valves, flow meters, fittings and other equipment are in good operating condition;
- Inspections of pipeline bund for erosion, degradation and to ensure pipeline remains within the confines of the bund;
- Inspections of active groundwater discharge point to ensure that operational procedures are being implemented in accordance with deposition plan; and
- Inspection of discharge pit water levels to ensure water levels are maintained within the nominated free board associated with the relevant licences (generally 6 metres below ground level).

Monthly Monitoring

Monthly monitoring includes:

- Monthly surveys of water levels within the discharge pit are required to be carried out and recorded to ensure the water levels do not breach the freeboard levels outlined in the relevant licences; and
- Flow meter readings are required to be recorded monthly from water meters associated with active dewatering pipelines.

Annual Monitoring

Groundwater quality sampling is required to be carried out annually (unless stated otherwise on a license). This should include sampling the following analytes (also unless stated otherwise) in all receiving pits:

- Electrical conductivity;
- Water temperature;
- pH;
- Total Dissolved Solids; and
- A metals suite analysis.

Ground water sampling procedures shall be conducted in accordance with Australian Standard AS/NZS 5667.11 and the groundwater samples sent to a NATA accredited laboratory for analyses.

Additional Inspections

The following additional inspections should be carried out following heavy rainfall events:

- Integrity of pipeline bund and of pipeline and pit access roads;
- Integrity of safety bund, diversion embankment and diversion trench; and
- Integrity of pit margins.

Additional monitoring requirements may be necessary in conjunction with those stipulated above, due to the nature of the area and/or the monitoring requirements outlined in the relevant licences.

7. RECORD KEEPING

Records of pipeline inspections will be maintained and stored within the Area Superintendents office, to be made available upon request when an internal or external audit is carried out.

Water level surveys, water meter readings and water quality analysis will be maintained by the Survey, Regional Infrastructure and Environment Sections and stored in an appropriately marked folder in the Environmental Superintendent's office, or in an appropriate digital folder on P drive.

8. CONTINGENCY PLAN

In the event of a spill, the following measures should be implemented to reduce the risk of further damage to the environment:

- Dewatering activities to stop immediately until the issue has been resolved;
- The Area Superintendent and Environment Section to be notified of spills or breaks in containment to ensure that appropriate remediation measures can be implemented;
- Pipeline breaks will be repaired immediately and spilled material collected or pumped and discharged into the pit; and
- In the event of erosion or scouring resulting from the spillage, appropriate remediation measures will be implemented, as per the Environmental Superintendent's advice.

9. REPORTING

All spills, pipeline infrastructure failures, breakdown of containment bunding and failure to carry out 12 hourly inspections without reasonable cause are classed as reportable incidents and are required to be entered into STEMS.

If the incident is also classified as externally reportable, the Environment Section will notify relevant government authorities within the timeframes stipulated by legislation or licence requirements and to the prescribed standard, usually within one working day of becoming aware of the incident, by verbal or written notification.

10. REVIEW

A review shall be carried out to ensure the content of this procedure is still applicable, current and practicable. A review should take place:

a. Whenever the process/equipment changes
b. At a periodic frequency (every two years)
c. At incident investigation.

11. LEGISLATION AND STANDARDS

- Environmental Protection Act 1986; and
- Rights in Water and Irrigation Act 1914.

12. RELEVANT DOCUMENTATION

The following documentation may be utilised or referenced to comply with the requirements of this procedure:

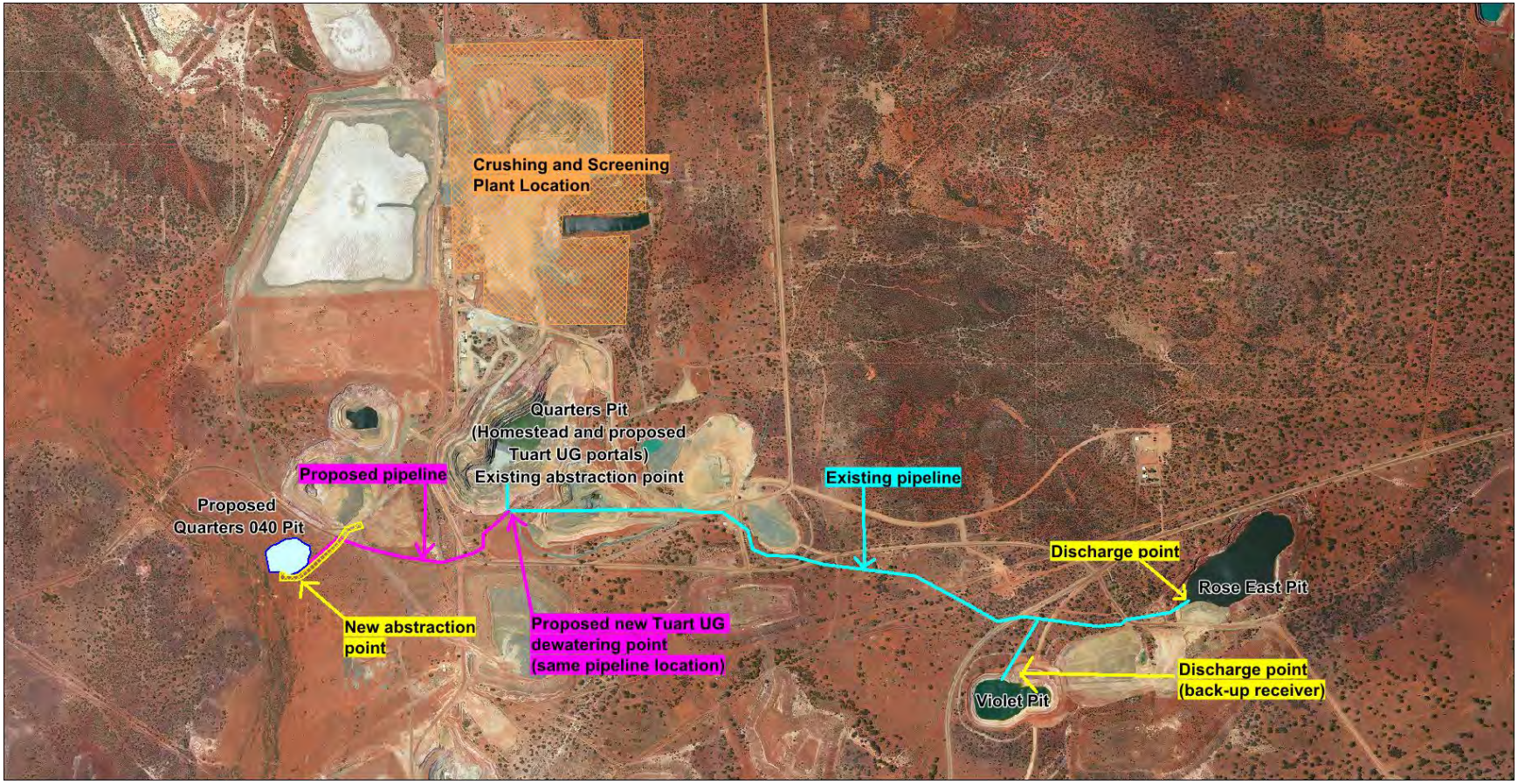
- Norton's Groundwater Operating Strategy

Department of Water:

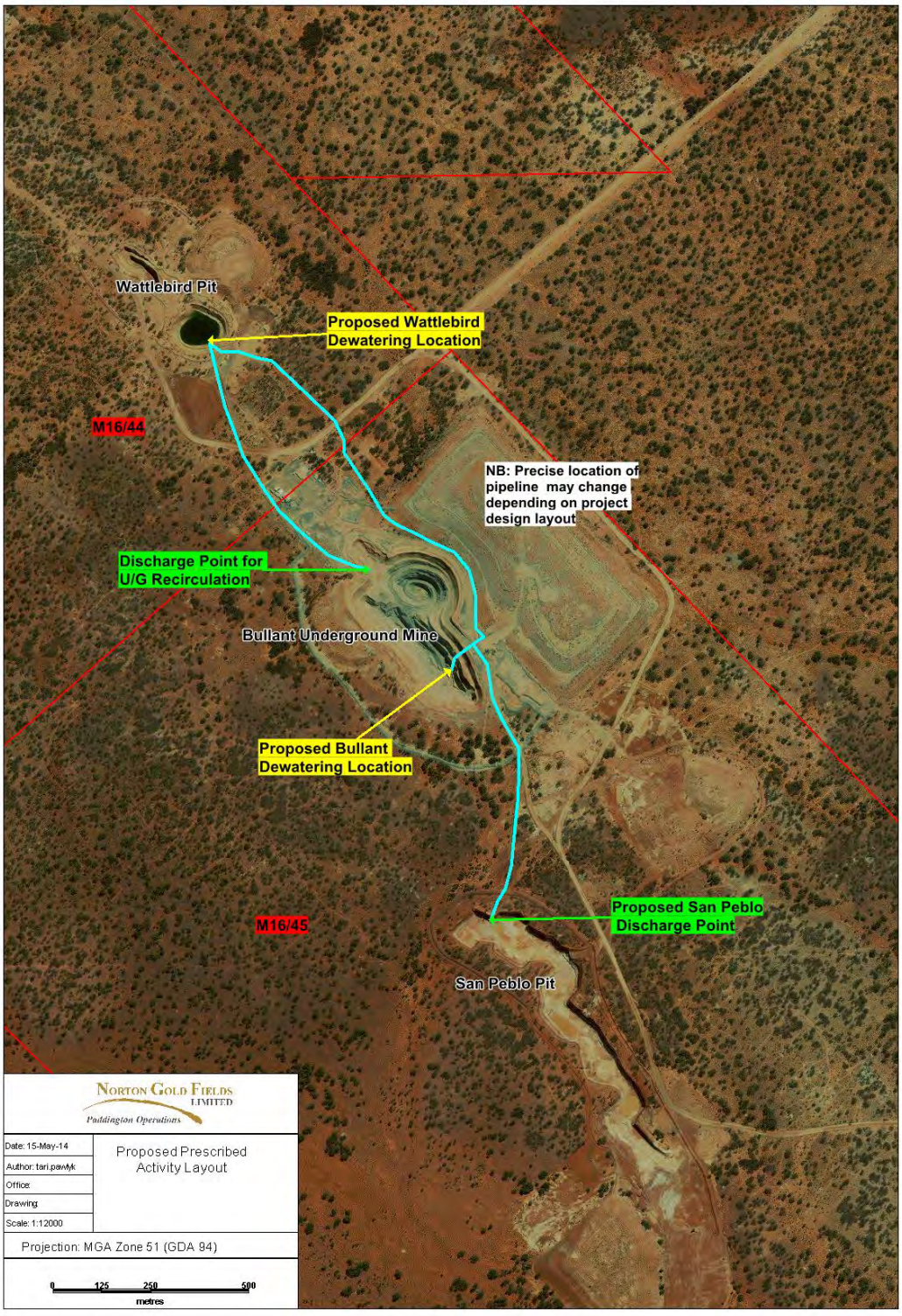
- Groundwater Well License 151865(10) – Paddington Gold
- Groundwater Well License 160697(3) – Ora Banda
- Groundwater Well License 167686(3) – Navajo Chief and Janet Ivy
- Groundwater Well License 182749(1) – Bullabulling

Department of Environment Regulation:

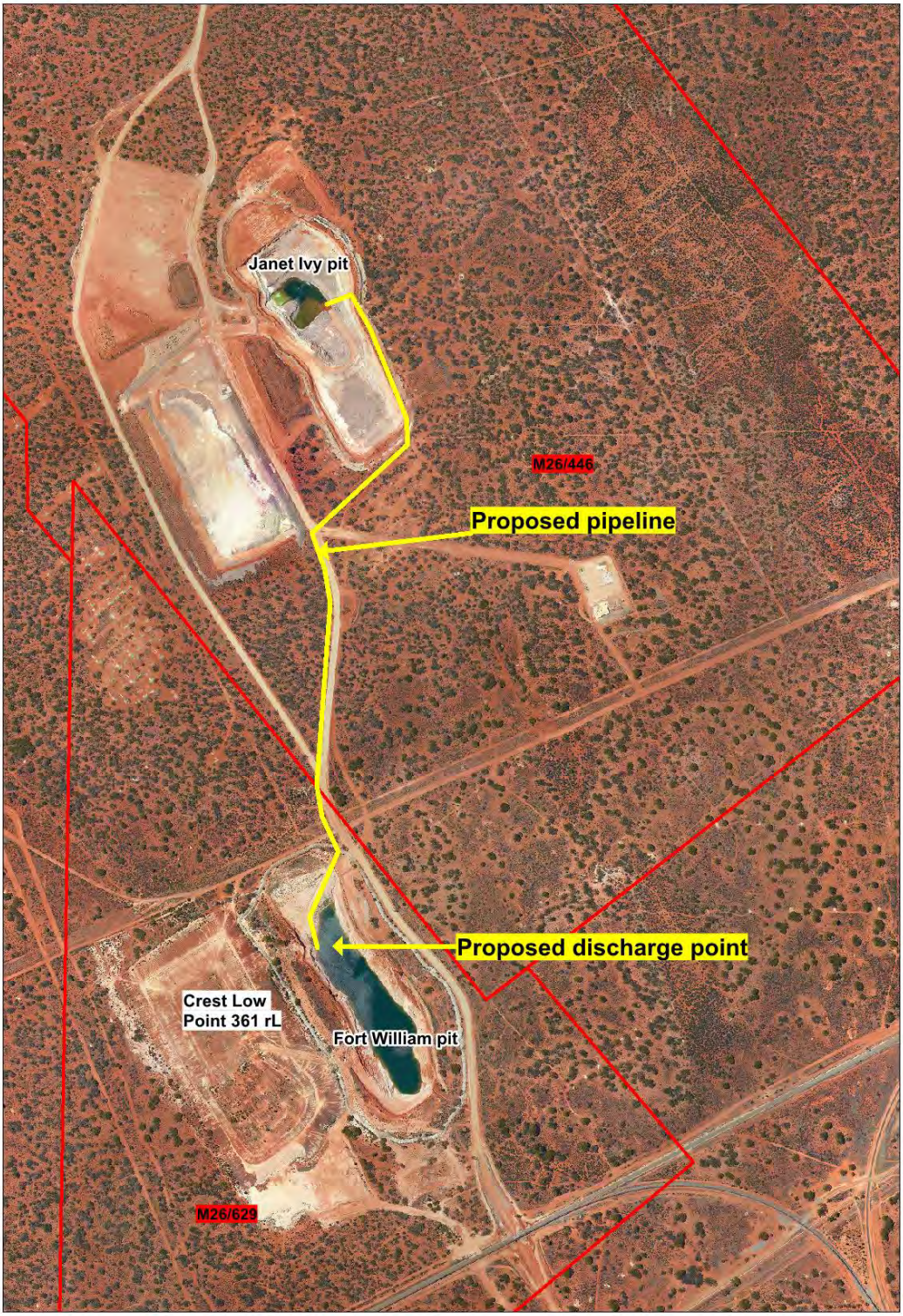
- Environmental Operating License L8327/2008/2 – Rose Pit
- Environmental Operating License L8512/2010/2 – Bullant and San Peblo
- Environmental Operating License L8692/2012/1 – Enterprise
- Environmental Operating License L9048/2017/1 – Janet Ivy



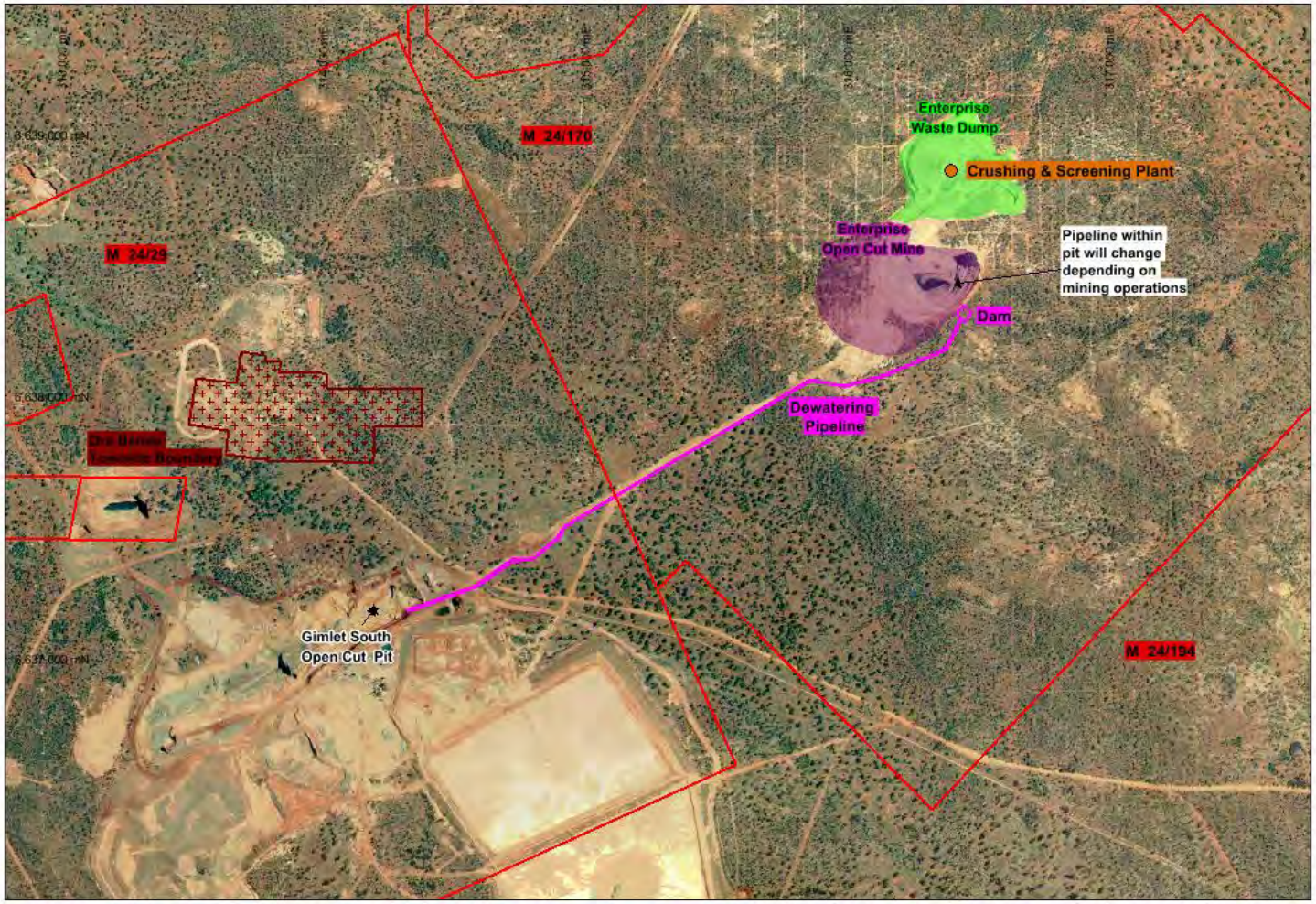
Appendix 1: Homestead and Quarters 040 DER License L8327/2008/2 Activities



Appendix 2: Bullant Underground DER License 8512/2010/2 Activities



Appendix 3: Janet Ivy DER License L9048/2017/1 Activities



Appendix 4: Enterprise DER License 8692/2012/1 Activities

NORTON GOLD FIELDS LIMITED
Paddington Operations

HSEC
Document Control Form

Section A – To be completed by Author/Document Owner

Name of Document: Mine Dewatering Procedure	
New Document: ☐	Revision ☒
Document Type: Procedure	
Document Purpose/ Purpose of change: Provide guidance to NGF employees and contractors on the process of mine dewatering out of open cut and underground mines.	
Date of Next Review: May 2019	
Author: Tari Pawlyk (reviewed)	Position: Environmental Advisor
Document Owner: Environment Department	Position:

Safety Management System

- ☐ Leadership, Accountability & Ethics
- ☐ Planning, Resources, Objectives etc.
- ☐ Competency & Behaviour
- ☐ Communication & Consultation
- ☐ Risk and Change Management
- ☐ Emergency Management
- ☐ Legal compliance Document Control
- ☐ Operations & Maintenance
- ☐ Health and Occupational Hygiene
- ☒ Biodiversity & Land Management
- ☐ Contractors, Suppliers & Partners
- ☐ Community
- ☐ Project Management
- ☐ Product Stewardship
- ☐ Incident Management
- ☐ Assessment & Reporting

Section B - Review (Safety and Training Superintendent to nominate reviewers if required)

Reviewers have made comment to the document author/ Owner

	Name	Signature	Date
Reviewer 1	Tari Pawlyk		29.05.17
Reviewer 2	Wayne Astill		29/5/17
Reviewer 3	Circulated on 19/05/2017 to Survey and Regional Maintenance Departments		

Section C – Authorisation

Standards and System Documents require authorisation by the HSE Manager and the General Manager. All other documents will be authorised by the HSE Manager only.

Date	Name	Position	Signature
	Wayne Astill	ECS Superintendent	
	Albert Schaus	GM – Paddington Operations (Acting)	

Document to remain attached to this form. Safety and Training Superintendent to file once authorised.

Appendix 4

Enterprise Paste Fill Plant and Dewatering Commissioning Plan

Enterprise Paste Fill Plant and Dewatering Works Approval - Commissioning Plan

Following installation of the paste fill plant infrastructure, Norton proposes a commissioning period to verify the correct installation and operation prior to obtaining an operating license. Commissioning will include both no-load and load commissioning to ensure compliance against design criteria. Load commissioning is proposed to occur for a period of either six months or until an operating license is obtained (whichever occurs sooner).

No-load commissioning

Prior to the production of paste, a no-load commissioning phase of the paste fill plant and any new dewatering infrastructure will occur to ensure correct installation and integrity of infrastructure. This will include but is not limited to;

- Confirming the weighing/batching system and shaft batch mixer is installed to standard
- Confirming PLC software & instrumentation control system is installed to specification and functioning as intended
- All other paste plant infrastructure, including crew conveyor cement silo, mobile hopper and dry tailings feeder system, paste batch mixer, water and compressed air storage tanks, QAQC lab, sump and dry tailings stockpile/storage area is installed to standard
- Ensuring safety shower is functional
- Connections to Western Power grid or generators (to be determined) is verified to be installed correctly by a licensed electrician
- Confirm the Enterprise underground bore hole meets design specifications with contingency in case of blockage
- The water line installed from existing Enterprise surface dam and Gimlet South pipeline to paste plant is complete
- Confirming pumps, flow meters, air valves and scour valves are installed correctly
- Inspecting pipeline weld integrity for potential points of failure
- Pressure testing of the pipeline to maximum credible operating pressure for a period of at least 2 hours
- Confirm pipeline has been anchored with earth or other measures at top of discharge locations (no pulling back from edge)
- Ensuring that the V drains are a minimum of 30 cm deep and sufficient to contain a volume of discharge in the event of pipeline failure
- Ensure that V drains contain entire pipeline
- Ensuring that scour pits have been installed at least every 500 m and at low points in the pipeline, and are of adequate size to contain any discharge from the pipeline

Load commissioning

To verify that the paste fill plant and any new dewatering infrastructure meets emission standards and discharge requirements, a load commissioning period will confirm operation complies with design criteria. This will include;

- Monitoring PLC software & instrumentation control system to ensure the system functions correctly
- Inspection of paste plant infrastructure under load, including crew conveyor cement silo, mobile hopper and dry tailings feeder system, paste batch mixer, water and compressed air storage tanks, QAQC lab, sump and dry tailings stockpile/storage area to ensure integrity
- Measure filling capacity and filling strength (after 28 days) to ensure paste meets required standards
- Check movement of paste through pipe with no blockages
- Checking the dewatering first flush emission for correct operation
- 12 hourly pipeline inspections for spills and / or leaks
- Weekly tests of pump and pipe pressure
- Weekly flow meter measurements to verify water quantities discharged
- Fortnightly measurements of water quality (pH, TDS, EC) at discharge locations
- Monthly monitoring of standing water level in all pits

Compliance certificate

After the 'No-load commissioning' and first flush emission for new dewatering infrastructure has been completed a compliance certificate will be prepared and sent to DWER alongside a discharge license application. The application and compliance certificate will be submitted within 1 month of the 'No-load commissioning'.

The load commissioning (and associated checks) will continue until a license to operate is obtained.

Appendix 5

2016 Enterprise Flora and Vegetation Survey, Botanica Consulting

Level 1 Flora & Vegetation Survey of the Enterprise Stage 4 Tenement: M24/170

Prepared For Norton Gold Fields Limited

December 2015 FINAL

Prepared by:
Botanica Consulting
PO Box 2027
Boulder WA 6432
90930024

Norton Gold Fields Limited

Disclaimer

Quality Assurance

An internal quality review process has been implemented to each project task undertaken by BC. Each document and its contents is carefully reviewed by core members of the Consultancy team and signed off at Director Level prior to issue to the client. Draft documents are submitted to the client for comment and acceptance prior to final production.

Document Job Number: 2015/74

Prepared by:
Pat Harton
Environmental Consultant
Botanica Consulting

Reviewed by:
Andrea Williams
Director
Botanica Consulting

Approved by:
Jim Williams
Director
Botanica Consulting

Contents

Tables

Figures

Plates

Appendices

Acronyms/Abbreviations:

BAM Act: Biosecurity and Agriculture Management Act 2007, WA Government.
BC: Botanica Consulting.
BOM: Bureau of Meteorology.
CALM: Department of Conservation and Land Management (now DPaW), WA Government.
DAFWA: Department of Agriculture and Food, WA Government.
DEC: Department of Environment and Conservation (now DPaW), WA Government.
DEH: Department of Environment and Heritage (now DoE), Australian Government.
DEP: Department of Environment Protection (now DER), WA Government.
DEWHA: Department of the Environment, Water, Heritage and the Arts (now DotE), Australian Government
DER: Department of Environment Regulation (formerly DEC, DoE), WA Government.
DMP: Department of Mines and Petroleum (formerly DoIR), WA Government.
DoE: Department of Environment (now DER/DPaW), WA Government.
DoIR: Department of Industry and Resources (now DMP), WA Government.
DotE: Department of the Environment (formerly DSEWPaC, DEWHA, and DEH), Australian Government.
DPaW: Department of Parks and Wildlife (formerly DEC, CALM, DoE), WA Government.
DSEWPaC: Department of Sustainability, Environment, Water, Population and Communities (now DotE, formerly DEH, DEWHA), Australian Government.
EP Act: Environmental Protection Act 1986, WA Government.
EP Regulations: Environmental Protection (Clearing of Native Vegetation) Regulations 2004, WA Government
EPA: Environmental Protection Authority, WA Government.
EPBC Act: Environment Protection and Biodiversity Conservation Act 1999, Australian Government.
ESA: Environmentally Sensitive Area.
Ha: Hectare (10,000 square metres).
IBRA: Interim Biogeographic Regionalisation for Australia.
IUCN: International Union for the Conservation of Nature and Natural Resources – commonly known as the World Conservation Union.
Km: Kilometre (1,000 metres).
MVG: Major Vegetation Groups.
Norton: Norton Gold Fields Limited.
NVIS: National Vegetation Information System.
OEPA: Office of the Environmental Protection Authority, WA Government.
PEC: Priority Ecological Community.
Survey Area: Enterprise Stage 4.
TEC: Threatened Ecological Community.
WA: Western Australia.
WAHERB: Western Australian Herbarium.
WC Act: Wildlife Conservation Act 1950, WA Government.

Executive Summary

BC was commissioned by Norton to undertake a Level 1 flora and vegetation survey of the Enterprise Stage 4 Project, encompassing the entire boundary of tenement M27/170 (excluding areas previously cleared for mining development). The survey area is located approximately 53km north-west of Kalgoorlie-Boulder. The survey was conducted on the 15th and 16th of December 2015.

The survey area comprised of nine broad vegetation communities. No Threatened Flora taxa, pursuant to subsection (2) of section 23F of the WC Act and the Commonwealth EPBC Act were identified within the survey area. Previous surveys in the area identified an annual Priority Flora taxon; *Gnephosis intonsa* (P3). This annual species was present during the survey, but had died off.

None of the vegetation communities within the survey area were found to have National Environmental Significance as defined by the Commonwealth EPBC Act. No TEC pursuant to Commonwealth or State legislation were recorded within the survey area. No PEC listed by DPaW was recorded within the survey area. The survey area is not located within an ESA listed under the EP Act; however approximately 2ha of the survey area is located within a Schedule 1 Area situated on the "Broad Arrow Ora Banda road". The survey area is not located within a listed or proposed conservation area managed by DPaW. The closest DPaW managed lands are the former pastoral lease "Credo Station", located approximately 8.5km west of the survey area and the Class C Nature Reserve – Clear and Muddy Lakes which is located approximately 20km west of the survey area.

1 Introduction

1.1 Project Description

BC was commissioned by Norton to undertake a Level 1 flora and vegetation survey and targeted flora survey of the Enterprise Stage 4 survey area (referred to as the 'survey area') (Figure 1). The survey area covered an area of approximately 597ha and encompassed the entire area of tenement M24/170 (excluding areas previously cleared for mining development). The survey area is located approximately 54km north-west of Kalgoorlie-Boulder.

The survey was conducted on the 15th and 16th of December 2015. The aim of the survey was to produce a vegetation map (Appendix 2) and species list (Appendix 3) as well as to document and map locations of any TEC, PEC, Threatened Flora or Priority Flora species within the survey area (Appendix 1).

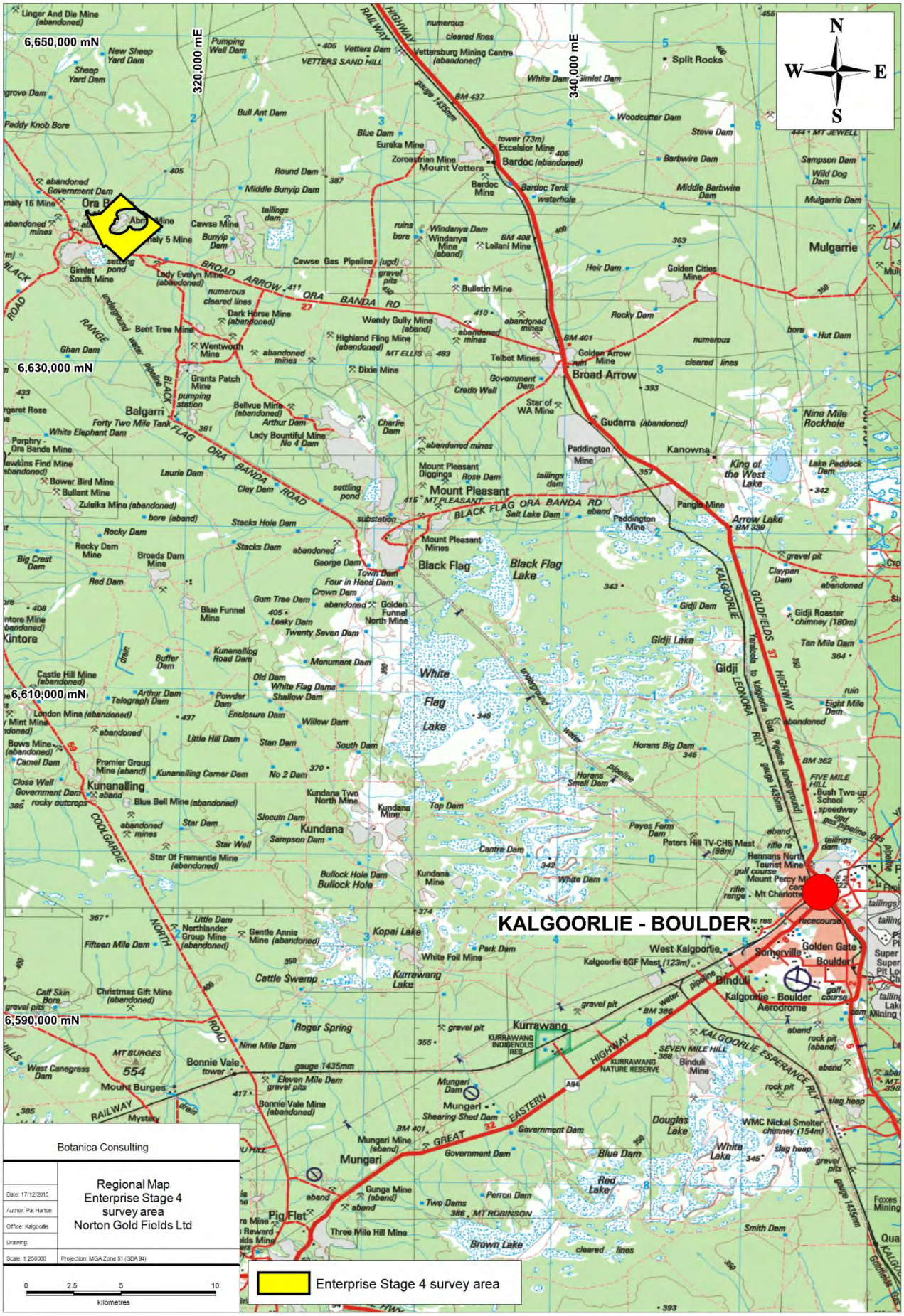


Figure 1: Regional map of the Enterprise Stage 4 survey area (survey area not to scale)

2 Regional Biophysical Environment

2.1 Regional Environment

The survey area lies within the Coolgardie Region of the South-Western Interzone of WA in an area known as the Coolgardie Botanical District. The Coolgardie Botanical District consists of predominantly Eucalyptus woodlands that become increasingly more open with a saltbush under-storey with increasing calcareous soils (Beard, 1990). The Coolgardie Region is further divided into subregions based on the Interim Biogeographic Regionalisation of Australia (IBRA), with the survey area located within the Eastern Goldfields (COO3) subregion and approximately 3km west of the Eastern Murchison (MUR1) subregion (Cowan, 2001). A map of the survey area in relation to IBRA subregions is provided in Figure 2 below.

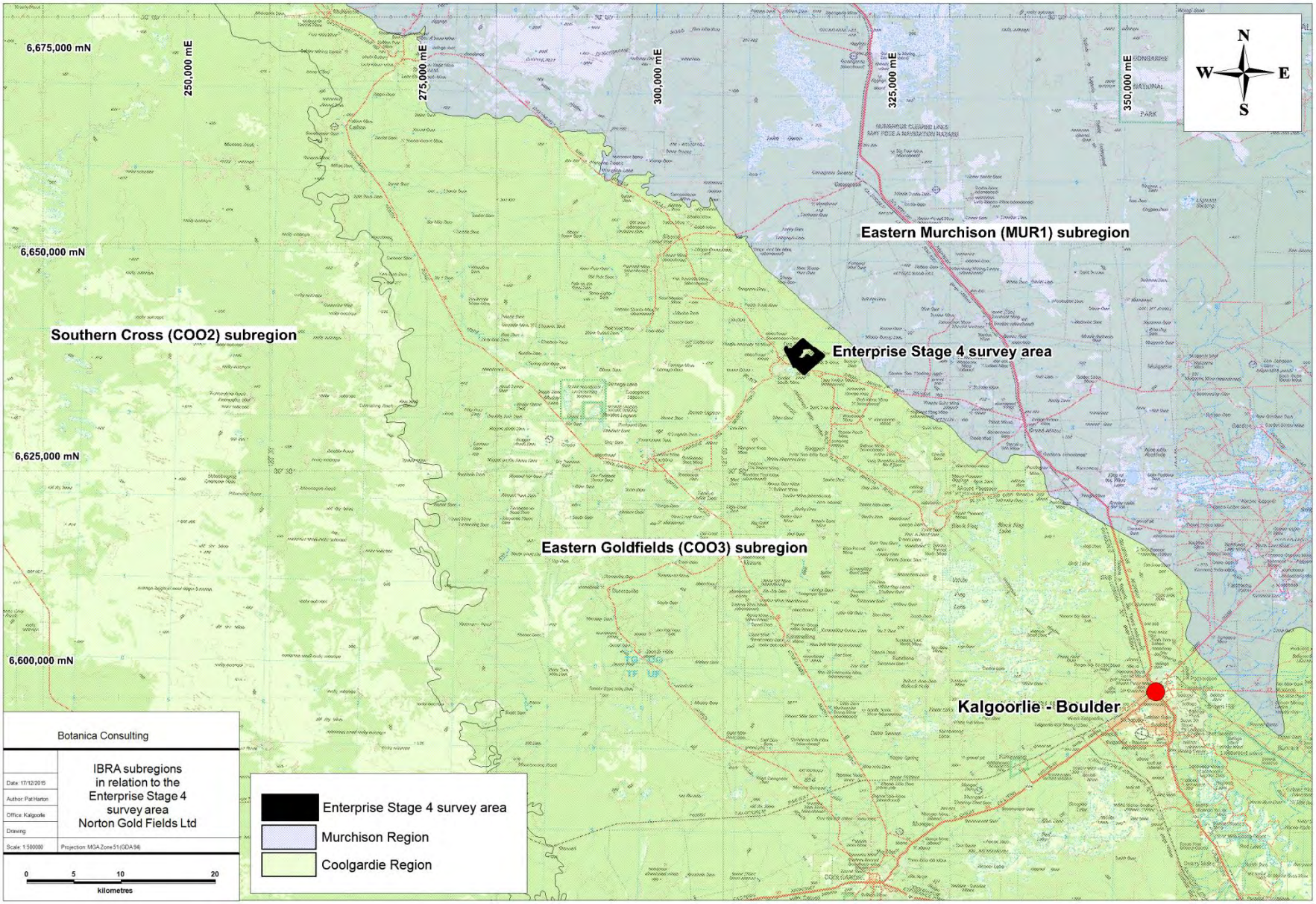


Figure 2: Map of IBRA subregions in the vicinity of the Enterprise Stage 4 survey area

2.2 Great Western Woodlands

The survey area lies within the Great Western Woodlands, located approximately 3km from the northern boundary. The Great Western Woodlands is considered by The Wilderness Society of WA to be of global biological and conservation importance as one of the largest and healthiest temperate woodlands on Earth, containing many endemic taxa. The region covers almost 16 million hectares, 160,000 square kilometres, from the southern edge of the Western Australian Wheat belt to the pastoral lands of the Mulga country in the north, the inland deserts to the northeast, and the treeless Nullarbor Plain to the east (Figure 3).

The area provides an eastward connection between southwest forests and inland deserts (Gondwana Link) as well as linking the north-west passage to Shark Bay. The majority of the Great Western Woodlands is unallocated crown land (61.1%) with other interests including pastoral leases (20.4%), conservation reserves (15.4%) unallocated crown land ex pastoral managed by the (DPaW 2011a) (2%) and private land (approximately 1%) (Watson *et. al.,* 2008).

No specific management strategy applies to the Great Western Woodlands, rather an approach to conservation which occurs across all land tenures and when different stakeholders work together with biodiversity in mind. The central component of this approach is to identify and conserve key large-scale, long term ecological processes that drive connectivity between ecosystems and taxa. The Great Western Woodlands currently includes towns, highways, roads, railways, private property, Crown Reserves, agricultural activities and mining tenements.

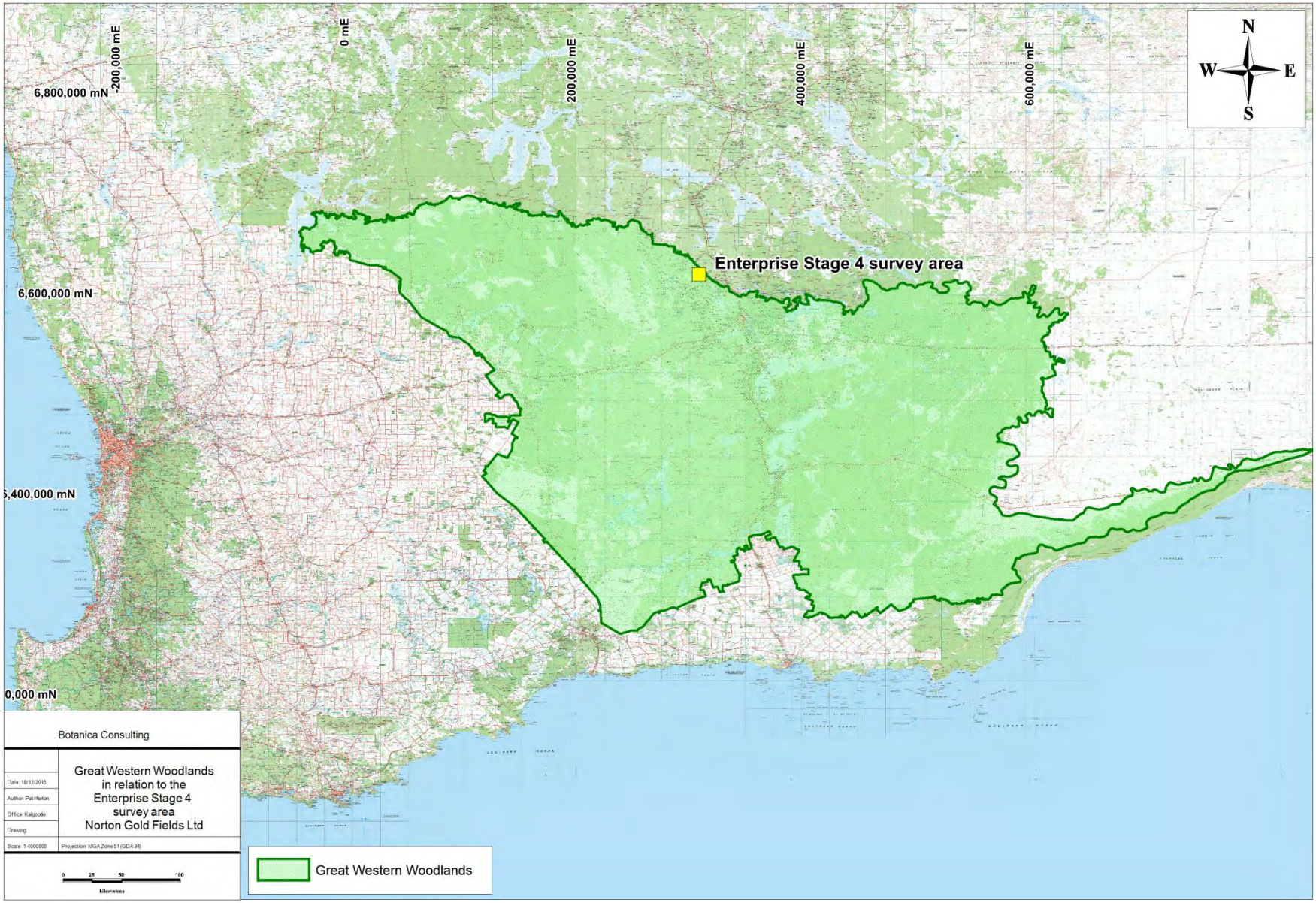


Figure 3: Location of Enterprise Stage 4 survey area within the Great Western Woodlands (DPaW, 2011a)

2.3 Vegetation

The vegetation of the Eastern Goldfields subregion is comprised of Mallee's, Acacia thickets and shrub heaths on sandplains. Diverse Eucalyptus woodlands occur around salt lakes, on ranges, and in valleys. Salt lakes support dwarf shrublands of samphire's and the area is rich in endemic Acacias (Cowan, 2001).

The DAFWA GIS file (2011) indicates that the survey area is within Pre-European Beard vegetation association Broad Arrow 2901. The extent of this association as described by the DAFWA is shown in Table 1 and (Figure 4).

Table 1: Remaining Beard Vegetation Associations within Western Australia (DAFWA, 2011)

Vegetation association	Pre-European Extent (ha)	Current Extent (ha)	Pre-European extent remaining (%)	% of Current extent within DPaW managed lands	Vegetation Description (Beard, 1990)
Broad Arrow 2901	35470.30	33995.60	95.84	3.55	Mosaic: Medium woodland*; Allocasuarina cristata* & goldfields blackbutt Shrublands; *Acacia quadrimarginea* thicket

Areas retaining less than 30% of their pre-European vegetation extent generally experience exponentially accelerated species loss, while areas with less than 10% are considered "endangered". Development within the survey area will not significantly reduce the extent of this vegetation association.

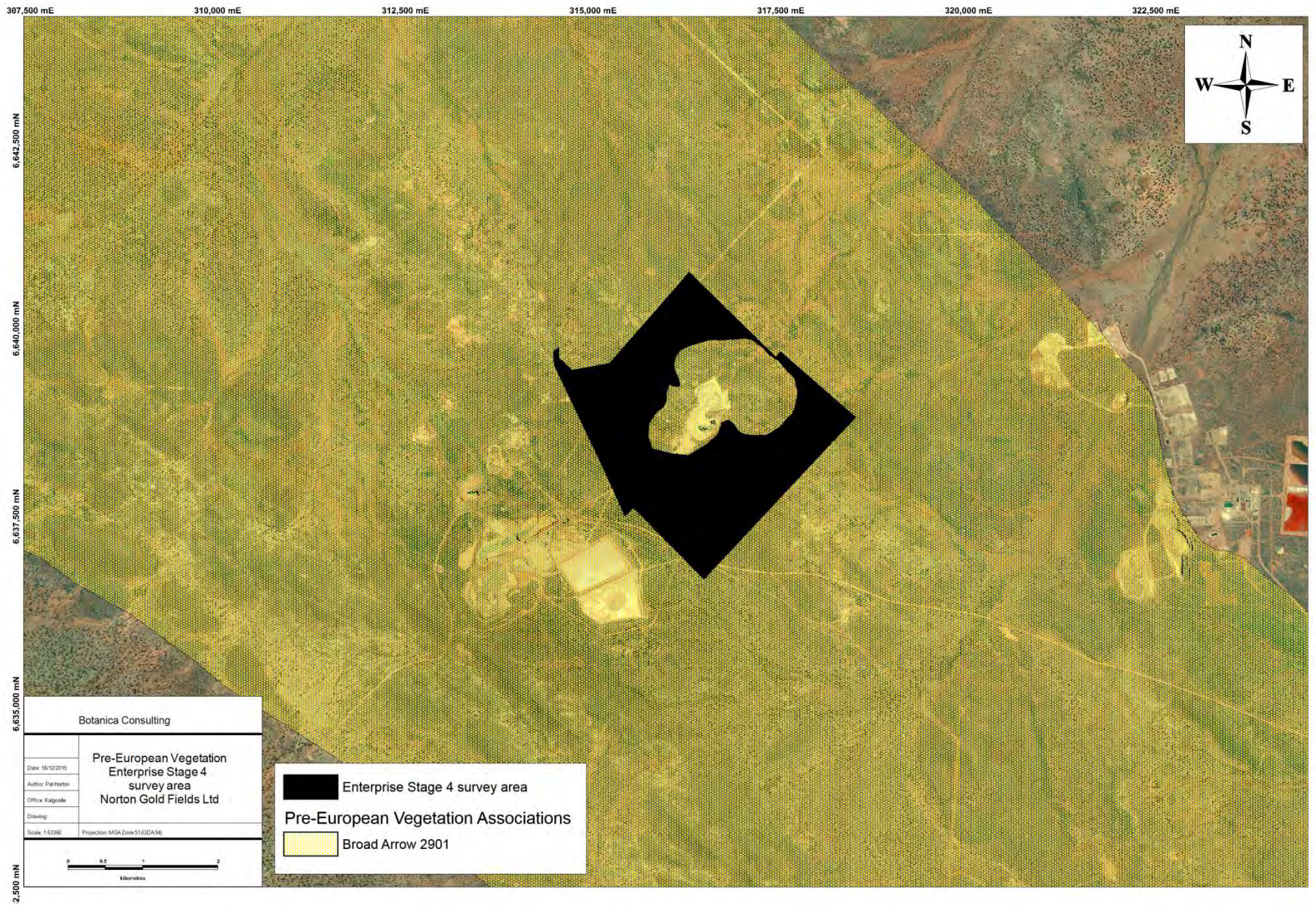


Figure 4: Map of Pre-European Vegetation Associations within the Enterprise Stage 4 survey area

2.4 Topography & Soils

The Eastern Goldfields subregion lies on the Yilgarn Craton's 'Eastern Goldfields Terrains'. The relief is subdued and comprised of gently undulating plains interrupted in the west with low hills and ridges of Archaean greenstones and in the east by a horst of Proterozoic basic granulite. The underlying geology is of gneisses and granites eroded into a flat plane covered with tertiary soils and with scattered exposures of bedrock. Calcareous earths are the dominant soil group and cover much of the plains and greenstone areas. A series of large playa lakes in the western half are the remnants of an ancient major drainage line (Cowan, 2001).

Based on geographic information provided by DAFWA (2014b), the survey area occurs within the Kambalda Zone (265) of the Kalgoorlie Province (26). The Kambalda Zone is characterised by flat to undulating plains (with hills, ranges and some salt lakes and stony plains) on greenstone and granitic rocks of the Yilgarn Craton. Soils are comprised of calcareous loamy earths and red loamy earths with Salt lakes soils and some redbrown hardpan shallow loams and red sandy duplexes. Vegetation is predominately red mallee blackbutt- salmon gum-gimlet woodlands with mulga and halophytic shrublands (and some spinifex grasslands). This zone is located in the south-eastern Goldfields between Menzies, Norseman and the Fraser Range. The survey area is located within two soil landscape systems as described in Table 2 and shown in Figure 5 below.

Table 2: Soil Landscape Systems within the survey area

Landscape System	Description
265Mx43	Gently undulating valley plains and pediments; some outcrop of basic rock
265BB5	Calcareous shallow loam & Calcareous loamy earth

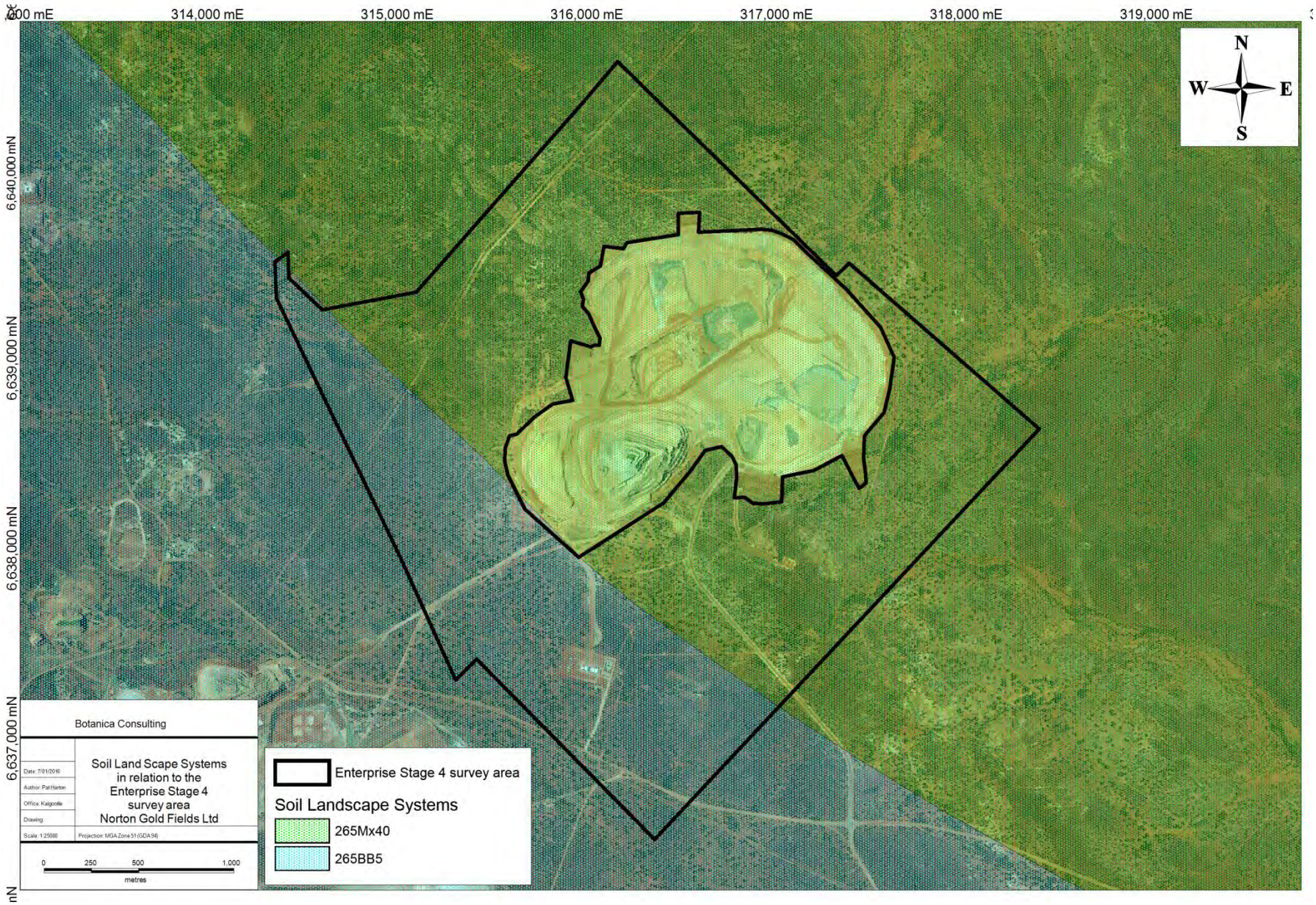


Figure 5: Map of Soil Landscape Systems within the Enterprise Stage 4 survey area

2.5 Climate

The climate of the Eastern Goldfields subregion is characterised as an arid to semi-arid climate with rainfall sometimes in summer but mainly winter rainfall and annual rainfall of approximately 200-300mm (Beard, 1990; Cowan, 2001). Rainfall data for the Kalgoorlie-Boulder Airport weather station (#12038) located approximately 56km south east of the survey area is shown in Figure 6 and 7 (Bureau of Meteorology, BOM, 2016).

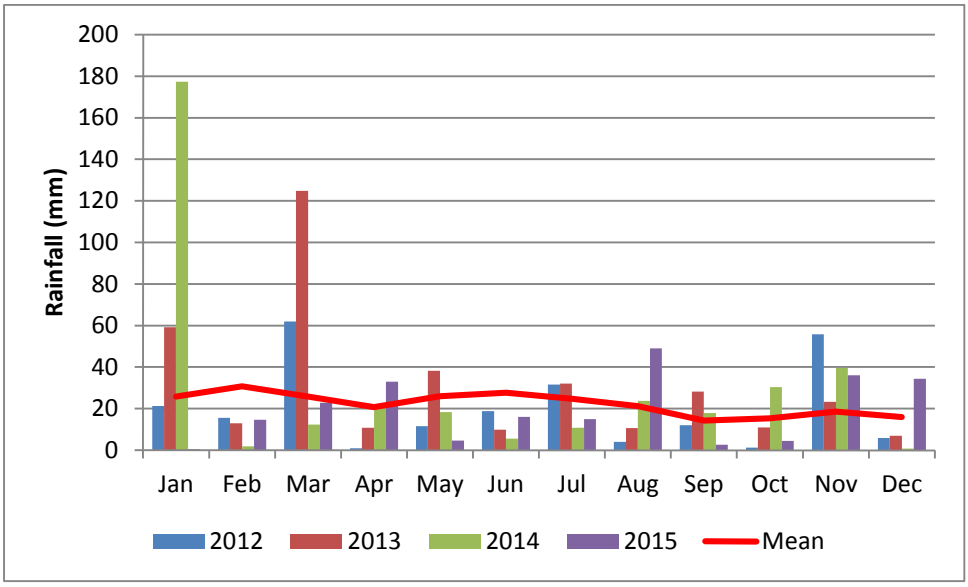


Figure 6: Monthly rainfall from January 2012 to December 2015 and mean monthly rainfall (January 1939 to December 2015) for the Kalgoorlie-Boulder Airport weather station #12038 (BOM, 2016).

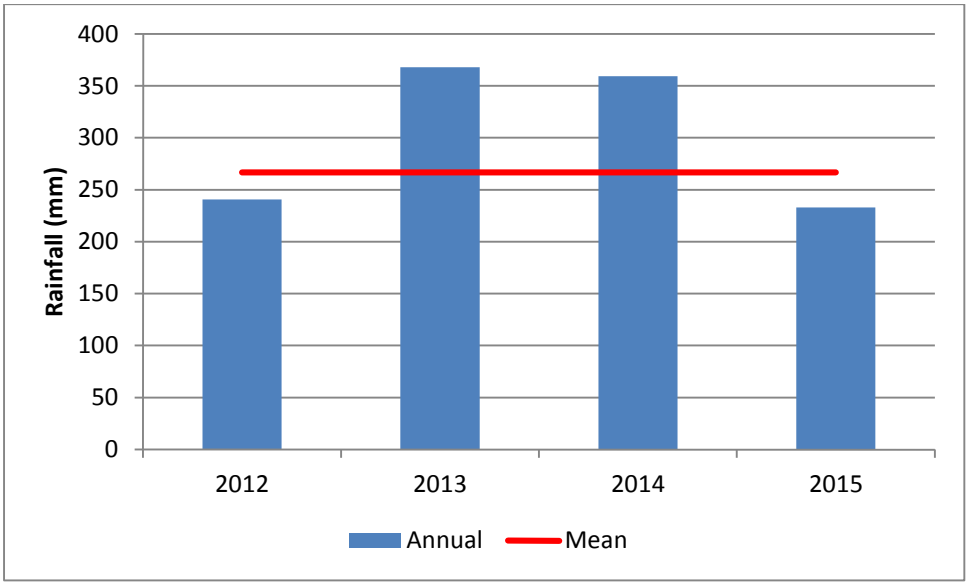


Figure 7: Annual rainfall and mean annual rainfall (January 1939 to December 2015) for the Kalgoorlie-Boulder Airport weather station #12038 (BOM, 2016).

2.6 Land Use

The dominant land uses of the Eastern Goldfields subregion are pasture land (38%), Nature Reserves (4.5%) with the remaining areas used for mining, exploration activities and freehold (Cowan, 2001), the survey area is located on vacant crown land.

2.7 Survey Objectives

The objectives of the survey undertaken were to:

- Compile broad scale vegetation community flora maps and species list of the survey area (Appendix 2 and 3);
- Document and map locations of any Threatened or Priority listed flora species located;
- Assess the regional and local conservation status of plant species and ecological communities within the survey area; and
- Identify and map occurrences of any “Declared and Environmental” weeds within the survey area.

3 Survey Methodology

3.1 Desktop Assessment

Searches of the following databases were undertaken to aid in the compilation of a list of flora taxon within the survey area:

- DPaW's Nature Map Database (DPaW, 2015);
- DPaW's Threatened and Priority Flora Database (DPaW, 2015a); and
- DotE Protected Matters search tool (DotE, 2015a).

The Nature Map and Protected Matters Search were conducted for an area encompassing a 20km radius of the centre coordinates – 121.086E, 30.372S. It should be noted that these lists are based on observations from a broader area than the survey area (20km radius) and therefore may include taxon not present. The databases also often included very old records that may be incorrect or in some cases the taxa in question have become locally or regionally extinct. Information from these sources should therefore be taken as indicative only and local knowledge and information also needs to be taken into consideration when determining what actual species may be present within the specific area being investigated.

Prior to the field survey, a combined search of the DPaW's Flora of Conservation Significance databases (DPaW, 2015a) was undertaken within a 50km radius of the survey, the results of which are provided in Appendix 4. These significant flora species were examined on the Western Australian Herbarium's (WAHERB) web page prior to the survey, to familiarise staff with their appearance. Locations of Threatened Flora and Priority Flora were overlaid on aerial photography of the area. Vegetation descriptions and available images of the Priority Flora were also obtained from Florabase.

Priority Flora and their respective vegetation types were targeted and all occurrences were traversed on foot specifically looking for the threatened flora associated with that vegetation description.

The conservation significance of flora taxon was assessed using data from the following sources:

- EPBC Act. Administered by the Australian Government DotE;
- WC Act. Administered by the WA DPaW (Govt. of WA 2015);
- Red List produced by the Species Survival Commission (SSC) of the World Conservation Union (also known as the IUCN Red List – the acronym derived from its former name of the International Union for Conservation of Nature and Natural Resources). The Red List has no legislative power in Australia but is used as a framework for State and Commonwealth categories and criteria; and
- DPaW Priority Flora list. A non-legislative list maintained by DPaW for management purposes.

Table 3 below represents the definitions of Flora of Conservation Significance ratings under the *WC Act 1950* as extracted from Florabase (WAHERB, 2016).

Table 3: Definitions of Rare and Priority Flora Species (WAHERB, 2016)

T: Schedule 1 Threatened Flora under the *Wildlife Conservation Act 1950*

Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
X: Declared Rare flora – Presumed Extinct Taxa
Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.
P1: Priority One – Poorly known Species
Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2: Priority Two – Poorly Known Species
Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3: Priority Three – Poorly known Species
Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4: Priority Four – Rare, Near Threatened and other species in need of monitoring
1. Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. 2. Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. 3. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5: Priority 5 – Conservation Dependent Species
Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

A search of the DPaW PEC and TEC database was also conducted within a 50km radius of the survey area (DPaW, 2015b).

3.2 Field Assessment

BC was commissioned by Norton to undertake a Level 1 flora and vegetation survey and a targeted Priority Flora search of the Enterprise Stage 4 survey area. The survey area covers an area of approximately 597ha. The objective of the survey was to document all observed flora taxon including flora of Conservation Significance and the occurrences of any “Environmental or Declared” weeds

observed within or adjacent to the survey area. The survey was completed on the 15th and 16th of December 2015 with the area traversed on foot and 4WD by two staff members (Figure 8).

Prior to the commencement of field work, aerial photography was inspected and obvious differences in the vegetation assemblages were identified. The different vegetation communities identified were then inspected during the field survey to assess their validity. A handheld GPS unit was used to record the co-ordinates of the boundaries between existing vegetation communities. At each sample point, the following information was recorded:

- GPS location;
- Photograph of vegetation;
- Dominant species;
- Collection and documentation of unknown plant specimens; and
- GPS location, photograph and collection of Threatened Flora if encountered.

Unknown specimens collected during the survey were identified with the aid of samples housed at the BC Herbarium and WAHERB. Presence/absence data of species from sample sites of similar vegetation was then compiled forming the best representative vegetation communities. Similar vegetation communities were recognised visually in the field. Vegetation communities were classified in accordance with the NVIS to a minimum Level 5 classification which includes recording Dominant growth form, height, cover and species for the three traditional strata (i.e. Upper, Middle and Ground). The Muir Life Form/Height Class classifications were used to classify vegetation communities (Appendix 5).

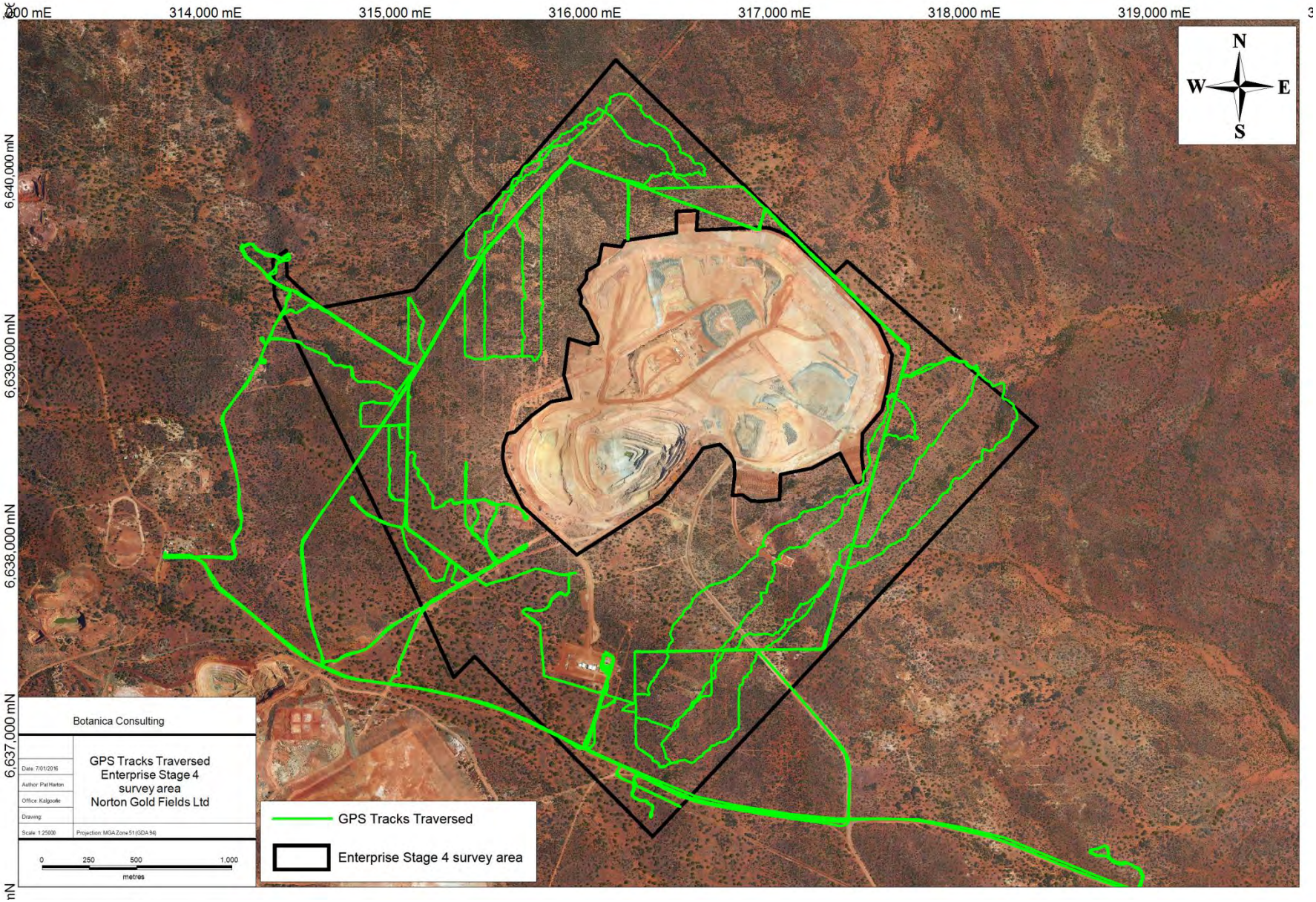


Figure 8: GPS tracks traversed throughout the Enterprise Stage 4 survey area

3.2.1 Personnel involved

Jim Williams - Environmental Consultant/Botanist (Diploma of Horticulture)
Pat Harton - Environmental Consultant (Bachelor of Environmental Science)

3.2.2 Scientific licences

Table 4: Scientific Licences of Botanica Staff coordinating the survey

Licensed staff	Permit Number	Valid Until
Jim Williams	SL011451	21-05-2016
Pat Harton	SL011452	21-05-2016

3.3 Flora survey limitations and constraints

It is important to note that flora surveys will entail limitations notwithstanding careful planning and design. Potential limitations are listed in Table 5.

Table 5: Limitations and constraints associated with the flora and vegetation survey.

Variable	Potential Impact on Survey	Details
Access problems	Not a constraint	The survey was conducted via 4WD and on foot.
Experience levels	Not a constraint	The BC personnel that conducted the survey were regarded as suitably qualified and experienced. **Coordinating Botanist:** Jim Williams **Field Staff:** Jim Williams & Pat Harton **Data Interpretation:** Jim Williams & Pat Harton
Timing of survey, weather & season	Minor constraint	Fieldwork was conducted in early December just outside of the EPA's recommended timing for flora surveys (i.e. spring) for detecting most ephemeral flora and when the majority of species are in flower. As a result, most annual species were not present, however many perennial species were in flower and able to be fully identified. Previous surveys have been conducted in the area during optimal flowering period prior to mining development.
Sources of information	Not a constraint	BC was able to obtain information about the area from previous research conducted within the area which enabled adequate background information about the region.
Mapping reliability	Minor constraint	BC were not able to obtain high quality ortho aerial images of the area however aerial imagery obtained was sufficient to reliably determine changes in vegetation within the survey area.
Area disturbance	Minor constraint	The survey area has been subject to multiple land use disturbance (historic mining, pastoralism and exploration activities).
Survey Intensity	Not a constraint	Survey intensity was appropriate for the size/significance of the area with a Level 1 survey completed to identify vegetation communities and any Flora of Conservation Significance. Previous surveys have been conducted in the area prior to mining development.
Resources	Not a constraint	Threatened flora database search provided by the DPaW was used to identify any potential locations of Threatened/Priority Flora species.

Variable	Potential Impact on Survey	Details
		DAFWA, DPaW and DotE databases were reviewed to obtain appropriate regional desktop information on the biophysical environment of the local region.
Completeness	Not a constraint	In the opinion of BC, the survey area was covered sufficiently in order to identify vegetation assemblages. Due to the extensive experience and familiarity of the BC staff with flora within the region, it is estimated that approximately 90% of the flora within the survey area was able to be fully identified. The vegetation communities for this study were based on visual descriptions of locations in the field. The distribution of these vegetation communities outside the study area is not known, however vegetation communities identified were categorised via comparison to vegetation distributions throughout WA specified in the NVIS obtained from the Australian Government (DotE, 2015b).

4 Results

4.1 Desktop Assessment

4.1.1 Flora of Conservation Significance

The results of the combined search of the DPaW's Flora of Conservation Significance databases (DPaW, 2015a) recorded no Threatened Flora and one Priority Flora taxon within the survey area; *Gnephosis intonsa* (P3). The location of this taxon was searched for however was not located during the survey. *Gnephosis intonsa* (P3) is an annual species and is only expected to be present during favourable seasonal conditions in spring. Ten Priority Flora taxa were listed by DPaW as occurring within a 50km radius of the survey area (Appendix 4). These taxa were assessed and ranked for their likelihood of occurrence within the survey area (Table 6). The rankings and criteria used were:

- Unlikely: Area is outside of the currently documented distribution for the species/no suitable habitat (type, quality and extent) was identified as being present during the field/desktop assessment.
- Possible: Area is within the known distribution of the species in question and habitat of at least marginal quality was identified as being present during the field/desktop assessment, supported in some cases by recent records being documented from within or near the area.
- Known to Occur: The species in question was positively identified as being present during the field survey.

Table 6: Likelihood of occurrence for Flora of Conservation Significance within the Enterprise Stage 4 survey area

Taxon	Conservation Code	Description (WAHERB, 2016)	Likelihood of Occurrence
Acacia epedunculata	1	Low spreading, becoming rounded, multi-stemmed shrub, 0.5-0.65 m high. Fl. yellow, Aug. Yellow sand. Sandplains.	Unlikely
Angianthus prostratus	3	Prostrate annual, herb. Fl. white-yellow, Jul to Sep. Red clay or loamy soils. Saline depressions.	Unlikely
Eremophila praecox	1	Broom-like shrub, 1.5-3 m high. Fl. purple, Oct or Dec. Red/brown sandy loam. Undulating plains.	Possible
Eucalyptus jutsonii subsp. *jutsonii*	4	Mallee, 4-7 m high, bark rough over most stems, grey to light grey-brown. Red to pale orange deep sands. Undulating areas and on dunes.	Unlikely
Gnephosis intonsa	3	Prostrate to ascending annual, herb, 0.01-0.04 m high. Fl. yellow-brown, Sep to Oct. Red/brown clay, stony saline loam.	Known to Occur
Gnephosis sp. Norseman (K.R. Newbey 8096)	3	Low spreading annual, herb, 0.03-0.07 m high, 0.08-0.18 m wide. Subsaline loam. Moderately exposed flat.	Possible
Gompholobium cinereum	3	Shrub, to 0.3 m high. Yellow sand, clayey sand, brown loam, sandy gravel, laterite. Well-drained open sites, slopes, plains, roadsides.	Unlikely

Taxon	Conservation Code	Description (WAHERB, 2016)	Likelihood of Occurrence
Phebalium appressum	1	Rounded shrub, ca 1 m high, leaves cordate-ovate, ca 2 mm long; flowers usually solitary; pedicels short, thick, ca 1 mm long. Fl. white, Jul. Yellow sandplain.	Unlikely
Ptilotus chortophytus	1	Small perennial herb to 12 cm high, 12 cm wide, green flowers, small succulent basal leaves.	Possible
Ricinocarpos sp. Eastern Goldfields (A. Williams 3)	1	Shrub 2 m high x 2 m wide. Flowers yellow. Rocky hillslope. Rocky surface. Red-brown sand-loam over felsic and mafic volcanics	Possible

4.1.2 Previous Flora Surveys

Flora and vegetation surveys, assessments and reviews have been undertaken in nearby areas in the past, though not all are publically available and could not be referenced. The most significant of those available have been used as the primary reference material for compiling the potential flora and vegetation communities for the general area (Table 7).

Table 7: Previous Flora and Vegetation Surveys within the surrounding area of the Enterprise Stage 4 survey area

Author & Year	Vegetation/Landforms	Flora of Conservation Significance
JSWT (2005)	Ten vegetation groups were encountered within the survey area. These vegetation groups were Salmon Gum woodland, *Eucalyptus celastroides* ssp *celastroides* woodland, *Eucalyptus yilgarnensis* woodland, *Grevillea nematophylla* ssp *nematophylla* woodland, *Casuarina pauper* woodland, *Eucalyptus salubris* woodland, Chenopod shrubland, *Acacia acuminata* thicket, *Eucalyptus clelandii* woodland and Gimlet woodland	No Threatened Flora taxa were identified. One Priority Flora *Gnephosis* sp Norseman (K.R. Newbey 8096) (P3) was identified within the survey area
BC, (2009)	Five vegetation groups were identified within the survey area. These were: 1) *Eucalyptus salmonophloia* Woodland 2) Open *Eucalyptus clelandii* Woodland 3) *Acacia acuminata* Woodland 4) Open *Eucalyptus salubris* Woodland 5) Open Chenopod Shrubland These groups were represented by a total of 22 Families, 33 Genera and 62 Species	No Threatened or Priority Flora taxa were identified within the survey area
GHD, (2009)	The Study Area is considered to be dominated by eucalypt –*Casuarina* woodlands, interspersed with *Acacia* shrublands. The vegetation of the survey area was classified into ten vegetation types. Vegetation within the Study Area is considered to be moderately diverse. A total of 148 taxa from 41 families were recorded from the Study Area. Of these, 137 taxa were native plant species.	No Threatened Flora taxa were identified. One Priority Flora *Gnephosis intonsa* (P3) was identified within the survey area
BC, (2013a)	Three vegetation communities were identified within the survey area. These three vegetation communities were represented by a total of 19 Families, 35 Genera and 61 Species (including sub-species and variants). 1. Open low woodland of *Eucalyptus salmonophloia* and *Eremophila longifolia* over low scrub of *Cratystylis subspinescens, Maireana pyramidata* and *Senna artemisioides* subsp. filifolia in drainage line; 2. Low woodland of *Casuarina pauper* over low scrub of *Maireana pyramidata* and *Maireana sedifolia;* and 3. Low woodland of *Eucalyptus salmonophloia* over low scrub of *Scaevola spinescens* and *Senna artemisioides* subsp. *filifolia.*	No Threatened or Priority Flora taxa were identified within the survey area
BC, (2013b)	Twelve vegetation communities were identified within the Castle Hill Project survey area, which were represented by a total of 30 Families, 59 Genera and 114 Taxa (including sub-species and variants). 1. Scrub of *Acacia* sp. narrow phyllode over low scrub of *Eremophila alternifolia;* 2. Low woodland of *E. campaspe* and *E. salmonophloia* over low scrub of *Atriplex nummularia, Eremophila dempsteri* and dwarf scrub of *Atriplex vesicaria;* 3. Open low woodland of *E. campaspe* over low scrub of *Eremophila dempsteri* and dwarf scrub of *Atriplex vesicaria;* 4. Low woodland of *E. clelandii* over scrub of *Acacia* sp. narrow phyllode and low scrub of *Acacia erinacea, Atriplex vesicaria* and *Eremophila pustulata;*	No Threatened or Priority Flora taxa were identified within the survey area

Author & Year	Vegetation/Landforms	Flora of Conservation Significance
	5. Low woodland of *E. campaspe* over low scrub of *Eremophila scoparia* and dwarf scrub of *Atriplex vesicaria;* 6. Very open shrub mallee of *E. griffithsii* over low scrub of *Dodonaea lobulata* and *Eremophila scoparia* over dwarf scrub of *Scaevola spinescens;* 7. Scrub of *Allocasuarina acutivalvis/Casuarina pauper* over low scrub of *Philotheca brucei* and dwarf scrub of *Prostanthera grylloana;* 8. Low woodland of *Acacia quadrimarginea* over scrub of *Acacia* sp. narrow phyllode, low scrub of *Dodonaea lobulata* and dwarf scrub of *Ptilotus obovatus;* 9. Low woodland of *E. ravida* over low scrub of *Atriplex nummularia/Eremophila scoparia* over dwarf scrub of *Atriplex vesicaria;* 10. Low woodland of *Eucalyptus clelandii/Eucalyptus torquata* over low scrub of *Eremophila interstans* subsp*. virgate;* 11. Low scrub of *Atriplex nummularia* subsp*. spatulata* and *Eremophila dempsteri* over open low grass of *Austrostipa nitida;* and 12. Low woodland of *Eucalyptus clelandii* over low scrub of *Eremophila interstans* subsp*. virgata/Eremophila scoparia.*	
BC, (2014)	Five vegetation communities were identified within the survey area: 1. Low Woodland of *Eucalyptus salmonophloia* over open low scrub of *Atriplex nummularia* subsp. s*patulata* and dwarf scrub of *Tecticornia disarticulata*; 2. Low Woodland of *Eucalyptus clelandii* over open low scrub of *Atriplex nummularia* subsp. *spatulata* and dwarf scrub of *Atriplex vesicaria/ Maireana pentatropis* and *Olearia muelleri*; 3. Low Woodland of *Eucalyptus griffithsii* over low scrub of *Acacia acuminata/ Dodonaea lobulata* and dwarf scrub of *Olearia muelleri* and *Ptilotus obovatus*; 4. Low woodland of *Eucalyptus campaspe* and *E. salmonophloia* over low scrub of *Atriplex nummularia* subsp. *spathulata, Eremophila dempsteri* and dwarf scrub of *Atriplex vesicaria*; and 5. Open Low Woodland of *Eucalyptus clelandii/ E. griffithsii/ Casuarina pauper* over low scrub of *Dodonaea lobulata/ Scaevola spinescens/ Eremophila oldfieldii* subsp. *angustifolia* and *Hakea kippistiana* and dwarf scrub of *Olearia muelleri* and *Ptilotus obovatus* on breakaway.	No Threatened or Priority Flora taxa were identified within the survey area
BC, (2015)	Seven broad vegetation communities were identified within the survey area. These communities comprised of two different landform types and three NVIS major vegetation groups. These communities were represented by a total 28 Families, 36 Genera and 75 Taxa, (including sub-species and variants) 1) Forest of *Casuarina pauper* over low woodland of *Acacia hemiteles* and dwarf scrub of *Olearia muelleri/ Scaevola spinescens* on clay-loam plain 2) Low woodland of *Eucalyptus salubris* over heath of *Eremophila scoparia* and dwarf scrub of *Olearia muelleri/ Sclerolaena diacantha* on clay-loam plain	No Threatened or Priority Flora taxa were identified within the survey area

Author & Year	Vegetation/Landforms	Flora of Conservation Significance
	3) Low woodland of *Eucalyptus clelandii/ E. transcontinentalis* over low scrub of *Acacia hemiteles/ Eremophila caperata* and dwarf scrub of *Eremophila parvifolia/ Olearia muelleri* on clay-loam plain 4) Low woodland of *Eucalyptus salmonophloia* over low scrub of *Acacia hemiteles/ Eremophila scoparia* and dwarf scrub of *Ptilotus obovatus* on clay-loam plain 5) Forest of *Eucalyptus ravida* over open low scrub of *Eremophila scoparia* and low heath of *Maireana oppositifolia/ Ptilotus obovatus* on clay-loam plain 6) Low woodland of *Eucalyptus clelandii*/ Open tree mallee of *E. griffithsii/ E. oleosa* over low scrub of *Eremophila caperata* and dwarf scrub of *Scaevola spinescens/ Senna artemisioides* subsp *filifolia* on clay-loam plain 7) Low woodland *Eucalyptus clelandii/ E. oleosa* over open low scrub of *Eremophila caperata* and low heath of *Cratystylis conocephala/ Eremophila pustulata* on hillslope	

4.2 Field Assessment

4.2.1 Flora of Conservation Significance

Flora of conservation significance identified in the desktop assessment as potentially occurring within the survey area were targeted during the field assessment. No Threatened taxa pursuant to subsection (2) of section 23F of the WC Act and the EPBC Act were identified within the survey area.

One Priority Flora taxon; *Gnephosis intonsa* (P3) is known to occur within the survey area based on previous flora surveys (GHD, 2009). The known location of this taxon was searched, however was not present. During the current survey BC identified an additional location of *Gnephosis intonsa* (P3) where approximately twelve dead taxa were present within one vegetation community; Low woodland *Eucalyptus salmonophloia/ E. transcontinentalis* over low scrub of *Eremophila scoparia/ Exocarpos aphyllus* and dwarf scrub of *Atriplex nummularia* subsp. *spathulata/ Maireana georgei* on clay-loam plain (Plate 1). The closest DPaW location of *Gnephosis intonsa* (P3) is approximately 270m north-east of the location identified by BC.

Gnephosis intonsa (P3) is an annual species and is only expected to be present during favourable seasonal conditions in spring. Its general flowering period is from September to October. It is known from 17 records and its distribution ranges from the east of Leonora to Ravensthorpe. The location of *Gnephosis intonsa* (P3) which were identified by BC in the current survey is displayed in Appendix 2 and the known locations of all of the *Gnephosis intonsa* (P3) identified within the survey area are provided in Appendix 7.

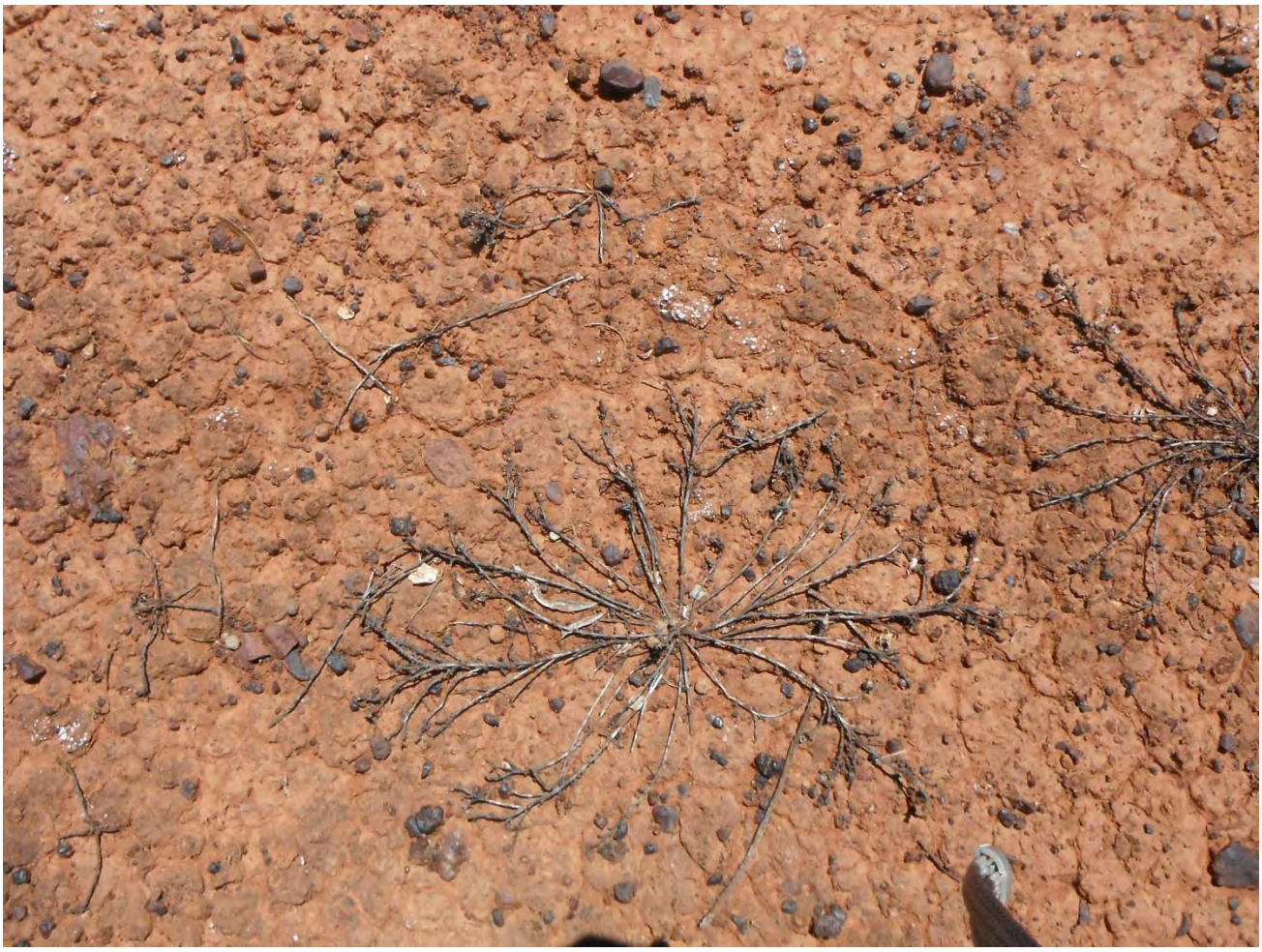


Plate 1: *Gnephosis intonsa* (P3) identified with the Enterprise Stage 4 survey area

4.3 Vegetation Communities

Nine broad vegetation communities were identified within the survey area. These communities comprised of two different landform types and four NVIS major vegetation groups (Table 8). These communities were represented by a total 28 Families, 43 Genera and 108 Taxa, (including sub-species and variants) as listed in Appendix 3. A map showing the vegetation communities present in the survey area is located in Appendix 2.

Table 8: Summary of vegetation communities and area within the Enterprise Stage 4 survey area

Landform	NVIS Vegetation Group	Code	Vegetation Community	Area (ha)	Area (%)
Clay-Loam Plain	Eucalypt Woodlands	CLP-EW1	Low woodland *Eucalyptus salmonophloia/ E. transcontinentalis* over low scrub of *Eremophila scoparia/ Exocarpos aphyllus* and dwarf scrub of *Atriplex nummularia* subsp. *spathulata/ Maireana georgei* on clay-loam plain	148	25
		CLP-EW2	Forest of *Eucalyptus ravida* over open low scrub of *Eremophila scoparia* and low heath of *Maireana oppositifolia/ Ptilotus obovatus* on clay-loam plain	12	2
	Casuarina Forests and Woodlands/ Eucalypt Woodlands	CLP-CFW/EW1	Low woodland of *Casuarina pauper/ Eucalyptus clelandii* over low scrub of *Eremophila scoparia/ Eremophila pustulata/ Scaevola spinescens* and dwarf scrub of *Acacia erinacea/ Olearia muelleri* on undulating clay loam plain	64	11
	Mallee Woodlands and Shrublands	CLP-MWS1	Open tree mallee of *Eucalyptus ebbanoensis* subsp. *ebbanoensis* over scrub of *Acacia ramulosa* var. *ramulosa/ Senna artemisioides* subsp. *filifolia* and dwarf scrub of *Olearia muelleri/ Ptilotus obovatus* on clay-loam plain	27	5
Rocky Hillslope	Acacia Forests and Woodlands	RH-AFW1	Low woodland of *Acacia ramulosa* var. *ramulosa/ A. quadrimarginea* over low scrub of *Eremophila granitica/ Melaleuca hamata* and open dwarf scrub of *Solanum lasiophyllum* on rocky hillslope	49	8
	Casuarina forests and Woodlands	RH-CFW1	Low woodland of *Casuarina pauper* over low scrub of *Eremophila scoparia/ Acacia acuminata* and open dwarf scrub of *A. erinacea/ Senna artemisioides* subsp. *filifolia/ Dodonaea lobulata* on rocky hillslope	71	12
	Eucalypt Woodlands	RH-EW1	Low woodland of *Eucalyptus clelandii* over low scrub of *Acacia erinacea*/ *Eremophila scoparia* and open dwarf scrub of *Dodonaea lobulata/ Senna artemisioides* subsp. *filifolia* on rocky hillslope	91	15
	Mallee Woodlands and Shrublands	RH-MWS1	Open tree mallee of *Eucalyptus griffithsii* over low woodland of *Acacia acuminata/ Eremophila scoparia/ Scaevola spinescens* and dwarf scrub of *Olearia muelleri/ Ptilotus obovatus* rocky hillslope	125	21
		RH-MWS2	Tree mallee of *Eucalyptus flavida* over heath of *Eremophila pustulata* and dwarf scrub of *Westringia rigida* on rocky hillslope	10	2
Total				**597**	**100**

Clay-Loam Plain - Eucalypt Woodlands

4.3.1 Low woodland *Eucalyptus salmonophloia/ E. transcontinentalis* over low scrub of *Eremophila scoparia/ Exocarpos aphyllus* and dwarf scrub of *Atriplex nummularia* subsp. *spathulata/ Maireana georgei* on clay-loam plain (CLP-EW1)

The total flora recorded within this vegetation community was represented by a total of 16 Families, 21 Genera and 49 Taxa (Plate 2). No Threatened or Priority Flora taxa were identified within this vegetation community. No introduced taxa were recorded within this vegetation community. Dominant taxa from the vegetation assemblage are shown in Table 9. According to the NVIS, this vegetation community is best represented by the MVG5-Eucalypt Woodlands (DotE, 2015b).

Table 9: Vegetation assemblage for Low woodland *Eucalyptus salmonophloia/ E. transcontinentalis* over low scrub of *Eremophila scoparia/ Exocarpos aphyllus* and dwarf scrub of *Atriplex nummularia* subsp. *spathulata/ Maireana georgei* on clay-loam plain

Life Form/Height Class	Canopy Cover	Dominant taxa present
Tree 5-15m	10-30%	*Eucalyptus salmonophloia* *Eucalyptus transcontinentalis*
Shrub 1.5-2m	10-30%	*Eremophila scoparia* *Exocarpos aphyllus*
Shrub 0.5-1m	10-30%	*Atriplex nummularia* subsp. *spathulata* *Maireana georgei*

Plate 2: Low woodland *Eucalyptus salmonophloia/ E. transcontinentalis* over low scrub of *Eremophila scoparia/ Exocarpos aphyllus* and dwarf scrub of *Atriplex nummularia* subsp. *spathulata/ Maireana georgei* on clay-loam plain

4.3.2 Forest of *Eucalyptus ravida* over open low scrub of *Eremophila scoparia* and low heath of *Maireana oppositifolia/ Ptilotus obovatus* on clay-loam plain (CLP-EW2)

The total flora recorded within this vegetation community was represented by a total of 14 Families, 19 Genera and 35 Taxa (Plate 3). No Threatened or Priority Flora taxa were identified within this vegetation community. No introduced taxa were recorded within this vegetation community. Dominant taxa from the vegetation assemblage are shown in Table 10. According to the NVIS, this vegetation community is best represented by the MVG5-Eucalypt Woodlands (DotE, 2015b).

Table 10: Vegetation assemblage for Forest of *Eucalyptus ravida* over open low scrub of *Eremophila scoparia* and low heath of *Maireana oppositifolia/ Ptilotus obovatus* on clay-loam plain

Life Form/Height Class	Canopy Cover	Dominant taxa present
Tree 5-15m	30-70%	*Eucalyptus ravida*
Shrub 1-1.5m	2-10%	*Eremophila scoparia*
Shrub 0.5-1m	30-70%	*Maireana oppositifolia* *Ptilotus obovatus*

Plate 3: Forest of *Eucalyptus ravida* over open low scrub of *Eremophila scoparia* and low heath of *Maireana oppositifolia/ Ptilotus obovatus* on clay-loam plain

Clay-Loam Plain- Casuarina Forests and Woodlands/Eucalypt Woodlands

4.3.3 Low woodland of *Casuarina pauper/ Eucalyptus clelandii* over low scrub of *Eremophila scoparia/ Eremophila pustulata/ Scaevola spinescens* and dwarf scrub of *Acacia erinacea/ Olearia muelleri* on undulating clay loam plain (CLP-CFW/EW1)

The total flora recorded within this vegetation community was represented by a total of 16 Families, 20 Genera and 34 Taxa (Plate 4). No Threatened taxa were identified within this vegetation community. One Priority Flora taxon; *Gnephosis intonsa* (P3) was identified within this vegetation community (dead annual). No introduced taxa were recorded within this vegetation community. Dominant taxa from the vegetation assemblage are shown in Table 11. According to the NVIS, this vegetation community is best represented by the MVG8- Casuarina Forests and Woodlands and MVG5-Eucalypt Woodlands (DotE, 2015b).

Table 11: Vegetation assemblage for Low woodland of Casuarina pauper/ *Eucalyptus clelandii* over low scrub of *Eremophila scoparia/ Eremophila pustulata/ Scaevola spinescens* and dwarf scrub of *Acacia erinacea/ Olearia muelleri* on undulating clay loam plain

Life Form/Height Class	Canopy Cover	Dominant taxa present
Tree 5-15m	10-30%	*Casuarina pauper* *Eucalyptus clelandii*
Shrub 1.5-2m	10-30%	*Eremophila scoparia* *Eremophila pustulata* *Scaevola spinescens*
Shrub <0.5m	10-30%	*Acacia erinacea* *Olearia muelleri*

Plate 4: Low woodland of *Casuarina pauper/ Eucalyptus clelandii* over low scrub of *Eremophila scoparia/ Eremophila pustulata/ Scaevola spinescens* and dwarf scrub of *Acacia erinacea/ Olearia muelleri* on undulating clay loam plain

Clay-Loam Plain- Mallee Woodlands and Shrublands

4.3.4 Open tree mallee of *Eucalyptus ebbanoensis* subsp. *ebbanoensis* over scrub of *Acacia ramulosa* var. *ramulosa/ Senna artemisioides* subsp. *filifolia* and dwarf scrub of *Olearia muelleri/ Ptilotus obovatus* on clay-loam plain (CLP-MWS1)

The total flora recorded within this vegetation community was represented by a total of 14 Families, 13 Genera and 20 Taxa (Plate 5). No Threatened or Priority Flora taxon was identified within this vegetation community. No introduced taxa were recorded within this vegetation community. Dominant taxa from the vegetation assemblage are shown in Table 12. According to the NVIS, this vegetation community is best represented by the MVG14- Mallee Woodlands and Shrublands (DotE, 2015b).

Table 12: Vegetation assemblage for Open tree mallee of *Eucalyptus ebbanoensis* subsp. *ebbanoensis* over scrub of *Acacia ramulosa* var. *ramulosa/ Senna artemisioides* subsp. *filifolia* and dwarf scrub of *Olearia muelleri/ Ptilotus obovatus* on clay-loam plain

Life Form/Height Class	Canopy Cover	Dominant taxa present
Mallee Tree Form	10-30%	*Eucalyptus ebbanoensis* subsp. *ebbanoensis*
Shrub 1.5-2m	10-30%	*Acacia ramulosa* var. *ramulosa* *Senna artemisioides* subsp. *filifolia*
Shrub <0.5m	10-30%	*Olearia muelleri* *Ptilotus obovatus*

Plate 5: Open tree mallee of *Eucalyptus ebbanoensis* subsp. *ebbanoensis* over scrub of *Acacia ramulosa* var. *ramulosa/ Senna artemisioides* subsp. *filifolia* and dwarf scrub of *Olearia muelleri/ Ptilotus obovatus* on clay-loam plain

Rocky Hillslope - Acacia Forest and Woodlands

4.3.5 Low woodland of *Acacia ramulosa* var. *ramulosa/ A. quadrimarginea* over low scrub of *Eremophila granitica/ Melaleuca hamata* and open dwarf scrub of *Solanum lasiophyllum* on rocky hillslope (RH-AFW1)

The total flora recorded within this vegetation community was represented by a total of 10 Families, 10 Genera and 11 Taxa (Plate 6). No Threatened or Priority Flora taxa were identified within this vegetation community. No introduced taxon was recorded within this vegetation community. Dominant taxa from the vegetation assemblage are shown in Table 13. According to the NVIS, this vegetation community is best represented by the MVG6- Acacia Forests and Woodlands (DotE, 2015b).

Table 13: Vegetation assemblage for Low woodland of *Acacia ramulosa* var. *ramulosa/ A. quadrimarginea* over low scrub of *Eremophila granitica/ Melaleuca hamata* and open dwarf scrub of *Solanum lasiophyllum* on rocky hillslope

Life Form/Height Class	Canopy Cover	Dominant taxa present
Tree <5m	10-30%	*Acacia ramulosa* var. *ramulosa* *Acacia quadrimarginea*
Shrub 1.5-2m	10-30%	*Eremophila granitica* *Melaleuca hamata*
Shrub 0.5-1m	10-30%	*Solanum lasiophyllum*

Plate 6: Low woodland of *Acacia ramulosa* var. *ramulosa/ A. quadrimarginea* over low scrub of *Eremophila granitica/ Melaleuca hamata* and open dwarf scrub of *Solanum lasiophyllum* on rocky hillslope

Rocky Hillslope - Casuarina Forests and Woodlands

4.3.6 Low woodland of *Casuarina pauper* over low scrub of *Acacia acuminata/ Eremophila scoparia* and open dwarf scrub of *A. erinacea/ Dodonaea lobulata/ Senna artemisioides* subsp. *filifolia* on rocky hillslope (RH-CFW1)

The total flora recorded within this vegetation community was represented by a total of 17 Families, 20 Genera and 40 Taxa (Plate 7). No Threatened or Priority Flora taxa were identified within this vegetation community. No introduced taxa were recorded within this vegetation community. Dominant taxa from the vegetation assemblage are shown in Table 14. According to the NVIS, this vegetation community is best represented by the MVG8- Casuarina Forests and Woodlands (DotE, 2015b).

Table 14: Vegetation assemblage for Low woodland of Low woodland of *Casuarina pauper* over low scrub of *Acacia acuminata/ Eremophila scoparia* and open dwarf scrub of A. erinacea/ *Dodonaea lobulata/ Senna artemisioides* subsp. *filifolia* on rocky hillslope

Life Form/Height Class	Canopy Cover	Dominant taxa present
Tree 5-15m	10-30%	*Casuarina pauper*
Shrub 1-1.5m	10-30%	*Acacia acuminata* *Eremophila scoparia*
Shrub 0.5-1m	10-30%	*Acacia erinacea* *Dodonaea lobulata* *Senna artemisioides* subsp. *filifolia*

Plate 7: Low woodland of Low woodland of *Casuarina pauper* over low scrub of *Acacia acuminata/ Eremophila scoparia* and open dwarf scrub of *A. erinacea/ Dodonaea lobulata/ Senna artemisioides* subsp. *filifolia* on rocky hillslope

Rocky Hillslope - Eucalypt Woodlands

4.3.7 Low woodland of *Eucalyptus clelandii* over low scrub of *Acacia erinacea/ Eremophila scoparia* and open dwarf scrub of *Dodonaea lobulata/ Senna artemisioides* subsp. *filifolia* on rocky hillslope (RH-EW1)

The total flora recorded within this vegetation community was represented by a total of 17 Families, 20 Genera and 40 Taxa (Plate 8). No Threatened or Priority Flora taxa were identified within this vegetation community. No introduced taxon was recorded within this vegetation community. Dominant taxa from the vegetation assemblage are shown in Table 15. According to the NVIS, this vegetation community is best represented by the MVG5- Eucalypt Woodlands (DotE, 2015b).

Table 15: Vegetation assemblage for Low woodland of *Eucalyptus clelandii* over low scrub of *Acacia erinacea/ Eremophila scoparia* and open dwarf scrub of *Dodonaea lobulata/ Senna artemisioides* subsp. *filifolia* on rocky hillslope

Life Form/Height Class	Canopy Cover	Dominant taxa present
Tree 5-15m	10-30%	*Eucalyptus clelandii*
Shrub 1-1.5m	2-10%	*Acacia erinacea* *Eremophila scoparia*
Shrub 0.5-1m	10-30%	*Dodonaea lobulata*

Plate 8: Low woodland of *Eucalyptus clelandii* over low scrub of *Acacia erinacea/ Eremophila scoparia* and open dwarf scrub of *Dodonaea lobulata/ Senna artemisioides* subsp. *filifolia* on rocky hillslope

Rocky Hillslope - Mallee Woodlands and Shrublands

4.3.8 Open tree mallee of *Eucalyptus griffithsii* over low woodland of *Acacia acuminata/ Eremophila scoparia/ Scaevola spinescens* and dwarf scrub of *Olearia muelleri/ Ptilotus obovatus* rocky hillslope (RH-MWS1)

The total flora recorded within this vegetation community was represented by a total of 20 Families, 26 Genera and 55 Taxa (Plate 9). No Threatened or Priority Flora taxa were identified within this vegetation community. No introduced taxon was recorded within this vegetation community. Dominant taxa from the vegetation assemblage are shown in Table 16. According to the NVIS, this vegetation community is best represented by the MVG14- Mallee Woodlands and Shrublands (DotE, 2015b).

Table 16: Vegetation assemblage for Open tree mallee of *Eucalyptus griffithsii* over low woodland of *Acacia acuminata/ Eremophila scoparia/ Scaevola spinescens* and dwarf scrub of *Olearia muelleri/ Ptilotus obovatus* rocky hillslope

Life Form/Height Class	Canopy Cover	Dominant taxa present
Mallee Tree Form	10-30%	*Eucalyptus griffithsii*
Shrub 1.5-2m	10-30%	*Acacia acuminata* *Eremophila scoparia* *Scaevola spinescens*
Shrub 0.5-1m	30-70%	*Olearia muelleri* *Ptilotus obovatus*

Plate 9: Open tree mallee of *Eucalyptus griffithsii* over low woodland of *Acacia acuminata/ Eremophila scoparia/ Scaevola spinescens* and dwarf scrub of *Olearia muelleri/ Ptilotus obovatus* rocky hillslope

4.3.9 Tree mallee of *Eucalyptus flavida* over heath of *Eremophila pustulata* and dwarf scrub of *Westringia rigida* on rocky hillslope (RH-MWS2)

The total flora recorded within this vegetation community was represented by a total of 8 Families, 9 Genera and 12 Taxa (Plate 10). No Threatened or Priority Flora taxa were identified within this vegetation community. No introduced taxa were recorded within this vegetation community. Dominant taxa from the vegetation assemblage are shown in Table 17. According to the NVIS, this vegetation community is best represented by the MVG14- Mallee Woodlands and Shrublands (DotE, 2015b).

Table 17: Vegetation assemblage for Tree mallee of *Eucalyptus flavida* over heath of *Eremophila pustulata* and dwarf scrub of *Westringia rigida* on rocky hillslope

Life Form/Height Class	Canopy Cover	Dominant taxa present
Mallee Tree Form	30-70%	*Eucalyptus flavida*
Shrub 1-1.5m	30-70%	*Eremophila pustulata*
Shrub 0.5-1m	10-30%	*Westringia rigida*

Plate 10: Tree mallee of *Eucalyptus flavida* over heath of *Eremophila pustulata* and dwarf scrub of *Westringia rigida* on rocky hillslope

4.4 Vegetation of Conservation Significance

No Threatened Flora, pursuant to subsection (2) of section 23F of the WC Act and the EPBC Act were identified within the survey area. One Priority Flora taxon; *Gnephosis intonsa* (P3) is known to occur within the survey area based on previous flora surveys in the area (GHD, 2009). The location of this taxon was searched, however no living specimens of this taxon were identified.

Gnephosis intonsa (P3) is an annual species and is only expected to be present during favorable seasonal conditions. BC identified an additional location of *Gnephosis intonsa* (P3) with the remnants of approximately twelve taxa within the Low woodland of *Casuarina pauper/ Eucalyptus clelandii* over low scrub of *Eremophila scoparia/ Eremophila pustulata/ Scaevola spinescens* and dwarf scrub of *Acacia erinacea/ Olearia muelleri* on undulating clay loam plain vegetation community.

None of the vegetation communities within the survey area were found to have National Environmental Significance as defined by the Commonwealth EPBC Act. No TEC pursuant to Commonwealth legislation or PEC as listed by the DPaW was recorded within the survey area.

The survey area is not located within any ESA as described in Regulation 6, clause 4 of the EP Regulations. Approximately 2ha of the survey area is located within a Schedule 1 Area situated along the “Broad-Arrow Ora Banda road”.

The survey area is not located within any DPaW managed land. The closest DPaW managed lands are the former pastoral lease “Credo Station”, located approximately 8.5km west of the survey area and the Class C Nature Reserve – Clear and Muddy Lakes which is located approximately 20km west of the survey area.

4.5 Vegetation Condition

Based on Keighery’s vegetation health rating scale (1994), all nine vegetation communities (Table 18) were rated as ‘Good’ (Figure 9) which depicts vegetation structures that have been significantly altered by very obvious signs of multiple disturbances, in this instance as a result of exploration activities, grazing, vehicle access, historic clearing and mining activities; however it retains its basic structure and has capacity to regenerate (Appendix 6).

Table 18: Health Rating of Vegetation Communities within the Enterprise Stage 4 survey area

Landform	NVIS Vegetation Group	Code	Vegetation Community	Health
Clay-Loam Plain	Eucalypt Woodlands	CLP-EW1	Low woodland *Eucalyptus salmonophloia/ E. transcontinentalis* over low scrub of *Eremophila scoparia/ Exocarpos aphyllus* and dwarf scrub of *Atriplex nummularia* subsp. *spathulata/ Maireana georgei* on clay-loam plain	Good
		CLP-EW2	Forest of *Eucalyptus ravida* over open low scrub of *Eremophila scoparia* and low heath of *Maireana oppositifolia/ Ptilotus obovatus* on clay-loam plain	Good
	Casuarina Forests and Woodlands/ Eucalypt Woodlands	CLP-CFW/EW1	Low woodland of *Casuarina pauper/ Eucalyptus clelandii* over low scrub of *Eremophila scoparia/ Eremophila pustulata/ Scaevola spinescens* and dwarf scrub of *Acacia erinacea/ Olearia muelleri* on undulating clay loam plain	Good
	Mallee Woodlands and Shrublands	CLP-MWS1	Open tree mallee of *Eucalyptus ebbanoensis* subsp. *ebbanoensis* over scrub of *Acacia ramulosa* var. *ramulosa/ Senna artemisioides* subsp. *filifolia* and	Good

Landform	NVIS Vegetation Group	Code	Vegetation Community	Health
			dwarf scrub of *Olearia muelleri/ Ptilotus obovatus* on clay-loam plain	
Rocky Hillslope	Acacia Forests and Woodlands	RH-AFW1	Low woodland of *Acacia ramulosa* var. *ramulosa/ A. quadrimarginea* over low scrub of *Eremophila granitica/ Melaleuca hamata* and open dwarf scrub of *Solanum lasiophyllum* on rocky hillslope	Good
	Casuarina Forests and Woodlands	RH-CFW1	Low woodland of *Casuarina pauper* over low scrub of *Eremophila scoparia/ Acacia acuminata* and open dwarf scrub of *A. erinacea/ Senna artemisioides* subsp. *filifolia/ Dodonaea lobulata* on rocky hillslope	Good
	Eucalypt Woodlands	RH-EW1	Low woodland of *Eucalyptus clelandii* over low scrub of Acacia erinacea/ *Eremophila scoparia* and open dwarf scrub of *Dodonaea lobulata/ Senna artemisioides* subsp. *filifolia* on rocky hillslope	Good
	Mallee Woodlands and Shrublands	RH-MWS1	Open tree mallee of *Eucalyptus griffithsii* over low woodland of A*cacia acuminata/ Eremophila scoparia/ Scaevola spinescens* and dwarf scrub of *Olearia muelleri/ Ptilotus obovatus* rocky hillslope	Good
		RH-MWS2	Tree mallee of *Eucalyptus flavida* over heath of *Eremophila pustulata* and dwarf scrub of *Westringia rigida* on rocky hillslope	Good

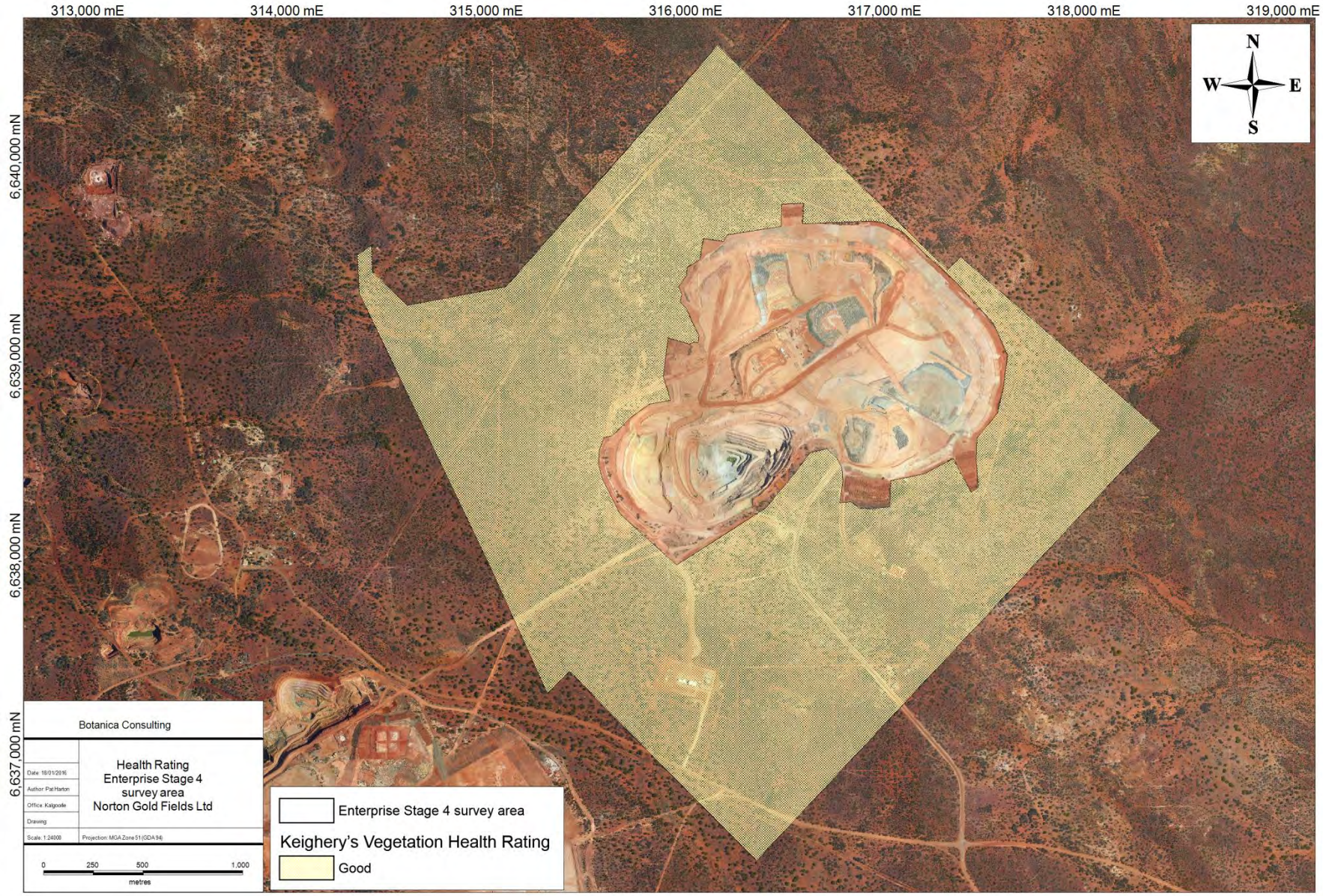


Figure 9: Health Condition of vegetation within the Enterprise Stage 4 survey area

4.6 Introduced Plant Taxa

No introduced taxa were identified within the survey area.

5 Relevant Legislation and Compliance with Recognised Standards

5.1 Commonwealth Legislation

Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*

The aim of this Act is to protect matters of national environmental significance, and is used by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) to list threatened taxa and ecological communities into categories based on the criteria set out in the Act (www.environment.gov.au/epbc/index.html). The Act provides a national environmental assessment and approval system for proposed developments and enforces strict penalties for unauthorised actions that may affect matters of national environmental significance.

The survey area does not have national environmental significance under the EPBC Act. There are no TEC or Threatened Flora as listed under the EPBC Act identified within the survey area.

5.2 State Legislation

5.2.1 Clearing of Native Vegetation

Under Section 51C of the EP Act and the EP Regulations any clearing of native vegetation in Western Australia that is not eligible for exemption under Schedule 6 of the EP Act or under the EP Regulations requires a clearing permit from the DER or DMP. Under Section 51A of the EP Act native vegetation includes aquatic and terrestrial vegetation indigenous to Western Australia, and intentionally planted vegetation declared by regulation to be native vegetation, but not vegetation planted in a plantation or planted with commercial intent. Section 51A of the EP Act defines clearing as "*the killing or destruction of; the removal of; the severing or ringbarking of trunks or stems of; or the doing of substantial damage to some or all of the native vegetation in an area, including the flooding of land, the burning of vegetation, the grazing of stock or an act or activity that results in the above*".

Exemptions under Schedule 6 of the EP Act and the EP Regulations do not apply for clearing an area exceeding 10ha per tenement; clearing in ESA's as declared under Section 51B of the EP Act or within Schedule 1 Areas as described in Regulation 6 and Schedule 1, clause 4 of the EP Regulations.

The survey area is not located within an ESA, however approximately 2ha of the survey area is located within a Schedule 1 Area; located along the "Broad Arrow Ora Banda road' (Appendix 1). If development of the project will require >10ha of clearing, a clearing permit is required.

5.2.2 Environmental Protection Act WA 1986

This Act pertains to the assessment of applications for clearing permits and aims to protect Declared Rare Flora and Threatened Ecological Communities from clearing. Threatened Ecological Communities are protected even where exemptions for a clearing permit may apply. The act enforces both financial and/or imprisonment penalties on those who unlawfully damage a TEC.

The survey area does not contain any TEC or Threatened Flora.

5.2.3 Wildlife Conservation Act WA 1950

This Act is used by the Western Australian DPaW to list flora taxa as being protected and the level of protection needed for such flora. Flora taxa are classified as 'Declared Rare Flora' when their populations are geographically restricted or are threatened by local processes. Under this Act all native flora (spermatophytes, Pteridophyta, bryophytes and thallophytes) are protected throughout the State. Financial penalties are enforced under this Act if threatened plant taxa are collected without an appropriate licence.

5.2.4 DPaW Priority lists

The DPaW lists 'Priority' flora taxa which are under consideration for declaration as Rare Flora. Taxa classed as Priority 1-3 are in urgent need of further survey, whereas Priority 4 taxa are considered to have been adequately surveyed but may become vulnerable or rare in future years. Priority 4 taxa are also taxa that have been removed from the threatened taxa list in the past 5 years. Priority 5 taxa are those taxa which are not currently threatened but are subject to a specific conservation program, the cessation of which would result in the taxon likely to become threatened within 5 years The DPaW also lists PECs, which identifies those communities that may need monitoring before possible nomination for TEC status. These priority taxa and communities have no formal legal protection until they are endorsed by the Minister as being Declared Rare Flora and TEC's respectively.

Results of the DPaW databases search (DPaW, 2015a) revealed ten flora of conservation significance within a 50km radius of the survey area, of which four had the potential to occur within the survey area. One annual Priority Flora taxon; *Gnephosis intonsa* (P3) is known to occur within the survey area.

5.3 EPA Position Statements

The EPA develops Position Statements to inform the public about environmental issues facing Western Australia, and the plans for the future to ensure protection and ecological sustainability of environmentally important ecosystems. It provides a set of principles to assist the public and decision-makers on their responsibilities for managing land with care. These principles also provide the basis for the Environmental Protection Authority to evaluate and report upon achieving environmental and ecological sustainability, and the protection of natural resources.

5.3.1 Position Statement No. 2

Environmental Protection of Native Vegetation in Western Australia (EPA 2000) outlines EPA policy on the protection of native vegetation in Western Australia, particularly in the agricultural area. It identifies basic elements that the EPA should consider when assessing proposals that impact on biological diversity. These include comparison of all proposal options; avoidance of taxa and community extinctions; an expectation that implementing the proposal will not take a vegetation type below the "threshold level" of 30%; and that proponents should demonstrate that on- and off-site impacts can be managed.

The survey area does not contain any Threatened Flora or TEC suggesting that clearing within the area will meet the EPA standards outlined in Position Statement No. 2. According to DAFWA (2011) the survey area occurs within the pre-European Beard vegetation association Broad Arrow 2901 which retain approximately 96% of the original pre-European vegetation extent.

5.3.2 Position Statement No. 3

Terrestrial Biological Surveys as an Element of Biodiversity Protection establishes that the EPA has adopted the definition and principles of biological diversity as defined in the *National Strategy for the Conservation of Australia's Biological Diversity* (Commonwealth of Australia, 1996), and has stipulated the following requirements:

- The quality of information and scope of field surveys should meet standards, requirements and protocols as determined and published by the EPA; and
- The IBRA regionalisation's should be used as the largest unit for Environmental Impact assessment (EIA) decision-making in relation to the conservation of biodiversity.

Pursuant to the IBRA regionalisation's, 26 bioregions in WA, which are affected by a range of different threatening processes and have varying levels of sensitivity to impact, have been identified. Terrestrial biological surveys should provide sufficient information to address both biodiversity conservation and ecological functional values within the context of proposals and the results of surveys should be publicly available.

The flora survey was planned and implemented as far as practicable according to the EPA Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004). Also, the IBRA regionalisation's have been used in preparing the report to identify the conservation status of the area and identify the main threats to the biodiversity of plant taxa in the region.

5.4 Native Vegetation Clearing Principles

Based on the outcomes from the survey undertaken, as presented in this report, BC provides the following comments regarding the native vegetation clearing principles (relevant to vegetation only) listed under Schedule 5 of the EP Act (Table 19).

Table 19: Assessment of development within the Enterprise Stage 4 survey area against native vegetation clearing principles

Letter	Principle	Assessment	Outcome
(a)	Native vegetation should not be cleared if it comprises a high level of biological diversity.	Vegetation identified within the survey area is not considered to be of high biological diversity, and is well represented outside of the proposed impact area.	Development within the survey area is unlikely to be at variance to this principle
(c)	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of rare flora.	No Threatened Flora taxa, pursuant to subsection (2) of section 23F of the WC Act and the EPBC Act were identified within the survey area.	Development within the survey area is unlikely to be at variance to this principle
(d)	Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a threatened ecological community (TEC).	No TEC listed under the EPBC Act or by the DPaW occur within the survey area.	Development within the survey area is unlikely to be at variance to this principle
(e)	Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared	According to DAFWA (2011), the survey area occurs in pre-European Beard vegetation association Broad Arrow 2901 in the Eastern Goldfields (COO3) subregion, which retains approximately 96% of the original vegetation extent.	Development within the survey area is unlikely to be at variance to this principle
(f)	Native vegetation should not be cleared if it is growing, in, or in association with, an environment associated with a watercourse or wetland	According to the Geoscience Australia (2001) GIS data on inland drainage, there are no watercourses associated with the survey area.	Development within the survey area is unlikely to be at variance to this principle
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	According to DAFWA (2011), the survey area occurs in pre-European Beard vegetation association Broad Arrow 2901 in the Eastern Goldfields (COO3) subregion, which retains approximately 96% of the original vegetation extent. Clearing within these vegetation associations is not likely to lead to land degradation issues such as salinity, water logging or acidic soils.	Development within the survey area is unlikely to be at variance to this principle
(h)	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The survey area is not located within a conservation area. The closest DPaW managed lands are the former pastoral lease “Credo Station”, located approximately 8.5km west of the survey area and the Class C Nature Reserve – Clear and Muddy Lakes which is located approximately 20km west of the	Development within the survey area is unlikely to be at variance to this principle

Letter	Principle	Assessment	Outcome
		survey area. Clearing of vegetation within the survey area in not anticipated to impact on the conservation values of the Nature Reserve.	

6 Conclusions

The Enterprise Stage 4 survey area comprised of nine broad vegetation communities which were represented by a total 28 Families, 43 Genera and 108 Taxa, including sub-species and variants. No Threatened Flora taxa, pursuant to subsection (2) of section 23F of the WC Act and the Commonwealth EPBC Act were identified within the survey area. Previous surveys in the area identified an annual Priority Flora taxon; *Gnephosis intonsa* (P3). Due to the timing of the survey this annual had completed its life cycle and only dead remains of this taxa were recorded.

None of the vegetation communities within the survey area were found to have National Environmental Significance as defined by the Commonwealth EPBC Act. No TEC pursuant to Commonwealth or State legislation were recorded within the survey area. None of the vegetation communities within the survey area were found to have National Environmental Significance as defined by the Commonwealth *EPBC Act 1999*. No TEC pursuant to the Commonwealth *EPBC Act 1999* or PEC as listed by the DPaW was recorded within the survey area.

The survey area is not located within any ESA as described in Regulation 6 and Schedule 1, clause 4 of the EP Regulations. Approximately 2ha of the survey area is located within a Schedule 1 Area; situated along the “Broad Arrow Ora Banda road’. The survey area is not located within any DPaW managed land. The closest DPaW managed lands are the former pastoral lease “Credo Station”, located approximately 8.5km west of the survey area and the Class C Nature Reserve – Clear and Muddy Lakes which is located approximately 20km west of the survey area.

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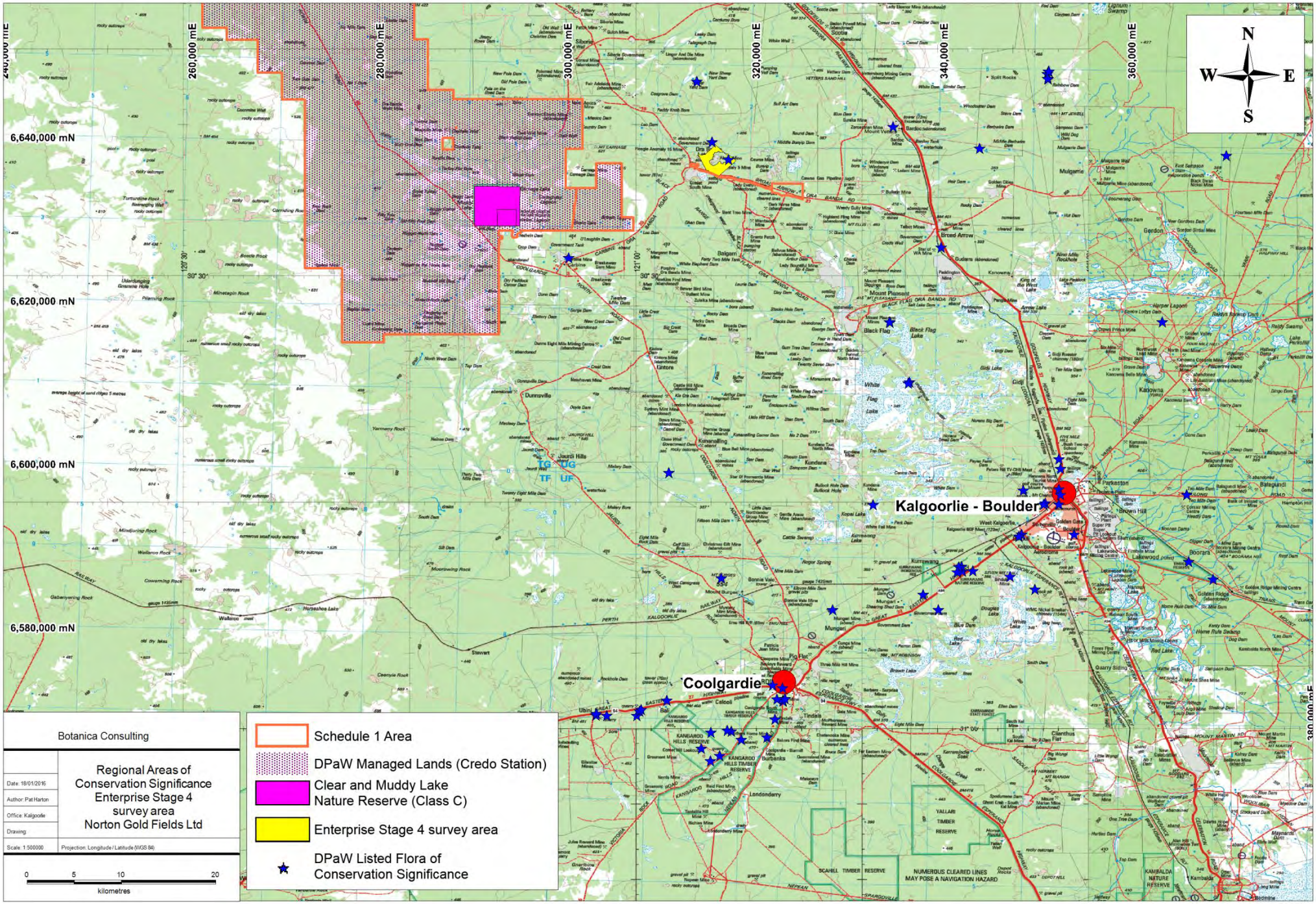
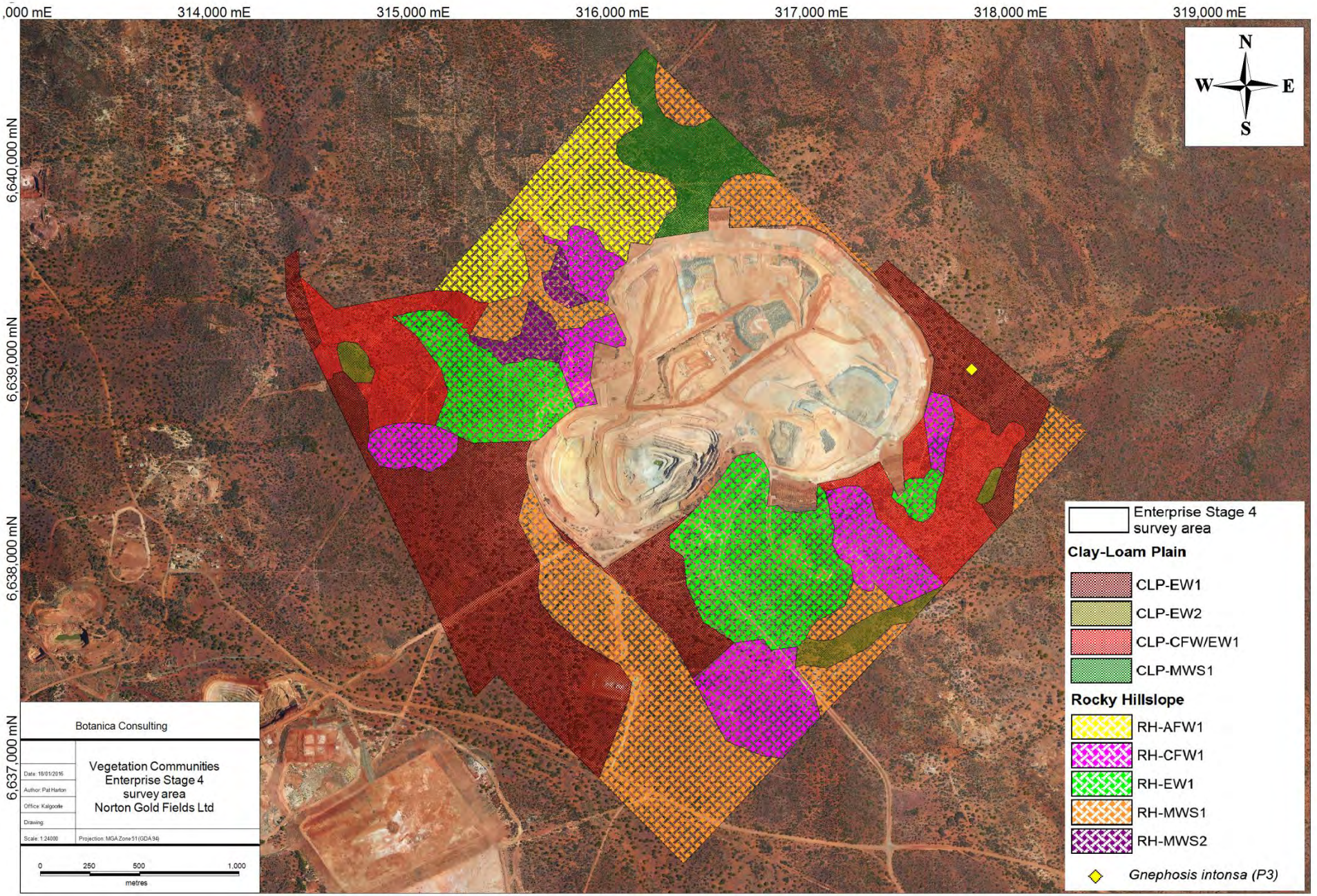
Appendix 1: Regional map of the Enterprise Stage 4 survey area including areas of conservation significance



Appendix 2: Vegetation Communities and Priority Flora Location of the Enterprise Stage 4 survey area



Appendix 3: List of species identified within each vegetation community

(P) Denotes Priority Flora Taxa; (A) Denotes Annual Taxa as listed on Florabase (WAHERB, 2016)

Family	Genus	Taxon	CLP-EW1	CLP-EW2	CLP-CFW/EW1	CLP-MWS1	RH-AFW1	RH-CFW1	RH-EW1	RH-MWS1	RH-MWS2
Amaranthaceae	*Ptilotus*	*nobilis*	*					*	*		
Amaranthaceae	*Ptilotus*	*obovatus*	*	*	*	*		*	*	*	
Apocynaceae	*Alyxia*	*buxifolia*		*	*	*		*	*	*	
Asclepiadaceae	*Marsdenia*	*australis*			*					*	
Asteraceae	*Gnephosis*	*intonsa* (P3)	*								
Asteraceae	*Olearia*	*muelleri*	*	*	*	*	*	*	*	*	
Asteraceae	*Olearia*	*pimeleoides*						*	*	*	
Asteraceae	*Ozothamnus*	*cassiope*								*	
Caesalpiniaceae	*Senna*	*artemisioides* subsp. *artemisioides*				*	*				
Caesalpiniaceae	*Senna*	*artemisioides* subsp. *filifolia*	*	*	*	*		*	*	*	*
Caesalpiniaceae	*Senna*	*cardiosperma*		*				*	*		
Casuarinaceae	*Allocasuarina*	*acutivalvis*			*						
Casuarinaceae	*Allocasuarina*	*campestris*								*	*
Casuarinaceae	*Allocasuarina*	*helmsii*									*
Casuarinaceae	*Casuarina*	*pauper*	*	*	*			*	*	*	*
Chenopodiaceae	*Atriplex*	*bunburyana*	*	*				*	*		
Chenopodiaceae	*Atriplex*	*codonocarpa (A)*					*				
Chenopodiaceae	*Atriplex*	*nummularia* subsp. *spathulata*	*	*		*		*	*	*	
Chenopodiaceae	*Atriplex*	*vesicaria*	*		*			*	*		
Chenopodiaceae	*Enchylaena*	*tomentosa*	*	*				*	*		
Chenopodiaceae	*Maireana*	*georgei*	*	*	*			*	*	*	
Chenopodiaceae	*Maireana*	*pyramidata*		*							
Chenopodiaceae	*Maireana*	*sedifolia*	*		*			*	*		
Chenopodiaceae	*Maireana*	*tomentosa*	*								
Chenopodiaceae	*Maireana*	*trichoptera*	*		*						
Chenopodiaceae	*Maireana*	*triptera*	*	*						*	
Chenopodiaceae	*Rhagodia*	*drummondii*	*					*	*		
Chenopodiaceae	*Sclerolaena*	*cuneata*	*								
Chenopodiaceae	*Sclerolaena*	*diacantha*	*	*							
Chenopodiaceae	*Sclerolaena*	*eurotioides*						*	*		

Family	Genus	Taxon	CLP-EW1	CLP-EW2	CLP-CFW/EW1	CLP-MWS1	RH-AFW1	RH-CFW1	RH-EW1	RH-MWS1	RH-MWS2
Chenopodiaceae	*Sclerolaena*	*obliquicuspis*	*								
Chenopodiaceae	*Sclerolaena*	*parviflora*		*							
Euphorbiaceae	*Euphorbia*	*drummondii* subsp. *drummondii*						*	*	*	
Fabaceae	*Acacia*	*collegialis*								*	
Fabaceae	*Acacia*	*colletioides*								*	
Fabaceae	*Acacia*	*erinacea*	*		*	*		*	*	*	
Fabaceae	*Acacia*	*hemiteles*	*	*	*			*	*	*	
Fabaceae	*Acacia*	*jennerae*	*					*	*		
Fabaceae	*Acacia*	*kalgoorliensis*									*
Fabaceae	*Acacia*	*kempeana*									*
Fabaceae	*Acacia*	*prainii*				*					
Fabaceae	*Acacia*	*quadrimarginea*									*
Fabaceae	*Acacia*	*ramulosa*				*				*	
Fabaceae	*Acacia*	*sibirica*								*	
Fabaceae	*Acacia*	*tetragonophylla*	*	*		*		*	*	*	
Frankeniaceae	*Frankenia*	*setosa*	*								
Goodeniaceae	*Scaevola*	*spinescens*	*		*	*	*	*	*	*	
Lamiaceae	*Prostanthera*	*campbellii*			*						
Lamiaceae	*Prostanthera*	*grylloana*			*						
Lamiaceae	*Westringia*	*cephalantha*			*						*
Lamiaceae	*Westringia*	*rigida*								*	
Loranthaceae	*Amyema*	*benthamii*					*				
Malvaceae	*Alyogyne*	*hakeifolia*		*							
Malvaceae	*Sida*	*spodochroma*				*					
Mimosaceae	*Acacia*	*acuminata*	*			*		*	*	*	
Mimosaceae	*Acacia*	*andrewsii*								*	
Mimosaceae	*Acacia*	*incurvaneura*						*	*	*	
Myrtaceae	*Eucalyptus*	*celastroides* subsp. *celastroides*	*	*	*			*	*	*	
Myrtaceae	*Eucalyptus*	*celastroides* subsp. *virella*	*		*						
Myrtaceae	*Eucalyptus*	*clelandii*	*	*	*			*	*	*	
Myrtaceae	*Eucalyptus*	*ebbanoensis* subsp. *ebbanoensis*				*					
Myrtaceae	*Eucalyptus*	*flavida*			*					*	*
Myrtaceae	*Eucalyptus*	*griffithsii*	*			*				*	
Myrtaceae	*Eucalyptus*	*ravida*	*		*			*	*	*	

Family	Genus	Taxon	CLP-EW1	CLP-EW2	CLP-CFW/EW1	CLP-MWS1	RH-AFW1	RH-CFW1	RH-EW1	RH-MWS1	RH-MWS2
Myrtaceae	*Eucalyptus*	*salmonophloia*	*	*				*	*		
Myrtaceae	*Eucalyptus*	*salubris*		*							
Myrtaceae	*Eucalyptus*	*transcontinentalis*	*	*	*			*	*		
Myrtaceae	*Eucalyptus*	*yilgarnensis*								*	
Myrtaceae	*Melaleuca*	*hamata*								*	
Myrtaceae	*Melaleuca*	*leiocarpa*								*	
Papilionaceae	*Mirbelia*	*depressa*					*				
Papilionaceae	*Templetonia*	*sulcata*	*					*	*		
Poaceae	*Austrostipa*	*elegantissima*		*							
Poaceae	*Austrostipa*	*nitida*	*		*			*	*	*	
Poaceae	*Triodia*	*scariosa*									*
Proteaceae	*Grevillea*	*acuaria*	*		*			*	*	*	*
Proteaceae	*Grevillea*	*oligomera*								*	
Proteaceae	*Hakea*	*preissii*								*	
Rhamnaceae	*Trymalium*	*myrtillus*					*				
Rutaceae	*Phebalium*	*canaliculatum*								*	
Rutaceae	*Philotheca*	*brucei*								*	
Santalaceae	*Exocarpos*	*aphyllus*	*	*	*					*	
Santalaceae	*Santalum*	*acuminatum*	*	*				*	*		
Santalaceae	*Santalum*	*spicatum*	*	*	*	*		*	*	*	*
Sapindaceae	*Alectryon*	*oleifolius*		*							
Sapindaceae	*Dodonaea*	*lobulata*	*		*	*		*	*	*	
Sapindaceae	*Dodonaea*	*viscosa* subsp. *angustissima*		*							
Scrophulariaceae	*Eremophila*	*alternifolia*	*							*	
Scrophulariaceae	*Eremophila*	*caperata*		*							
Scrophulariaceae	*Eremophila*	*clarkei*		*							
Scrophulariaceae	*Eremophila*	*georgei*								*	
Scrophulariaceae	*Eremophila*	*glabra*	*							*	
Scrophulariaceae	*Eremophila*	*granitica*					*	*	*		
Scrophulariaceae	*Eremophila*	*interstans* subsp. *virgata*	*	*		*					
Scrophulariaceae	*Eremophila*	*ionantha*		*							
Scrophulariaceae	*Eremophila*	*latrobei*					*				
Scrophulariaceae	*Eremophila*	*maculata*	*		*						
Scrophulariaceae	*Eremophila*	*oldfieldii* subsp. *angustifolia*	*	*	*	*		*	*	*	

Family	Genus	Taxon	CLP-EW1	CLP-EW2	CLP-CFW/EW1	CLP-MWS1	RH-AFW1	RH-CFW1	RH-EW1	RH-MWS1	RH-MWS2
Scrophulariaceae	*Eremophila*	*oppositifolia* subsp. *angustifolia*	*		*			*	*	*	
Scrophulariaceae	*Eremophila*	*parvifolia* subsp. *auricampa*	*							*	
Scrophulariaceae	*Eremophila*	*pustulata*	*		*			*	*	*	
Scrophulariaceae	*Eremophila*	*scoparia*	*	*	*			*	*	*	
Scrophulariaceae	*Eremophila*	sp. Mt Jackson (G.J Keighery 4372)			*					*	
Solanaceae	*Solanum*	*hoplopetalum*								*	
Solanaceae	*Solanum*	*lasiophyllum*								*	
Solanaceae	*Solanum*	*nummularium*		*						*	
Sterculiaceae	*Brachychiton*	*gregorii*					*				
Thymelaeaceae	*Pimelea*	*microcephala*					*				
Violaceae	*Hybanthus*	*floribundus* subsp. *curvifolius*				*					

Appendix 4: DPaW Threatened Flora Database search results within 50km of the Enterprise Stage 4 survey area (DPaW, 2015a)

Taxon	Conservation Code	Description (WAHERB, 2016)
Acacia epedunculata	1	Low spreading, becoming rounded, multi-stemmed shrub, 0.5-0.65 m high. Fl. yellow, Aug. Yellow sand. Sandplains.
Angianthus prostratus	3	Prostrate annual, herb. Fl. white-yellow, Jul to Sep. Red clay or loamy soils. Saline depressions.
Eremophila praecox	1	Broom-like shrub, 1.5-3 m high. Fl. purple, Oct or Dec. Red/brown sandy loam. Undulating plains.
Eucalyptus jutsonii subsp. *jutsonii*	4	Mallee, 4-7 m high, bark rough over most stems, grey to light grey-brown. Red to pale orange deep sands. Undulating areas and on dunes.
Gnephosis intonsa	3	Prostrate to ascending annual, herb, 0.01-0.04 m high. Fl. yellow-brown, Sep to Oct. Red/brown clay, stony saline loam.
Gnephosis sp. Norseman (K.R. Newbey 8096)	3	Low spreading annual, herb, 0.03-0.07 m high, 0.08-0.18 m wide. Subsaline loam. Moderately exposed flat.
Gompholobium cinereum	3	Shrub, to 0.3 m high. Yellow sand, clayey sand, brown loam, sandy gravel, laterite. Well-drained open sites, slopes, plains, roadsides.
Phebalium appressum	1	Rounded shrub, ca 1 m high, leaves cordate-ovate, ca 2 mm long; flowers usually solitary; pedicels short, thick, ca 1 mm long. Fl. white, Jul. Yellow sandplain.
Ptilotus chortophytus	1	Small perennial herb to 12 cm high, 12 cm wide, green flowers, small succulent basal leaves.
Ricinocarpos sp. Eastern Goldfields (A. Williams 3)	1	Shrub 2 m high x 2 m wide. Flowers yellow. Rocky hillslope. Rocky surface. Red-brown sand-loam over felsic and mafic volcanics

Appendix 5: Muir Life Form/Height Class (Muir, 1977).

LIFE FORM/HEIGHT CLASS	CANOPY COVER			
	DENSE 70% -100%	**MID DENSE 30% -70%**	**SPARSE 10% -30%**	**VERY SPARSE 2% -10%**
Trees > 30m Trees 15 – 30m Trees 5 – 15m Trees < 5m	Dense Tall Forest Dense Forest Dense Low Forest A Dense Low Forest B	Tall Forest Forest Low Forest A Low Forest B	Tall Woodland Woodland Low woodland A Low Woodland B	Open Tall Woodland Open Woodland Open Low Woodland A Open Low Woodland B
Mallee Tree Form Mallee Shrub Form	Dense Tree Mallee Dense Shrub Mallee	Tree Mallee Shrub Mallee	Open Tree Mallee Open Shrub Mallee	Very Open Tree Mallee Very Open Shrub Mallee
Shrubs > 2m Shrubs 1.5 – 2m Shrubs 1 – 1.5m Shrubs 0.5 – 1m Shrubs 0 – 0.5m	Dense Thicket Dense Heath A Dense Heath B Dense Low Heath C Dense Low Heath D	Thicket Heath A Heath B Low Heath C Low Heath D	Scrub Low Scrub A Low Scrub B Dwarf Scrub C Dwarf Scrub D	Open Scrub Open Low Scrub A Open Low Scrub B Open Dwarf Scrub C Open Dwarf Scrub D
Mat Plants Hummock Grass Bunch grass >0.5m Bunch grass < 0.5m Herbaceous spp.	Dense Mat Plants Dense Hummock Grass Dense Tall Grass Dense Low Grass Dense Herbs	Mat Plants Mid-dense Hummock Grass Tall Grass Low Grass Herbs	Open Mat Plants Hummock Grass Open Tall Grass Open Low Grass Open Herbs	Very Open Mat Plants Open Hummock Grass Very Open Tall Grass Very Open Low Grass Very Open Herbs
Sedges > 0.5m Sedges < 0.5m	Dense Tall Sedges Dense Low Sedges	Tall Sedges Low Sedges	Open Tall Sedges Open Low Sedges	Very Open Tall Sedges Very Open Low Sedges
Ferns Mosses, liverworts	Dense ferns Dense Mosses	Ferns Mosses	Open Ferns Open Mosses	Very Open Ferns Very Open Mosses

Appendix 6: Keighery Health rating scale (1994).

Health Description	Definition
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as “parkland cleared’ with the flora comprising weed or crop species with isolated native trees or shrubs.

Appendix 7: GPS Locations of Gnephosis intonsa (P3) identified within the survey area

Taxon	Conservation Code	No. Of Specimens	Reference	Location (GDA94)
Gnephosis intonsa	3	12	BC 2015	317773 6638906
Gnephosis intonsa	3	1	GHD 2009	317557 6638741

Appendix 6

2009 Enterprise Flora and Fauna Survey, GHD

CLIENTS | PEOPLE | PERFORMANCE

Paddington Gold Pty Ltd

Enterprise Development Activities

Flora and Fauna Assessment

November 2009

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Executive Summary

Paddington Gold Pty Ltd (Paddington Gold) is proposing to undertake development activities at its Enterprise tenements, located approximately 55 km northwest of Kalgoorlie, Western Australia. Paddington Gold has commissioned GHD Pty Ltd (GHD) to undertake a baseline flora and fauna assessment of the project area to provide necessary information to support associated clearing permit and mining proposal submissions. This report details the findings of the assessment.

The Study Area is situated approximately 500 metres to east of the Ora Banda townsite in the Goldfields of Western Australia and covers an area of approximately 921 ha. The Study Area lies within mining leases M24/170 and M24/29, both of which are intersected by the Ora Banda - Broad Arrow Road.

The flora and fauna assessment was undertaken in September 2009. Results from the desktop study and field survey are summarised below:

- There are no natural permanent watercourses or wetlands within the study area. All drainage lines in the Study Area are small and intermittent, flowing only after major rainfall events.
- No Environmentally Sensitive Areas occur within the vicinity of the Study Area. No reserves or conservation areas occur within the vicinity of the study area.
- A Schedule One Area encompassing the Ora Banda townsite is located immediately to the west of the Site. Development activities are not expected to impact on this area.
- Based on the mapping by Shepherd (2002, 2005) the vegetation association present within the Study Area is well represented in the region and falls into the status category of *Least Concern.*
- No Threatened Ecological Communities were recorded within the Study Area. No Priority Ecological Communities were recorded within the study area.
- The Study Area is dominated by eucalypt – *Casuarina* woodlands, interspersed with *Acacia* shrublands. Vegetation was classified into ten vegetation types on the basis of structure and species composition.
- Disturbances from mining, exploration and pastoral activities are evident across much of the Study Area; however, the majority of vegetation was considered to be in *Excellent* (2) to *Very Good* (3) condition. The most noticeable areas of disturbance are the two previously mined open pit sites and associated operational areas. Both areas are considered to be *Completely Degraded* (6). All formed roads within the Study Area were also considered to be *Completely Degraded* (6).
- Vegetation within the Study Area is considered to be moderately diverse. A total of 148 taxa from 41 families were recorded from the Study Area.
- No Declared Rare Flora (DRF) species were recorded within the Study Area.

- One Priority Flora species was recorded during the field survey: *Gnephosis intonsa* (Priority 1). This taxon was recorded on colluvial flats within mining lease M24/170, approximately 900 m north east of the existing Enterprise Pit. Only one plant was recorded during this survey.
- A total of 11 weed species were recorded, comprising approximately 7% of the total number of plant species recorded in the Study Area. One Declared Plant taxa, **Carthamus lanatus* (Saffron Thistle), was recorded from the Study Area adjacent to the access track on the eastern perimeter of the Enterprise Pit.
- A total of 29 bird species, five mammal species and three reptile species were recorded within the Study Area during the reconnaissance survey. It is considered that the short duration and the general limitations associated with a Level 1 survey resulted in the low number of reptile and mammal species recorded.
- No threatened or significant fauna species or habitats of significance were recorded from the Study Area.
- This project is considered unlikely to be significantly at variance with any of the '10 Clearing Principles'.
- Vegetation clearing should be minimised as far as possible.
- Areas to be avoided during construction, such as Priority Flora locations, should be clearly defined and demarcated on the ground to prevent accidental clearing.
- Appropriate management measures will assist in mitigating potential impacts, such as erosion, weed spread and fauna mortality during construction and ongoing operations.

1. Introduction

1.1 Background

Paddington Gold is proposing to undertake development activities at its Enterprise tenements, located approximately 55 km northwest of Kalgoorlie, Western Australia. The tenements were acquired by Paddington Gold through its acquisition of the Paddington Gold mine in August 2007. Mining has been undertaken previously at the site; however, limited biological survey information is available.

Paddington Gold has commissioned GHD Pty Ltd (GHD) to undertake a baseline flora and fauna assessment of the project area to provide necessary information to support associated clearing permit and mining proposal submissions. This report details the findings of the assessment.

1.2 Study Area

The Study Area is situated approximately 500 metres east of the Ora Banda townsite in the Goldfields of Western Australia and covers an area of approximately 921 ha. The Study Area lies within mining leases M24/170 and M24/29, both of which are intersected by the Ora Banda - Broad Arrow Road (refer Figure 1). Much of the Study Area has been previously disturbed from mining and exploration activities.

1.3 Scope of Works

This flora and fauna assessment involved both desktop and field assessments. The desktop assessment included:

- A review of existing biological survey information for the area and relevant information on the existing physical environment;
- A review of aerial photography to assist in the delineation of vegetation types present in the study area;
- A review of the local and regional significance of plant communities;
- A search of the Department of Environment and Conservation's (DEC) Rare and Priority Flora databases;
- A search of the DEC's *NatureMap* database for threatened fauna;
- A search of the DEC's Environmentally Sensitive Areas (ESA) database;
- A search of the Western Australian *NatureMap* database for threatened and endangered fauna; and
- A search of the Department of Environment, Water, Heritage and the Arts' (DEWHA) database for areas listed under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*.

The field survey verified the findings of the desktop study and provided an assessment of the existing environment within the Study Area and its relationship to adjoining areas. The field survey included the following:

- Compiling an inventory of the vascular plant species in the Study Area, undertaken through the use of walking transect survey methods;
- Searching for significant flora species, including Declared Rare Flora (DRF) and Priority flora (locations of significant flora will be mapped and population sizes recorded);
- Compiling an inventory of dominant exotic plants, including declared noxious plants and environmental weed species;
- Describing and recording locations of plant communities, including GIS mapping and photographs;
- Rating the condition of the vegetation communities or areas using a published rating scale (Keighery, 1994);
- Reviewing the local and regional significance of the plant communities in terms of their intrinsic value, extent, rarity and condition;
- Compiling inventory of the vertebrate fauna species in the survey area through targeted searches and opportunistic recording of species;
- Identifying any habitats of significance;
- Reviewing fauna species considered to be rare or in need of special protection; and
- Reviewing the presence and abundance of pest, declared or feral animals.

2. Desktop Assessment

2.1 Previous Studies

A number of biological surveys have been undertaken previously in the Eastern Goldfields region, the most notable being the broad scale mapping of vegetation assemblages conducted by Beard as part of the Western Australian mapping project (Beard, 1980), and the comprehensive biological survey of the region undertaken by the Biological Surveys Committee during the late 1970s and early 1980's (Biological Survey Committee, 1984). The latter study not only described vegetation assemblages present but also recorded vertebrate fauna sampled from all major habitats within the region. Detailed studies of avifauna (Storr, 1984) and herpetofauna (Storr *et al*., 1981) have also been undertaken within the Eastern Goldfields and a review of the region's biodiversity significance was recently undertaken by the Wilderness Society (Watson, 2008).

A number of biological surveys have also been undertaken within the local area, including a flora survey undertaken within mining lease M24/29 (Minesite Rehabilitation Services, 2004) and an extensive long-term terrestrial fauna study of disturbed and undisturbed habitats within the vicinity of Ora Banda (Thompson and Thompson, 2002, 2005, 2006). Additional local studies include surveys of the Cawse Find Project Area (Mattiske Consulting, 1995) and the Cawse Nickel Gas Pipeline Route (Ecologia, 1997) as well as a broad comprehensive survey of the Black Flag and Kurnalpi areas in the late 1970s and early 1980s (McKenzie and Hall, 1992).

2.2 Climate

The Goldfields region experiences an arid to semi-arid climate with hot summers and mild winters with cool nights (Australian Natural Resource Atlas, 2008). Rainfall is unreliable, but mean delivery per month tends to be slightly higher during the winter period. Rainfall patterns are typically associated with cold fronts in winter and thunderstorms and rain bearing depressions in summer (Hall and McKenzie, 1993). Whilst the intense summer rainfalls are efficient for plant growth, the light more regular winter rains are ineffective for growth other than herbs and grasses (Milewski, 1981).

The closest official Bureau of Meteorology weather recording station is at the Kalgoorlie Airport where climate data is available for the period from 1939 to 2009. Kalgoorlie's mean annual rainfall is 264.9 mm, with monthly averages ranging from 31.2 mm in February to 14 mm in September (BoM, 2009). The evaporation rate is 2665 mm per annum, which is approximately 10 times the annual rainfall. Rainfall levels in the three months preceding the survey were considered to be within normal range limits.

Seasonal variations in temperature are reasonably large. Summer temperatures may exceed 40°C and winter frosts within the region are not uncommon. Mean maximum temperatures recorded range from 33.6°C in January to 16.7°C in July. Mean minimum temperatures range from 18.2°C in January to 5°C in July.

Table 1 outlines the mean minimum and mean maximum temperatures as well as the mean rainfall for Kalgoorlie (BoM, 2009).

Table 1 Climate Data for Kalgoorlie (source: BoM, 2009)

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean maximum temperature (ºC)	33.6	32.1	29.5	25.2	20.6	17.5	16.7	18.6	22.3	25.7	28.9	31.9	25.2
Mean minimum temperature (ºC)	18.2	17.8	16.0	12.6	8.7	6.2	5.0	5.5	8.0	11.0	14.0	16.5	11.6
Mean Monthly rainfall (mm)	23.6	31.2	24.0	21.3	26.5	28.9	24.9	21.3	14.0	14.9	17.6	16.4	264.9

Source: (BoM, 2009)

2.3 Geology

The Study Area is situated within the Kalgoorlie Province, which is on the central eastern portion of the Yilgarn Craton. The underlying geology of the province consists of Achaean greenstone basement rocks with a north-south strike and steep westerly dip. This is overlayed with granitic rocks and greenstone of the Yilgarn Craton that have been extensively weathered and laterised (Department of Agriculture and Food, 2006). Superficial deposits are typically comprised of colluvial and alluvial sediments.

2.4 Topography and Soils

The Study Area falls largely within the Undulating Plain landform habitat unit as described by Newby and Milewski (1984). The unit consists of colluvial flats interspersed with low ridges and hills which have formed from the differential weathering of bedrock. The topography of the Study Area is typical of the unit with a band of low stony rises and rocky breakaways intersecting the broader colluvial flats. The highest point within 10 km of the Study Area is 475m (AHD) while the lowest point is 380m (AHD).

Soils in the region are characterised by neutral red earths on the plains, calcareous loams and brown calcareous earths on the hilly portions and saline soils on and near playa lakes. The dominant soils types within the Study Area were red earths and brown loams with sandy clays in low lying areas.

2.5 Hydrology

2.5.1 Surface Water

A search of the Western Australian Wetlands Database (*WetlandBase*) did not identify any permanent watercourses or natural wetland areas within the Study Area. The closest identified wetland was an artificial water body recorded at the tailings storage facility site within mining lease M 24/29. Paddington Gold staff have advised that the tailings facility is being progressively rehabilitated and no longer contains standing water (A. Lindsay *pers. comm.*, 2009).

Drainage lines identified within the Study Area are poorly defined and are only likely to flow following major rainfall events. Sheetflow is also likely following periods of heavy rainfall.

2.5.2 Groundwater

A description of the main aquifer types in the area is provided below:

» Fractured basement rocks – minor aquifers commonly formed near the mafic/ultramafic contacts.

» Weathered and vuggy siliceous cap rock aquifers – developed over some mafics/ultramafics.

» Tertiary paleochannels - formed where channels are infilled with medium to coarse sediments.

» Quaternary/Recent alluvium and chemical sediments – sands and calcretes/silicates form aquifers in shallow infilled valleys.

Regional groundwater quality varies from fresh to hypersaline, with most aquifer types yielding brackish to saline water.

2.6 Phytogeography

The Study Area is located within Eastern Goldfields subregion as delineated under the Interim Biogeographic Regionalisation for Australia (IBRA) system. IBRA is a national planning framework in which 85 biogeographic regions and 403 sub-regions have been established to assist in setting reservation targets across the entire Australian landscape. Each bioregion is a geographically distinct area of land with common characteristics such as geology, landform patterns, climate, vegetation and fauna. Sub-regions were defined on the basis of major geomorphological features within each bioregion.

The Coolgardie bioregion correlates largely to the Coolgardie Botanical District defined by Beard (1990) and is described broadly as lying within the interzone between mulga/spinifex country and eucalypt environments (ANRA, 2008). The Eastern Goldfields sub-region is summarised as supporting diverse Eucalypt woodlands on low greenstone hills, valley floors, broad plains and salt lake surrounds; samphire shrublands on saline valley floors; and Mallees, *Acacia* thickets and shrub-heaths on sandplains, playas, laterite areas and granite outcrops (Thackway and Cresswell, 1995).

Vegetation of the Study Area is also likely to be influenced by the East Murchison subregion which lies less than 5 km to the north-east. The East Murchison sub-region is characterised by elevated red desert sandplains, internal drainage and salt lake systems. Mulga woodlands (often with a rich ephemeral understorey), hummock grasslands, saltbush shrublands and samphire shrublands comprise the dominant vegetation units (ANRA, 2008).

2.7 Reserves and Conservation Areas

No reserves or conservation areas occur within the immediate vicinity of the study area.

The nearest DEC estate is Credo Station, a former pastoral lease, which lies 5.3 km to the west of the Study Area. Clear and Muddy Lakes Nature Reserve and Rowles Lagoon Conservation Park are both situated approximately 19 km southwest of the Study Area. Goongarrie Station, a former pastoral lease (now managed by the DEC), lies approximately 20 km to the north of the Study Area.

2.8 Environmentally Sensitive Areas (ESA)

The DEC's online Native Vegetation Viewer provides information on the location of ESAs, as declared by a Notice under section 51B of the *Environmental Protection Act 1986* (*EP Act*). These databases also indicate areas where low impact mineral and petroleum activities cannot occur without a Native Vegetation Clearing Permit, as defined under Schedule One of the Environmental Protection (Clearing of native Vegetation) Regulations 2004.

The DEC's online Native Vegetation Viewer was searched to determine the location of any ESA's or Schedule One areas within the vicinity of the study area. No ESAs were identified within the vicinity of the Study Area; however, a Schedule One Area encompassing the Ora Banda townsite is located immediately to the west of the Site (refer Figure 1). Development activities are not expected to impact on this area.

2.9 Vegetation

2.9.1 Vegetation Description, Extent and Status

The vegetation of the Eastern Goldfields region was mapped by Beard as part of the Western Australian mapping project conducted from 1964-1981. The Vegetation Association recorded for the Study Area (No: 2901) is described as 'Mosiac: Medium woodland; *Allocasuarina cristata* & goldfields blackbutt and Shrublands: *Acacia quadrimarginea* thicket'.

A vegetation type is considered underrepresented if there is less than 30 percent of its original distribution remaining. From a purely biodiversity perspective, and not taking into account any other land degradation issues, there are several key criteria now being applied to vegetation in States where clearing is still occurring (EPA, 2000).

- The "threshold level" below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at 30% of the pre-European / pre-1750 extent for the vegetation type;
- A level of 10% of the original extent is regarded as being a level representing *Endangered*; and
- Clearing which would put the threat level into the class below should be avoided.

Such status can be delineated into five classes, where:

- *Presumed Extinct*: Probably no longer present in the bioregion
- *Endangered**: <10% of pre-European extent remains
- *Vulnerable**: 10-30% of pre-European extent exists
- *Depleted**: >30% and up to 50% of pre-European extent exists
- *Least Concern*: >50% pre-European extent exists and subject to little or no degradation over a majority of this area.

* or a combination of depletion, loss of quality, current threats and rarity gives a comparable status

The native vegetation association represented in the survey area; its regional extent and reservation status is drawn from Shepherd, *et al*. (2002) and Shepherd *pers. comm.* (2005) (refer Table 2).

Table 2 Vegetation Extent and Status in the Coolgardie IBRA Region

Vegetation Association Number	Association Description	Pre-European Extent (ha) in Coolgardie IBRA region	Current Extent (ha) in Coolgardie IBRA region	% Remaining	% Pre-European Extent in IUCN Class I-IV Reserves
2901	Mosiac: Medium woodland; Allocasuarina cristata & goldfields blackbutt Shrublands; Acacia quadrimarginea	35,470	35,470	100	0

Vegetation within the Study Area (as mapped by Beard) is considered to be of *Least Concern* in terms of its regional extent (i.e. intact, with 100% of its pre-European extent considered to be remaining).

2.9.2 Threatened Ecological Communities (TECs)

Ecological communities are defined as 'naturally occurring biological assemblages that occur in a particular type of habitat' (English and Blythe, 1997). TECs are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. Presumed Totally Destroyed, Critically Endangered, Endangered, and Vulnerable.

Some TECs are protected under the *EPBC Act*. Although TECs are not formally protected under the State *Wildlife Conservation Act 1950,* the loss of, or disturbance to, some TECs trigger the *EPBC Act*. The Environmental Protection Authority's (EPA's) position on TECs states that proposals that result in the direct loss of TECs are likely to require formal assessment.

Possible TECs that do not meet survey criteria are added to the DEC's Priority Ecological Community (PEC) Lists under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

The DEC's TEC database was queried for known occurrences of TECs or PECs near the Study Area. There are no known occurrences of TECs or PECs recorded within 10 km of the Study Area (Department of Environment and Conservation, 2008).

2.10 Flora

2.10.1 Significant Flora

Commonwealth

Species of significant flora are protected under both Commonwealth and State Acts. Any activities that are deemed to have a significant impact on species that are recognised by the *EPBC Act* and the *Wildlife Conservation Act 1950* (*WC Act*) can trigger referral to the DEWHA and/or the EPA.

A description of Conservation Categories delineated under the *EPBC Act* is detailed in Table 3. These are applicable to threatened flora and fauna species.

Table 3 Conservation Categories and Definitions for *EPBC Act* Listed Flora and Fauna Species

Conservation Category	Definition
Extinct	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild	Taxa known to survive only in captivity.
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable	Taxa facing a high risk of extinction in the wild in the medium-term.
Near Threatened	Taxa that risk becoming Vulnerable in the wild.
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern	Taxa that are not considered Threatened.

A search of the *EPBC Act* Protected Matters Search Tool was undertaken to identify Commonwealth protected flora species which may be present within the vicinity of the Study Area. *Gastrolobium graniticum* (Granite Poison) was the only species of significance recorded. It is currently listed as 'Endangered'.

State

In addition to the *EPBC Act,* significant flora in Western Australia is protected by the *WC Act*. This *Act*, which is administered by the DEC, protects DRF species. The DEC also maintains a list of Priority Listed Flora (PLF) species. Conservation codes for flora species are assigned by the DEC to define the level of conservation significance. PLF are not currently protected under the *Wildlife Conservation Act 1950*. PLF may be rare or threatened, but cannot be considered for declaration as rare flora until adequate surveys have been undertaken of known sites and the degree of threat to these populations clarified. Special consideration is often given to sites that contain PLF, despite them not having formal legislatory protection. A description of the DEC's Conservation Codes that relate to flora species is provided in Table 4.

Table 4 Conservation Codes and Descriptions for DEC Declared Rare and Priority Flora Species

Conservation Code	Description
X: Declared Rare Flora – Presumed Extinct	Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee.
R: Declared Rare Flora – Extant Taxa	Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
P1: Priority One – Poorly Known Taxa	Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2: Priority Two – Poorly Known Taxa	Taxa which are known from one or a few (generally<5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P3: Priority Three – Poorly Known Taxa	Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.
P4: Priority Four – Taxa in need of monitoring	Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5 – 10 years.

The DEC's *NatureMap* database was queried for records of significant flora occurring within 40 km of the Study Area. No DRF species were recorded. PLF species recorded are listed in Table 5.

Table 5 Significant Flora Present Within 40 km of the Study Area from Records of the DEC's *NatureMap* Database

Species	Conservation Code	Description[1]
Acacia epedunculata	P1	Low spreading, multi-stemmed shrub, 0.5 – 0.65 m high. Fl yellow, Aug. Yellow sand, sandplains habitat.
Alyxia tetanifolia	P3	Erect, rigid, pungent shrub, 1–2 m high, to 2.5 m wide. Fl. white, cream, May–Jun/Nov. Occurs in drainage lines, near lakes.
Angianthus prostratus	P3	Prostrate annual, herb. Fl. white, yellow, Jul–Sep. Red clay or loamy soils. Saline depressions.
Atriplex lindleyi subsp. *conduplicata*	P3	Monoecious, short-lived annual or perennial, herb, ca 0.2 m high.
Eremophila praecox	P1	Broom-like shrub, 1.5–3 m high. Fl. purple, Oct–Dec. Red/brown sandy loam. Occurs on undulating plains.
Eucalyptus jutsonii	P2	Mallee, 4–8 m high, bark rough, fibrous. Fl. white, Nov or Mar. Occurs in deep yellow to orange to red sands on sandplains & sandhills.
Gnephosis sp. *Norseman (K.R. Newby 8096)*	P1	Low spreading annual, herb, 0.03–0.07 m high, 0.08-0.18 m wide. Occurs in subsaline loam on moderately exposed flat.
Gompholobium cinereum	P3	Shrub, to 0.3 m high. Fl. pink to purple, Sep–Oct. Found in yellow sand, clayey sand, brown loam, sandy gravel, laterite.
Rumex crystallinus	P2	Annual, herb, 0.06–0.4 m high. Arid & semi-arid areas.

[1] Data Source: Department of Environment and Conservation (2009) Florabase accessed on line at http://florabase.calm.wa.gov.au/ in September 2009.

Previous Studies

No significant flora species were recorded during the previous vegetation and flora survey undertaken within mining lease M24/29 (Minesite Rehabilitation Services, 2004). No additional site specific flora surveys have been undertaken within the Study Area.

2.11 Fauna

2.11.1 Fauna Searches

A DEC *NatureMap* online search was conducted for the Study Area. The search identifies terrestrial vertebrate species recorded in various databases including collections from the Western Australian Museum. The search identified the potential presence of three amphibian species, 21 mammal, 10 bird and 60 reptile species.

A full list of species recorded from the DEC *Nature Map* search is presented in Table 15, Appendix C. No significant fauna species were identified.

It should be noted that some of the records of the Museum are historical and some of the recorded species may now be locally extinct. Additionally these records may include species (particularly bird species) that are vagrants or present in the general area but not present within the Study Area due to lack of suitable habitat.

Previous Studies

Thompson and Thompson (2006) recorded the presence of three amphibian, 10 mammal and 53 reptile species in the Ora Banda region over a five-year vertebrate fauna trapping program.

2.11.2 Threatened or Otherwise Protected Fauna

The conservation status of fauna species is assessed under both Commonwealth and State Acts, namely the *EPBC Act* and the *WC Act*.

The significance levels for fauna used in the *EPBC Act* are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN). A description of Conservation Categories delineated under the *EPBC Act* is provided in Table 3 and the circumstances under which a project will trigger referral to the DEWHA are described in Appendix C. These categories are applicable to both threatened flora and fauna species.

The *EPBC Act* also protects migratory species that are listed under the following International Agreements:

- Appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals) for which Australia is a Range State under the Convention;
- The Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA);
- The Agreement between the Government of Australia and the Republic of Korea for the protection of migratory shorebirds and their habitat (ROKAMBA); and
- The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Listed migratory species also include species identified in other international agreements approved by the Commonwealth Environment Minister.

The *WC Act* uses a set of Schedules but also classifies species using some of the IUCN categories. These categories and schedules are described in Table 6. These may be trigger species in the *EPBC Act*.

Table 6 Western Australian Threatened Fauna Categories

Category	Code	Description
Schedule 1	S1	Fauna which is rare or likely to become extinct.
Schedule 2	S2	Fauna which is presumed extinct.
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	S4	Fauna that is otherwise in need of special protection.

In Western Australia, the DEC also produces a supplementary list of Priority Fauna, these being species that are not considered Threatened under the *WC Act*, but for which the Department feels there is a cause for concern. These species have no special legislative protection, but their presence would normally be considered. Such taxa need further survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. Levels of Priority are described in Table 7.

Table 7 Department of Environment and Conservation Priority Codes

Category	Code	Description
Priority 1	P1	Taxa with few, poorly known populations on threatened lands.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	P4	Taxa in need of monitoring which are considered not currently threatened or in need of special protection, but could be if present circumstances change. Usually represented on conservation lands.
Priority 5	P5	Taxa in need of monitoring which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

2.11.3 Threatened Fauna Searches

The DEWHA maintains a database of matters of national environmental significance that are protected under the *EPBC Act*. An *EPBC Act* Protected Matters Report was generated (from the website of the DEWHA), in September 2009 for the matters of significance that may occur in, or may relate to, the Study Area. Marine species listed in this search were included in the list. A search of the DEC's *NatureMap* database for any rare and priority species that may occur in the Study Area was also undertaken at that time.

Protected fauna species identified from DEC and DEWHA databases as potentially occurring within the Study Area are listed in Table 8.

It should be noted that some species that appear in the *EPBC Act* Protected Matters Search Tool are often not likely to occur within the specified area, as the search provides an approximate guidance to matters of national significance that require further investigation. The records from the DEC search provide more accurate information for the general area; however some records of sightings or trappings can be dated and often misrepresent the current range of threatened species.

Table 8 Listing of Potentially Occurring Significant, Rare and Priority Fauna Species within the Study Area, with Information Source

Genus	Species	Common Name	Listing under Wildlife Conservation Act 1950 or DEC Priority List	Listing under *EPBC Act*	DEC NatureMap Database	EPBC Protected Matters Search Tool
Birds						
Acanthiza	*iredalei iredalei*	Slender-billed Thornbill (western)		Vulnerable		+
Apus	*pacificus*	Fork-tailed Swift		Migratory, Marine		+
Ardea	*alba*	Great Egret, White Egret		Migratory, Marine		+
Ardea	*ibis*	Cattle Egret		Migratory, Marine		+
Ardeotis	*australis*	Australian Bustard	Priority 4		+	
Leipoa	*ocellata*	Malleefowl	Schedule 1	Vulnerable	+	+
Merops	*ornatus*	Rainbow Bee-eater		Migratory, Marine		+

2.12 Pathogens

Phytophthora cinnamomi threatens over 2,300 (40%) of different plant species in Western Australia. Introduced following European settlement, *Phytophthora cinnamomi* is a soil-borne pathogen that kills a wide range of native plant species in the south west of Western Australia by attacking their root system. *Phytophthora cinnamomi* can also survive and reproduce on a wide range of native plant species without killing them. It has a widespread but discontinuous range in areas of the south west with an annual rainfall above 400 mm (Dieback Working Group, 2005).

The Study Area is not considered to occur in an area susceptible to the development of the pathogen.

3. Field Assessment

3.1 Field Survey Methods

3.1.1 Vegetation and Flora

GHD's qualified ecologists conducted the field flora survey during the period 23 – 24 September 2009. The survey was conducted with regards to the EPA's Guidance Statement No. 51, *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004a), where possible.

A combination of vehicle and walking traverses was deemed to be the most appropriate survey method. Data collected from walking traverses included information on substrate, vegetation condition (including weed status), vascular flora species present and the dominant species within each vegetation type. Vehicle traverses were undertaken across the site to assist in vegetation type and condition mapping and any areas considered suitable to host significant flora taxa, such as rock outcrops or drainage lines, were surveyed thoroughly.

A list of flora species recorded from the survey was generated for the Study Area. Where identification of flora species was uncertain, confirmation was made at the Western Australian State Herbarium (WAHERB). The presence of significant flora and/or potential TECs within the Study Area was assessed and aerial photography was used to assist in the delineation of vegetation types.

3.1.2 Fauna

GHD's qualified ecologists conducted the fauna investigation in conjunction with the flora investigation during the period 23-24 September 2009. The fauna survey included desktop investigations and field surveys, conducted with regard to the EPA's Guidance Statement No. 56 *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004b), where possible. Fauna trapping was not undertaken.

Habitat Assessment

A habitat assessment was undertaken to determine the likelihood of any species of conservation significance utilising the areas that will be potentially impacted by the proposed mining activities. Landform-vegetation associations observed within the Study Area were used as a basis for delineating broad fauna habitats. The quality and integrity of each habitat type was then assessed to determine its ability to support threatened species likely to occur in the area.

Opportunistic and Systematic Searches

The opportunistic searches involved visual and aural surveys for any fauna species utilising the Study Area. Systematic searches of habitat types likely to support significant fauna species were also undertaken. Any fauna signs observed within the Study Area, such as tracks, scats, bones, diggings and feeding signs were also recorded.

3.1.3 Nomenclature

Nomenclature used in this report follows that used by the DEC's *FloraBase* program and *NatureMap* database as they are deemed to contain the most up-to-date species information for Western Australia.

3.1.4 Limitations

Complete flora and fauna surveys can require multiple surveys, at different times of year, and over a period of a number of years, to enable observation of all species present. Some flora species, such as annuals, are only available for collection at certain times of the year, and others are only identifiable at certain times (such as when they are flowering). Additionally, climatic and stochastic events (such as fire) may affect the presence of plant species. Species that have a very low abundance in the area are more difficult to locate, due to above factors. Whilst the flora survey was relatively thorough, there is a possibility that some species in the area may have been overlooked.

The flora survey was also predominantly restricted to flowering plants, with consideration of some other vascular plants such as cycads. Non-vascular plants were not systematically searched for, as the information available on these plants is generally limited.

The fauna survey undertaken was a reconnaissance survey only and thus only sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats and diggings. Many cryptic and nocturnal species would not have been identified during a reconnaissance survey. Extensive detailed fauna surveys, involving trapping surveys, are required to obtain a more comprehensive list of fauna species that may utilise the site. This survey was also aimed at identifying the terrestrial vertebrate fauna of the Study Area. No sampling of invertebrates or aquatic species occurred.

3.2 Vegetation and Flora Results

3.2.1 Vegetation Description

The Study Area is considered to be dominated by eucalypt – *Casuarina* woodlands, interspersed with *Acacia* shrublands. The vegetation of the survey area was classified into ten vegetation types. These vegetation types have been mapped (Figure 2, Appendix A) and are summarised in Table 9.

Table 9 Vegetation Type Description

Code	Vegetation Type Description	Vegetation Type Photograph
VOW	Very open woodland of *Eucalyptus salmonophloia*, *Eucalyptus transcontinentalis* and *Eucalyptus celastroidies* subsp. *celastroidies* with occasional *Eucalyptus ravida* over midstorey of *Eremophila scoparia, Eremophila oldfieldii* subsp. *angustifolia, Exocarpos aphyllus* and understorey of *Atriplex nummularia* subsp. *spathulata, Maireana georgei* and *Sclerolaena obliquicuspis* on plains.	
OLW	Open low woodland of *Eucalyptus celastroidies* subsp. *celastroidies* with occasional *Eucalyptus ravida* over midstorey of *Acacia* sp. narrow phyllodes/*Acacia burkittii, Eremophila oldfieldii* subsp. *angustifolia, Eremophila scoparia*, and *Ricinocarpus styolus* over understorey of *Eremophila pustulata, Scaevola spinescens*, *Grevillea acuaria*, *Olearia muelleri*, and *Westringia rigida* on flats with quartzite surface fragments.	
OLW2	Open low woodland of *Eucalyptus griffithsii*, *Eucalyptus celastroidies* subsp. *celastroidies, Eucalyptus clelandii* and *Casuarina pauper* over midstorey of *Acacia* sp.narrow phyllodes/*Acacia burkittii, Eremophila scoparia, Alyxia buxifolia over Prostanthera grylloana, Scaevola spinescens, Grevillea oligomera, Dodonaea lobulata, Eremophila pustulata, Grevillea acuaria, Olearia muelleri, and Ptilotus obovatus* on low stony ridges with occasional rock outcropping, interspersed with *Acacia ramulosa* var. *ramulosa and Allocasuarina campestris* on rises and woodlands of *Eucalyptus celastroidies* over *Scaevola spinescens* and *Olearia muelleri* on the lower slopes and adjoining flats.	

Code	Vegetation Type Description	Vegetation Type Photograph
LEW	Low mixed eucalypt woodland of *Eucalyptus ravida, Eucalyptus celastroidies* subsp. *celastroidies, Eucalyptus clelandii and Eucalyptus transcontinentalis* with *Casuarina pauper* over *Eremophila oldfieldii* subsp. *angustifolia, Eremophila oppositifolia subsp. angustifolia, Eremophila scoparia over Alyxia buxifolia, Scaevola spinescens, Eremophila pustulata* over understorey of *Acacia erinacea, Grevillea acuaria* and *Olearia muelleri* on gently undulating plains.	
OLW3	Open low woodland of *Eucalyptus griffithsii, Eucalyptus celastroidies* subsp. *celastroidies* with occasional *Eucalyptus salmonophloia* over midstorey of *Eremophila oppositifolia subsp. angustifolia, Santalum spicatum, Eremophila scoparia, Senna artemisioides* subsp. *filifolia* over *Dodonaea lobulata, Atriplex nummularia* subsp. *spathulata, Scaevola spinescens and Acacia hemiteles.*	
OS	Open shrubland of *Acacia ramulosa* var. *ramulosa, Acacia quadrimaginea, Melaleuca hamata,* Allocasuarina *campestris, Dodonaea lobulata, Thryptomene* sp., and *Eremophila granitica* over a sparse understorey of *Mirbelia depressa, Chrysocephalum puteale and Solanum lasiophyllum* on low rise with quartzite surface fragments	

Code	Vegetation Type Description	Vegetation Type Photograph
LW	Low woodland of *Eucalyptus ebbanoensis* subsp. *ebbanoensis and Eucalyptus griffithsii* over tall scrub of *Acacia ramulosa* var. *ramulosa over Dodonaea lobulata, Atriplex nummularia* subsp. *spathulata, Senna artemisioides* subsp. *filifolia, Alyxia buxifolia, Trymalium mrytillis and Eremophila interstans* over understorey of *Scaevola spinescens, Olearia muelleri, Ptilotus obovatus, Waitzia acuminata* and *Hybanthus floribundus* subsp. *curvifolius*	
CPW	Woodland of *Casuarina pauper* and mixed eucalypts (*Eucalyptus celastroidies* subsp. *celastroidies, Eucalyptus salmonophloia* and *Eucalyptus transcontinentalis*) over midstorey of *Eremophila scoparia, Exocarpos aphyllus, Acacia erinacea* and *Acacia hemiteles* over understory of mixed chenopods on drainage lines, interspersed with low forests (groves) of *Eucalyptus ravida* with sparse understorey of *Acacia erinacea, Senna artemisioides* subsp. *filifolia* and *Dodonaea lobulata.*	
RE	Shrubland of *Acacia* sp. narrow phyllodes/*Acacia burkittii, Cryptandra aridicola, Dodonaea lobulata, Grevillea oligomera, Scaevola spinescens, Prostanthera grylloana* and *Acacia kalgoorliensis* on rehabilitation area.	
CD	Cleared/degraded areas – few native species present (primarily disturbance response species).	

3.2.2 Vegetation Condition

The vegetation condition of the site was rated using the vegetation condition rating scale developed by Keighery (1994), which recognises the intactness of vegetation and is defined by the following:

» Completeness of structural levels;

» Extent of weed invasion;

» Historical disturbance from tracks and other clearing or dumping; and

» The potential for natural or assisted regeneration.

The scale consists of six rating levels from pristine or nearly so to completely degraded. The Vegetation Condition Rating Scale is outlined in below in Table 10.

Table 10 Vegetation Condition Rating Scale (after Keighery, 1994)

Vegetation Condition Rating	Vegetation Condition	Description
1	*Pristine or Nearly So*	No obvious signs of disturbance.
2	*Excellent*	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species.
3	*Very Good*	Vegetation structure altered, obvious signs of disturbance.
4	*Good*	Vegetation structure significantly altered by very obvious signs of multiple disturbances retains basic vegetation structure or ability to regenerate it.
5	*Degraded*	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not in a state approaching good condition without intensive management.
6	*Completely Degraded*	The structure of the vegetation is no longer intact and the area is completely or almost without native species.

Disturbances from mining, exploration and pastoral activities are evident across much of the Study Area; however the majority of vegetation was considered to be in *Excellent* (2) to *Very Good* (3) condition.

The most noticeable areas of disturbance are the two previously mined open pit sites and associated operational areas. The first is located centrally within mining lease M24/170 (Enterprise Pit) and the second occupies much of the Study Area within mining lease M24/29 (Gimlet Pit). Both areas are considered to be *Completely Degraded* (6). All formed roads within the Study Area were also considered to be *Completely Degraded* (6).

Historical workings were also evident across the site (particularly rocky hills and small breakaways). Such areas have not been mapped as the footprint of disturbance is limited and sites were generally isolated. Minor tracks traverse much of the site. These tracks have not been mapped but are considered to be Degraded (5) to Completely Degraded (6).

The rehabilitation site in the south-west corner of M24/170 was seeded in 1997. Good vegetation cover has been established; however, structural diversity is limited and species richness was lower than in surrounding vegetation units.

General vegetation condition has been mapped in Figure 3, Appendix A.

3.2.3 Threatened Ecological Communities (TECs)

No TECs were recorded during the field survey.

No PECs were recorded during the field survey.

3.2.4 Flora Species

Vegetation within the Study Area is considered to be moderately diverse. A total of 148 taxa from 41 families were recorded from the Study Area. Of these, 137 taxa were native plant species. Seven collections could not be identified beyond genus level due to lack of flowering parts or fruiting bodies, or because they were only found in a juvenile form.

Dominant families recorded included:

- Chenopodiaceae (chenopods): 18 taxa
- Mimosaceae (wattles): 15 taxa
- Asteraceae (daisies): 15 taxa
- Myoporaceae (poverty bushes): 14 taxa
- Myrtaceae (eucalypts, melaleucas): 14 taxa

Dominant genera recorded from the Study Area included:

- *Acacia*: 15 taxa
- *Eremophila:* 14 taxa
- *Eucalyptus:* 10 taxa
- *Maireana:* 6 taxa
- *Atriplex:* 5 taxa
- *Ptilotus:* 5 taxa

A full list of flora species present in the Study Area is provided in Table 14, Appendix B.

It should be noted that the Study Area is at the northern range of *Acacia* sp. narrow phyllodes and at the southern range of *Acacia burkittii*. Considerable overlap exists in morphology between the two taxa and specimens are indistinguishable within the local area without fruits. Given that specimens observed in the field were sterile, the taxon observed is referred to in this report as *Acacia* sp. narrow phyllodes/ *Acacia burkittiii*.

3.2.5 Significant Flora

No DRF species were recorded from the Study Area during this survey.

One Priority Flora species was recorded during the field survey: *Gnephosis intonsa* (Priority 1). This taxon was recorded on colluvial flats within mining lease M24/170, approximately 900m north east of the existing Enterprise Pit (317558 E, 6638741 N). Approximately 50 plants were recorded at this location during this survey. See Figure 2, Appendix A for species location.

Gnephosis intonsa (P1) is a prostrate to ascending annual herb, ranging in height from 0.01-0.04m. Its general flowering period is from September to October and has yellow, brown flowers (Department of Environment and Conservation, 2009). It is known from 17 records and its distribution ranges from east of Leonora to Ravensthorpe in the south. The taxon was readily identifiable from its general morphology.

Plate 1: *Gnephosis intonsa* (P1), specimen collected 900m north east of the existing Enterprise Pit (Collection Number: PM 339b)

The presence of this Priority Listed Flora species should be taken into consideration when siting mine infrastructure and this area should be avoided wherever possible.

3.2.6 Species Exhibiting an Extension to Known Range

Species exhibiting an extension to their known range are considered to be locally significant by the EPA (2004a, Guidance Statement No 51.). Two flora taxa were recorded during the field survey which exhibited an extension to their known ranges: *Ricinocarpos stylosus* and *Corrigiola litoralis*. *Corrigiola litoralis* is an exotic (weed) species.

3.2.7 Other Potentially Significant Flora

***Hibbertia* sp.**

The identification of the *Hibbertia* species recorded adjacent to a small breakaway, 200m east of the Enterprise Pit remains unresolved. The closest match with material held at the Western Australian State Herbarium was *Hibbertia hamulosa* which has a recorded distribution between Fitzgerald River National Park and Esperance. Wheeler J.R. (2000) states that the genus is badly in need of revision so this taxon may not necessarily be locally significant.

Plate 2: *Hibbertia* sp., specimen collected 200m east of the Enterprise Pit (Collection Number: PM 321).

Thryptomene sp.

The genus *Thryptomene* has undergone a series of major reviews of its nomenclature in the last decade. Taxonomists have identified a large number of separate *Thryptomene* species, each occupying a relatively geographically isolated and/or unique area. As such, new species have been identified occupying relatively restricted locations. The collection made within the Study Area could not be matched to any known *Thryptomene* species. It may be that this collection forms part of an as-yet undescribed *Thryptomene* taxon, but certainty cannot be delineated.

The status of this collection will remain unresolved until a taxonomic specialist looks at the specimen following submission to the Western Australian Herbarium. GHD proposes to submit this taxon, along with the *Hibbertia* sp. and *Gnephosis intonsa* specimens to the Western Australian Herbarium. Any time-frame for examining submitted specimens or identity checks remains to be set by the Western Australian Herbarium.

3.2.8 Weeds

Given previous disturbances, weed levels across the site were relatively low. A total of 11 weed species were recorded, comprising approximately 7% of the total number of plant species recorded in the Study Area. Weed species recorded are listed in Table 11.

Table 11 Weed Species Recorded Within the Study Area

Genus	Species	Common Name
Corrigiola	*litoralis*	Strapwort
Carthamus	*lanatus*	Saffron Thistle
Helichrysum	*luteoalbum*	Jersey Cudweed
Sonchus	*oleraceus*	Common Sowthistle
Chenopodium	*album*	Fat Hen
Cucumis	*myriocarpus*	Prickly Paddy Melon
Cuscuta	*planiflora*	
Isolepis	*marginata*	Coarse Club-rush
Salvia	*verbenaca*	Wild Sage
Medicago	*minima*	Small Burr Medic
Anagallis	*arvensis* subsp. *caerulea*	Pimpernel

Significant Weed Species

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WONS) is based on four major criteria: invasiveness, impacts, potential for spread, and socio-economic and environmental values.

» No WONS species were recorded from the Study Area.

Weeds that are, or may become, a problem to agriculture or the environment can be formally classified as Declared Plants under the *Agriculture and Related Resources Protection Act, 1976* (ARRP Act). The Department of Agriculture and Food and the Agriculture Protection Board maintains a list of Declared Plants for Western Australia. If a plant is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to comply with the specific category of control. Declarations specify a category, or categories, for each plant according to the control strategies or objectives which the Agriculture Protection Board believes are appropriate in a particular place.

Among the factors considered in categorising declared plants are:

» The impact of the plant on individuals, agricultural production and the community in general;

» Whether it is already established in the area; and

» The feasibility and cost of possible control measures.

These Declared Plants are divided into 5 control code categories, which are detailed in Table 12.

Table 12 Department of Agriculture and Food Declared Plant Control Code Category

Control Code Category	Description of Landholder Obligations
P1	Prohibits movement of plants or their seeds within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P2	Eradicate infestation to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
P3	Control infestation in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants.
P4	Prevent the spread of infestation from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set on all plants.
P5	Infestations on public lands must be controlled.

One Declared Plant taxa, **Carthamus lanatus* (Saffron Thistle), was recorded from the Study Area adjacent to the access track on the eastern perimeter of the Enterprise Pit. This taxa has been assigned Control Categories P1, P3 and P4.

3.3 Vertebrate Fauna Results

3.3.1 Fauna Habitat Assessment

No habitats were recorded that are considered to be exclusive to the Study Area. The broad habitat types identified within the Study Area included:

» Mixed woodland over mixed shrubs;

» *Acacia* dominated shrublands; and

» Pits and cleared areas.

Habitat Value

The mixed woodland over mixed shrubs habitat is considered to provide a medium level of habitat value to fauna. The vegetation has good structural diversity with medium sized eucalypts, mallees and a healthy understorey of small and larger shrubs present. Such heterogeneity within the habitat provides a range of ecological niches for vertebrate and invertebrate fauna. Occasional hollows present in the larger Salmon Gums (*Eucalyptus salmonophloia*) across the site provide good habitat for a range of fauna species.

Although the *Acacia* dominated shrublands are likely to support lower diversity than the mixed woodland habitat, the vegetation present was in very good to excellent condition and is also considered provide a medium level of habitat to fauna. The dominant fauna are likely to be the highly mobile passerine bird community, particularly the thornbills. Ground dwelling reptile species are likely to be less prevalent, given the typically sparse understorey and litter layer within this habitat.

The pits and cleared areas (operational areas, haul roads, roads, etc) are highly disturbed, devoid of vegetation and offer little habitat value for fauna. The species diversity for all taxanomic groups is likely to be very limited in this habitat type.

Habitat Linkages

Habitat linkages are important to allow animals to move between areas of resource availability. Habitat linkage is important for ground and aerial fauna, providing cover, resources, and linking areas suitable for rest and reproduction.

Fragmentation of habitat limits the resources available to species, particularly sedentary species, which means they may be more vulnerable to natural disasters or habitat changes over time. Fragmentation of habitat can also lead to edge effects, leading to degradation of the habitat. Where the distance between habitat fragments is small, species may still be able to move between these habitat areas, but may be more exposed to predation pressures in the cleared areas.

The Study Area is surrounded by relatively intact vegetation and is not considered to constitute a significant corridor or habitat linkage for fauna.

Habitats of Significance

No fauna habitats were recorded within the Study Area that are considered to be significant. All habitats observed are widespread within the region.

3.3.2 Fauna Species

A total of 29 bird species, five mammal species and three reptile species were recorded within the Study Area during the reconnaissance survey.

It is considered that the short duration of the survey and absence of trapping resulted in the low number of reptile and mammal species recorded. Further, as no conservation significant reptiles or mammals were identified during the desktop review, these taxonomic groups were not specifically targeted during the survey.

It should also be noted that surveys such as this provide a brief snapshot of those species present at the time of sampling (daytime), in one season, in one year. Not all potentially occurring species would be recorded during a single survey due to spatial and temporal variations in fauna population numbers.

3.3.3 Significant Fauna Species

No significant fauna species were recorded during the opportunistic field survey; however, the desktop searches indicated that a number of protected fauna may occur within the Study Area. The habitat requirements of these species and the likelihood of their occurrence in the Study Area are considered below.

Slender-billed Thornbill – western (*Acanthiza iredalei iredalei*)

The Slender-billed Thornbill is listed as Vulnerable under the *EPBC Act*. This species preferred habitat is chenopod shrublands and sandplain heath, expected along shores of salt lakes and other saline-clay pans (DEWHA, 2004). It is unlikely to occur within the Study Area given the lack of suitable habitat.

Malleefowl (*Leipoa ocellata*)

Malleefowl build large mounds from soil, leaves and sticks from the surrounding mallee shrublands and woodlands (DEC, 2007). The Mallee Fowl's habitat can be broadly described as semi-arid areas and remnant vegetation within agricultural zones. The species main danger lies through land clearing, predation and altered fire regimes (DEC, 2007). The Study Area is considered to be at the north-eastern extremity of its range and although it may potentially occur in woodlands of the Study Area, no evidence of its presence was recorded during the survey. It is recommended that areas containing suitable habitat for Malleefowl (i.e. dense vegetation and reasonable litter layer) be searched before clearing commences.

Australian Bustard (*Ardeotis australis)*

The Australian Bustard is listed as a Priority 4 species under the *WA Wildlife Conservation Act (1950*). It is possible this species could occur in the Study Area as their habitat includes woodlands and grasslands. Given their mobility and general habit of moving over large areas, any impact on this species from proposed development activities would be minimal.

Rainbow Bee-eater (*Merops ornatus)*

The Rainbow Bee-eater (Migratory, *EPBC Act*) is a migratory species listed under the *EPBC Act*, migrating to south-western Australia to breed during spring and summer. The Rainbow Bee-eater nests in burrows excavated in sandy ground or banks (Australian Museum, 2008). The Rainbow Bee-eater is a common and widespread species. Proposed development activities are unlikely to impact on the conservation significance of the species as it will move its foraging (and breeding) to adjacent areas of undisturbed habitat.

Fork-tailed Swift (*Apus pacificus)*

Likely to utilise the Study Area but is an aerial species, and as such is unlikely to be affected by proposed development activities.

Great Egret (*Ardea alba)* and Cattle Egret (*Ardea ibis)*

Both species are migratory and are unlikely to be affected by proposed development activities.

3.3.4 Introduced Species

Four introduced mammal species were recorded from the Study Area (refer Table 16).

4. Assessment of Flora and Fauna Impacts

4.1 Potential Flora and Fauna Impacts

The main impacts on flora and fauna are:

- *Vegetation Clearing:* This project will require the clearing of native vegetation in very good to excellent condition; however, the extent of clearing required is relatively minor compared to the large areas of similar vegetation adjacent to the Study Area.
- *Soil degradation and erosion*: Native vegetation serves an important role in the stabilisation of soil within the landscape. Removal of vegetation can cause land degradation, including erosion. Retaining vegetation within existing drainage lines and their surrounds will assist in maintaining slope stability.
- *Weed introduction and invasion*: The majority of the Study Area is largely weed free. Disturbance from development activities has the potential to introduce weeds to the areas directly impacted by clearing.
- *Hydrological Changes:* Changes to natural drainage from clearing or other activities may impact on both vegetation structure and fauna habitat in adjoining areas. Appropriate surface water management measures
- *Habitat loss and damage*: The amount of area required for proposed development activities is small relative to the amount of good quality habitat surrounding the Study Area and the impacts on fauna species are expected to be minimal.
- *Death or harm to fauna species*: Any construction works have the potential to cause death or harm to fauna species. Vegetation clearing and vehicle movements are likely to result in an increased incidence of animal death or injury. Slower moving land animals (including mammals, reptiles and amphibians) are most at risk, as they are often unable to vacate disturbed areas of vegetation quickly enough to avoid harm. Animals may become disorientated following destruction of their current habitat ranges.

4.2 Management of Issues

Impacts on flora and fauna can be minimised and managed by a number of measures which are outlined below:

- All clearing operations should be kept to a minimum and designated clearing areas should be clearly defined and contractors should be adequately briefed to ensure accidental clearing does not occur. Clearing should occur from the most disturbed areas towards undisturbed areas, thereby directing fleeing species away from the disturbance zone. Where possible, a fauna clearance team should be available to remove fauna during the clearing process.
- The Priority One Flora species: *Gnephosis intonsa* should be retained where possible. Specimens to be retained should be clearly marked on site and an appropriate buffer from clearing provided.
- Management measures should be implemented to ensure clearing does not cause appreciable land degradation, including minimising runoff from the cleared areas.

- Management measures should be implemented to minimise the introduction and spread of weeds, such as avoiding movement of soils containing weedy species.
- Management measures should be implemented to maintain natural surface water flow paths where practicable.
- Management measures should be implemented to ensure fauna species are not adversely impacted during construction. This may include keeping pits and trenches open for minimal periods, providing exit ramps, regularly inspecting excavations and liaising with the DEC as necessary regarding the relocation of fauna species. Staff and contractors should also be educated during inductions on significant fauna species which may potentially be present in the area.
- Destruction of fauna habitat should be minimised during clearing. Dead, standing or fallen timber should be retained as habitat, wherever possible. Where micro-habitats, such as rocks, logs and other debris, must be disturbed for construction, these should be retained and used in rehabilitation;
- Avoid driving vehicles at dusk and dawn where possible, to minimise the potential for collisions with nocturnal animals.
- Areas containing suitable habitat for Malleefowl (i.e. dense vegetation and a reasonable litter layer) should be searched before clearing commences.
- Dewater points/water holding areas should be fenced from Kangaroo species to prevent deaths from drowning.
- Management measures should be implemented to prevent impacts on adjacent flora and fauna from pollution, such as litter and oil spills.
- Implement measures to reduce the risk of fire starting from activities at site.
- Disturbed areas not required for the operation or ongoing maintenance of the facility should be rehabilitated where possible. Topsoil and vegetation should be stockpiled for later use in rehabilitation works.

4.3 Assessment against Clearing Principles

Any clearing of native vegetation will require a permit under Part V Division 2 of the *EP Act*, except where an exemption applies under Schedule 6 of the Act or is prescribed by regulation in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, and it is not in an ESA.

Table 13 provides an assessment of the proposed project against the '10 Clearing Principles' as outlined in Schedule 5 of the *Environmental Protection Amendment Act 2003* to determine whether it is at variance to the Principles. These Principles aim to ensure that all potential impacts resulting from removal of native vegetation can be assessed in an integrated way.

This project is considered unlikely to be significantly at variance against any of the '10 Clearing Principles'. The presence of the Priority One Flora species: *Gnephosis intonsa* within the Study Area is assessed in Principle (c).

Table 13 Assessment Against the 10 Clearing Principles

Principle Number	Principle	Assessment	Outcome
(a)	Native vegetation should not be cleared if it comprises a high level of biological diversity.	The Study Area is not considered to be of higher biodiversity than the broader surrounding area and the proposed clearing is unlikely to have any significant impact on the biodiversity of the region.	The proposal is not considered to be at variance with the Principle.
(b)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	No specific habitat was noted within the Study Area that was not present in the local area. The vegetation and associated fauna habitat within the Study Area is considered to be minimal in a regional perspective. Fauna species present in the Study Area are likely to find similar habitat adjacent to the Study Area. The area required to be cleared for the proposed power station facility is not likely to impact on significant fauna or required habitat.	The proposal is not considered to be at variance with the Principle.
(c)	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	No DRF species have been recorded within the Study Area. The Priority One Flora species: *Gnephosis intonsa* was recorded within the Study Area. The recorded location of this species is beyond the proposed clearing footprint. Clearing works are considered unlikely to impact on the continued existence of this flora species.	The proposal is not considered to be significantly at variance with the Principle.
(d)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a TEC.	No TECs or PECs or associated native vegetation will be impacted by the proposed works.	The proposal is not considered to be at variance with the Principle.
(e)	Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	Clearing native vegetation within the Study Area will not significantly reduce the known extent from pre-European extents.	The proposal is not considered to be at variance with the Principle.

Principle Number	Principle	Assessment	Outcome
(f)	Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	There are no permanent watercourses or wetlands within the Study Area. However a number of drainage lines traverse the site. All drainage lines in the Study Area are intermittent flowing only after major rainfall events. Appropriate mitigation measures will be implemented to minimise runoff and sedimentation to these flow paths.	The proposal is not considered likely to be at variance with the Principle.
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	Short-term soil erosion may occur within the Study Area following any potential clearing. Soil erosion can be mitigated by use of appropriate water management and rehabilitation regimes.	The proposal is not considered to be at variance with the Principle.
(h)	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	There are no conservation areas within or in close proximity to the Study Area.	The proposal is not considered to be at variance with the Principle.
(i)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	The clearing of native vegetation is not considered likely to alter the quality of surface or ground waters within the Study Area. Erosion may occur following any potential clearing. Erosion can be mitigated by the use of appropriate surface water management and rehabilitation techniques.	The proposal is not considered to be at variance with the Principle.
(j)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	The clearing of native vegetation is not considered likely to cause or exacerbate the incidence or intensity of flooding. Clearing on, or around watercourses should be avoided where possible.	The proposal is not considered to be at variance with the Principle.

5. Report Limitations

This report presents the results of a Flora and Fauna Assessment prepared for the purpose of this commission. The data and advice provided herein relate only to the project and structures described herein and must be reviewed by a competent scientist/botanist before being used for any other purpose. GHD accepts no responsibility for other use of the data.

Where reports, searches, any third party information and similar work has been performed and recorded by others, GHD has used this data in the form that it was provided. The responsibility for the accuracy of such data therefore remains with the issuing authority, not with GHD.

An understanding of site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experience based. Hence, this report should not be altered, amended or abbreviated, issued in part or incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances that arise from the issue of the report that has been modified in any way as outlined above.

6. References

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Appendix A

Figures

295,000 310,000 325,000 340,000

6,645,000

6,630,000

NEW MEXICO RD

DAVYHURST-ORA BANDA RD

GOLDFIELDS HWY

BARDOC

ORA BANDA

BLACK RANGE

BROAD ARROW-ORA BANDA RD

GRANTS PATCH RD

BROAD ARROW

COOLGARDIE NORTH RD

CARBINE-ORA BANDA RD

BALGARRI

BLACK FLAG-ORA BANDA RD

Locality Map

LAVERTON
MENZIES
KALGOORLIE-BOULDER
MERREDIN
NORSEMAN
LAKE GRACE
KATANNING
RAVENSTHORPE
HOPETOUN
ESPERANCE
ALBANY
SOUTHERN OCEAN

1:125,000 (at A3)

0 0.75 1.5 3 4.5 6

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 51

N

LEGEND

- Locality
- Road
- Vegetation Survey Boundary
- DEC Estate
- Clearing Regulations - Schedule One Areas
- Clearing Regulations - Environmentally Sensitive Areas

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NORTON GOLD FIELDS LIMITED

Paddington Gold Pty Limited
Flora and Fauna Survey at Ora Banda

Job Number 61-24596
Revision 0
Date 24 NOV 2009

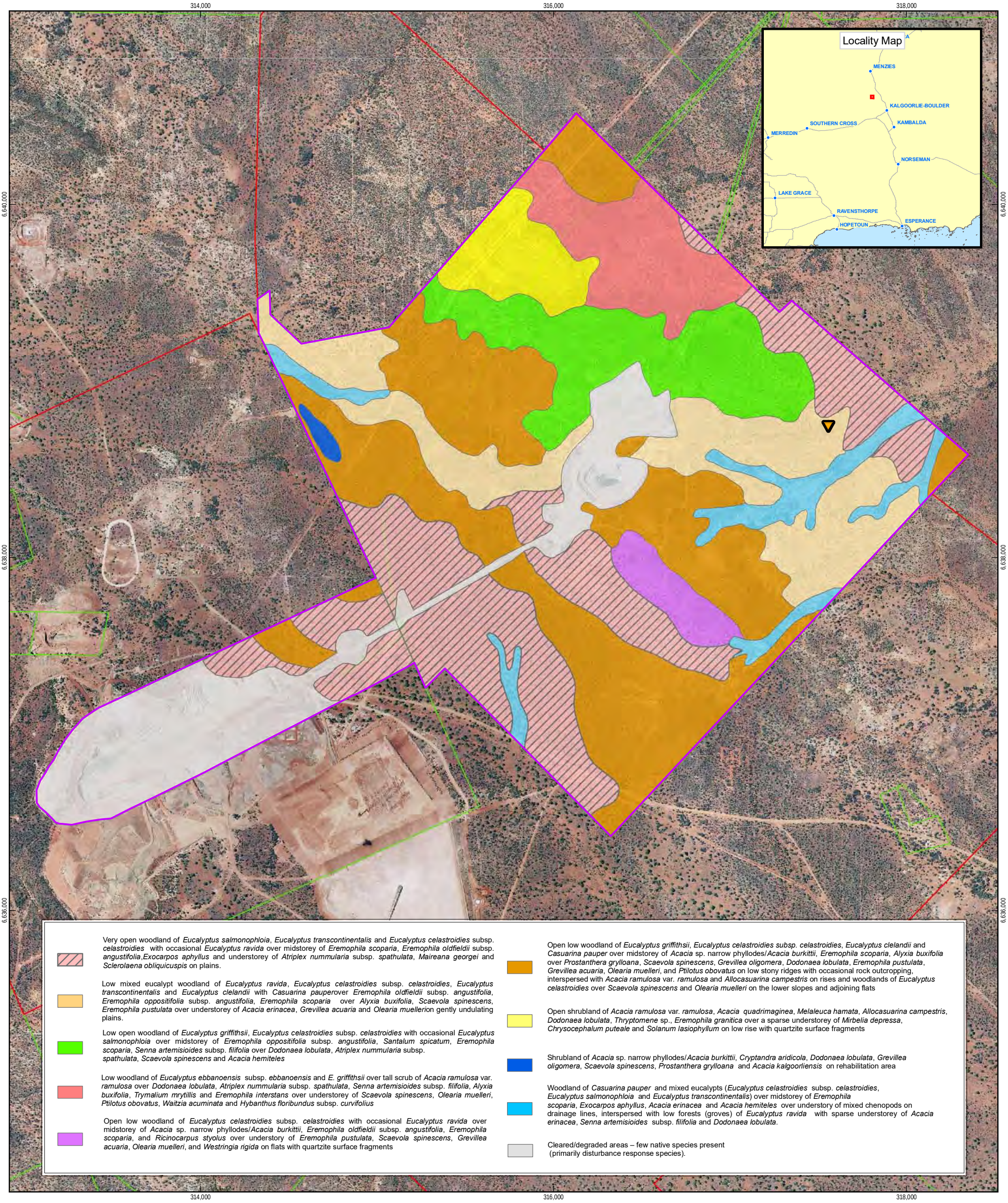
Location Map and Environmental Constraints

Figure 1

G:\61\24596\GIS\MXDS\6124596-G004_Rev0.mxd

Data Source: GHD: Study Area (Paddington Gold Lease) - 20090915; DEC: DEC Estate - 20091110, Clearing Regulations - Environmentally Sensitive Areas - 20080822, Clearing Regulations - Schedule One Areas - 20080821; Landgate: Davyhurst Mosaic 2006 - 2006, Bardoc 2006 Mosaic - 2006, Kalgoorlie 2006 Mosaic - 2006, Dunnsville 2006 Mosaic - 2006; GA: Topo 250k Series 3 Topographic Data - 200607. Created by: kdiralu

GHD House, 239 Adelaide Terrace Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au



Very open woodland of *Eucalyptus salmonophloia*, *Eucalyptus transcontinentalis* and *Eucalyptus celastroidies* subsp. *celastroidies* with occasional *Eucalyptus ravida* over midstorey of *Eremophila scoparia*, *Eremophila oldfieldii* subsp. *angustifolia*,*Exocarpos aphyllus* and understorey of *Atriplex nummularia* subsp. *spathulata*, *Maireana georgei* and *Sclerolaena obliquicuspis* on plains.

Low mixed eucalypt woodland of *Eucalyptus ravida*, *Eucalyptus celastroidies* subsp. *celastroidies*, *Eucalyptus transcontinentalis* and *Eucalyptus clelandii* with *Casuarina pauper*over *Eremophila oldfieldii* subsp. *angustifolia*, *Eremophila oppositifolia* subsp. *angustifolia*, *Eremophila scoparia* over *Alyxia buxifolia*, *Scaevola spinescens*, *Eremophila pustulata* over understorey of *Acacia erinacea*, *Grevillea acuaria* and *Olearia muellerion* gently undulating plains.

Low open woodland of *Eucalyptus griffithsii*, *Eucalyptus celastroidies* subsp. *celastroidies* with occasional *Eucalyptus salmonophloia* over midstorey of *Eremophila oppositifolia* subsp. *angustifolia*, *Santalum spicatum*, *Eremophila scoparia*, *Senna artemisioides* subsp. *filifolia* over *Dodonaea lobulata*, *Atriplex nummularia* subsp. *spathulata*, *Scaevola spinescens* and *Acacia hemiteles*

Low woodland of *Eucalyptus ebbanoensis* subsp. *ebbanoensis* and *E. griffithsii* over tall scrub of *Acacia ramulosa* var. *ramulosa* over *Dodonaea lobulata*, *Atriplex nummularia* subsp. *spathulata*, *Senna artemisioides* subsp. *filifolia*, *Alyxia buxifolia*, *Trymalium mrytillis* and *Eremophila interstans* over understorey of *Scaevola spinescens*, *Olearia muelleri*, *Ptilotus obovatus*, *Waitzia acuminata* and *Hybanthus floribundus* subsp. *curvifolius*

Open low woodland of *Eucalyptus celastroidies* subsp. *celastroidies* with occasional *Eucalyptus ravida* over midstorey of *Acacia* sp. narrow phyllodes/*Acacia burkittii*, *Eremophila oldfieldii* subsp. *angustifolia*, *Eremophila scoparia*, and *Ricinocarpus styolus* over understory of *Eremophila pustulata*, *Scaevola spinescens*, *Grevillea acuaria*, *Olearia muelleri*, and *Westringia rigida* on flats with quartzite surface fragments

Open low woodland of *Eucalyptus griffithsii*, *Eucalyptus celastroidies subsp. celastroidies*, *Eucalyptus clelandii* and *Casuarina pauper* over midstorey of *Acacia* sp. narrow phyllodes/*Acacia burkittii*, *Eremophila scoparia*, *Alyxia buxifolia* over *Prostanthera grylloana*, *Scaevola spinescens*, *Grevillea oligomera*, *Dodonaea lobulata*, *Eremophila pustulata*, *Grevillea acuaria*, *Olearia muelleri*, and *Ptilotus obovatus* on low stony ridges with occasional rock outcropping, interspersed with *Acacia ramulosa* var. *ramulosa* and *Allocasuarina campestris* on rises and woodlands of *Eucalyptus celastroidies* over *Scaevola spinescens* and *Olearia muelleri* on the lower slopes and adjoining flats

Open shrubland of *Acacia ramulosa* var. *ramulosa*, *Acacia quadrimaginea*, *Melaleuca hamata*, *Allocasuarina campestris*, *Dodonaea lobulata*, *Thryptomene* sp., *Eremophila granitica* over a sparse understorey of *Mirbelia depressa*, *Chrysocephalum puteale* and *Solanum lasiophyllum* on low rise with quartzite surface fragments

Shrubland of *Acacia* sp. narrow phyllodes/*Acacia burkittii*, *Cryptandra aridicola*, *Dodonaea lobulata*, *Grevillea oligomera*, *Scaevola spinescens*, *Prostanthera grylloana* and *Acacia kalgoorliensis* on rehabilitation area

Woodland of *Casuarina pauper* and mixed eucalypts (*Eucalyptus celastroidies* subsp. *celastroidies*, *Eucalyptus salmonophloia* and *Eucalyptus transcontinentalis*) over midstorey of *Eremophila scoparia*, *Exocarpos aphyllus*, *Acacia erinacea* and *Acacia hemiteles* over understory of mixed chenopods on drainage lines, interspersed with low forests (groves) of *Eucalyptus ravida* with sparse understorey of *Acacia erinacea*, *Senna artemisioides* subsp. *filifolia* and *Dodonaea lobulata*.

Cleared/degraded areas – few native species present (primarily disturbance response species).

LEGEND

- Paddington Gold Lease
- Vegetation Survey Boundary
- Tenement Boundary
- Priority 1 *Gnephosis intonsa* Location

1:20,000 (at A3)

0 100 200 400 600 800 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 51

N

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Paddington Gold Pty Limited
Flora and Fauna Survey at Ora Banda

Job Number 61-24596
Revision 0
Date 25 NOV 2009

Vegetation Type

Figure 2

G:\61\24596\GIS\MXDS\6124596-G002_Rev0.mxd

GHD House, 239 Adelaide Terrace Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data Source: GHD: Paddington Gold Study Area - 20090915; DMP: Mining Tenements - 20090709; Landgate: Bardoc 2006 Mosaic - 2006 (SLIP: 20090915); GHD: Vegetation Types - 20091103; GA: Topo 250k Series 3 Topographic Data - 200607; GHD: *Gnephosis intonsa* Location - 20091124. Created by: KDIRALU, slee2, kdiralu

314,000 316,000 318,000

6,640,000 6,638,000 6,636,000

6 2-3 4-5

LEGEND

- Paddington Gold Lease
- Vegetation Survey Boundary
- Tenement Boundary

Vegetation Condition

1. Pristine or nearly so
2. Excellent
3. Very Good
4. Good
5. Degraded
6. Completely degraded

- Rehabilitation Area

1:20,000 (at A3)

0 100 200 400 600 800 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 51

N

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Norton Gold Fields Limited

Paddington Gold Pty Limited
Flora and Fauna Survey at Ora Banda

Job Number 61-24596
Revision 0
Date 24 NOV 2009

Vegetation Condition

Figure 3

G:\61\24596\GIS\MXDS\6124596-G003_Rev0.mxd

GHD House, 239 Adelaide Terrace Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data Source: GHD: Paddington Gold Study Area - 20090915; DMP: Mining Tenements - 20090709; Landgate: Bardoc 2006 Mosaic - 2006 (SLIP: 20090915); GHD: Vegetation Types - 20091103; GHD: Vegetation Survey Boundary - 20091110; GA: Topo 250k Series 3 Topographic Data - 200607. Created by: KDIRALU, slee2, kdiralu

Appendix B

Flora

Flora Species Recorded During Field Survey of the Study Area – September 2009

Table 14 Flora Species Recorded During Field Survey of the Study Area – September 2009

					Vegetation Types (Codes)								
Family	**Genus**	**Species**	**Common name**	**Status**	**VOW**	**OLW2**	**OLW3**	**LEW**	**OLW**	**OS**	**LW**	**RE**	**CPW**
Aizoaceae	*Corrigiola*	*litoralis*	Strapwort	*RE				+					
Amaranthaceae	*Ptilotus*	*aervoides*					+						
Amaranthaceae	*Ptilotus*	*carlsonii*											
Amaranthaceae	*Ptilotus*	*exaltatus*	Tall Mulla Mulla		+								+
Amaranthaceae	*Ptilotus*	*helichrysoides*				+							
Amaranthaceae	*Ptilotus*	*obovatus*	Cotton Bush		+	+	+	+			+		+
Apiaceae	*Daucus*	*glochidiatus*	Australian Carrot		+								
Apocynaceae	*Alyxia*	*buxifolia*	Dysentery Bush			+	+	+			+		+
Asclepiadaceae	*Marsdenia*	*australis*	Cogla		+		+						
Asparagaceae	*Thysanotus*	*manglesianus*	Fringed Lily			+				+			
Asteraceae	*Angianthus*	*tomentosus*	Camel-grass		+								+
Asteraceae	*Carthamus*	*lanatus*	Saffron Thistle	*DP		+							
Asteraceae	*Centipeda*	*crateriformis* subsp. *crateriformis*						+					
Asteraceae	*Chrysocephalum*	*puteale*					+						
Asteraceae	*Gnephosis*	*intonsa*	Shaggy Gnephosis	P1	+								
Asteraceae	*Helichrysum*	*luteoalbum*	Jersey Cudweed	*				+					

					Vegetation Types (Codes)								
Family	**Genus**	**Species**	**Common name**	**Status**	**VOW**	**OLW2**	**OLW3**	**LEW**	**OLW**	**OS**	**LW**	**RE**	**CPW**
Asteraceae	*Isoetopsis*	*graminifolia*	Cushion Grass		+								
Asteraceae	*Olearia*	*muelleri*	Goldfields Daisy		+	+	+	+	+	+	+		+
Asteraceae	*Olearia*	*pimeleoides*				+	+						+
Asteraceae	*Ozothamnus*	*cassiope*				+							
Asteraceae	*Rhodanthe*	*oppositifolia* subsp. *oppositifolia*					+						
Asteraceae	*Schoenia*	*cassiniana*	Schoenia										+
Asteraceae	*Senecio*	sp. (insufficient material)											
Asteraceae	*Sonchus*	*oleraceus*	Common Sowthistle	*		+							
Asteraceae	*Streptoglossa*	*liatroides*					+		+				
Asteraceae	*Waitzia*	*acuminata*	Orange Immortelle								+		
Brassicaceae	*Stenopetalum*	*filifolium*				+	+						
Caesalpiniaceae	*Senna*	*artemisioides* subsp. *artemisoides*								+	+		
Caesalpiniaceae	*Senna*	*artemisioides* subsp. *filifolia*			+	+	+	+			+		+
Caesalpiniaceae	*Senna*	*cardiosperma*											+
Campanulaceae	*Wahlenbergia*	*gracilenta*	Annual Bluebell										
Casuarinaceae	*Allocasuarina*	*acutivalvis*						+					

					Vegetation Types (Codes)								
Family	**Genus**	**Species**	**Common name**	**Status**	**VOW**	**OLW2**	**OLW3**	**LEW**	**OLW**	**OS**	**LW**	**RE**	**CPW**
Casuarinaceae	*Allocasuarina*	*campestris*				+							
Casuarinaceae	*Casuarina*	*pauper*	Black Oak		+	+	+	+					+
Chenopodiaceae	*Atriplex*	*bunburyana*	Silver Saltbush		+								+
Chenopodiaceae	*Atriplex*	*codonocarpa*	Flat-topped Saltbush							+			
Chenopodiaceae	*Atriplex*	*nummularia* subsp. *spathulata*	Old Man Saltbush		+	+	+				+		+
Asteraceae	*Senecio*	sp. (insufficient material)											
Asteraceae	*Sonchus*	*oleraceus*	Common Sowthistle	*		+							
Asteraceae	*Streptoglossa*	*liatroides*					+		+				
Asteraceae	*Waitzia*	*acuminata*	Orange Immortelle								+		
Brassicaceae	*Stenopetalum*	*filifolium*				+	+						
Caesalpiniaceae	*Senna*	*artemisioides* subsp. *artemisoides*								+	+		
Caesalpiniaceae	*Senna*	*artemisioides* subsp. *filifolia*			+	+	+	+			+		+
Caesalpiniaceae	*Senna*	*cardiosperma*											+
Campanulaceae	*Wahlenbergia*	*gracilenta*	Annual Bluebell										
Casuarinaceae	*Allocasuarina*	*acutivalvis*						+					
Casuarinaceae	*Allocasuarina*	*campestris*				+							

					Vegetation Types (Codes)								
Family	**Genus**	**Species**	**Common name**	**Status**	**VOW**	**OLW2**	**OLW3**	**LEW**	**OLW**	**OS**	**LW**	**RE**	**CPW**
Casuarinaceae	*Casuarina*	*pauper*	Black Oak		+	+	+	+					+
Chenopodiaceae	*Atriplex*	*bunburyana*	Silver Saltbush		+								+
Chenopodiaceae	*Atriplex*	*codonocarpa*	Flat-topped Saltbush							+			
Chenopodiaceae	*Atriplex*	*nummularia* subsp. *spathulata*	Old Man Saltbush		+	+	+				+		+
Chenopodiaceae	*Atriplex*	*quadrivalvata*								+			
Chenopodiaceae	*Atriplex*	*vesicaria*	Bladder Saltbush		+			+					+
Chenopodiaceae	*Chenopodium*	*album*	Fat Hen	*		+							
Chenopodiaceae	*Enchylaena*	*tomentosa*	Barrier Saltbush		+		+						+
Chenopodiaceae	*Maireana*	*carnosa*	Cottony Bluebush				+						
Chenopodiaceae	*Maireana*	*georgei*	Satiny Bluebush		+	+	+	+					+
Chenopodiaceae	*Maireana*	*sedifolia*	Pearl Bluebush		+		+	+					+
Chenopodiaceae	*Maireana*	*tomentosa*	Felty Bluebush		+								
Chenopodiaceae	*Maireana*	*trichoptera*	Downy Bluebush		+		+	+					
Chenopodiaceae	*Maireana*	*triptera*	Threewinged Bluebush	*	+	+	+					+	
Chenopodiaceae	*Rhagodia*	*drummondii*			+								+
Chenopodiaceae	*Sclerolaena*	*cuneata*	Yellow Bindii		+								
Chenopodiaceae	*Sclerolaena*	*diacantha*	Grey Copperburr		+								

					Vegetation Types (Codes)								
Family	**Genus**	**Species**	**Common name**	**Status**	**VOW**	**OLW2**	**OLW3**	**LEW**	**OLW**	**OS**	**LW**	**RE**	**CPW**
Chenopodiaceae	*Sclerolaena*	*eurotioides*	Fluffy Bindii										+
Chenopodiaceae	*Sclerolaena*	*obliquicuspis*	Limestone Bindii		+		+						
Cucurbitaceae	*Cucumis*	*myriocarpus*	Prickly Paddy Melon	*	+								
Cuscutaceae	*Cuscuta*	*planiflora*		*	+								
Cyperaceae	*Isolepis*	*marginata*	Coarse Club-rush	*				+					
Dilleniaceae	*Hibbertia*	sp.							+				
Eurphorbiceae	*Eurphorbia*	*drummondii* subsp. *drummondii*				+							+
Eurphorbiceae	*Ricinocarpos*	*styolus*		RE		+			+				
Frankeniaceae	*Frankenia*	*?cinerea* (insufficient material)			+								
Geraniaceae	*Erodium*	*cygnorum*	Blue Heronsbill		+			+					+
Goodeniaceae	*Goodenia*	*pinnatifida*					+						+
Goodeniaceae	*Scaevola*	*spinescens*	Currant Bush		+	+	+	+	+	+	+	+	+
Haloragaceae	*Haloragis*	*trigonocarpa*			+								
Lamiaceae	*Prostanthera*	*campbelli*					+						
Lamiaceae	*Prostanthera*	*grylloana*				+	+					+	
Lamiaceae	*Salvia*	*verbenaca*	Wild Sage	*		+							
Lamiaceae	*Westringia*	*cephalantha*				+	+						

					Vegetation Types (Codes)								
Family	**Genus**	**Species**	**Common name**	**Status**	**VOW**	**OLW2**	**OLW3**	**LEW**	**OLW**	**OS**	**LW**	**RE**	**CPW**
Lamiaceae	*Westringia*	*rigida*	Stiff Westringia			+			+				
Loranthaceae	*Amyema*	*benthamii*								+			
Malvaceae	*Sida*	sp.									+		
Mimosaceae	*Acacia*	sp. Norseman (B. Archer 1554)				+							
Mimosaceae	*Acacia*	*andrewsii*				+			+				
Mimosaceae	*Acacia*	*aneura* var. *intermedia*	Mulga			+	+						+
Mimosaceae	*Acacia*	*colletioides*	Wait-a-while			+	+						
Mimosaceae	*Acacia*	*erinacea*			+	+	+	+			+		+
Mimosaceae	*Acacia*	*hemiteles*	Tan Wattle		+	+	+	+					+
Mimosaceae	*Acacia*	*jennerae*			+								+
Mimosaceae	*Acacia*	*kalgoorliensis*										+	
Mimosaceae	*Acacia*	*lasiocalyx*				+							
Mimosaceae	*Acacia*	*pranni*									+		
Mimosaceae	*Acacia*	*quadrimarginea*					+						
Mimosaceae	*Acacia*	*ramulosa var. ramulosa*	Horse Mulga			+	+				+		
Mimosaceae	*Acacia*	sp. narrow phyllodes (B.R. Maslin 7831)/*burkittii*			+	+	+		+		+	+	+

					Vegetation Types (Codes)								
Family	**Genus**	**Species**	**Common name**	**Status**	**VOW**	**OLW2**	**OLW3**	**LEW**	**OLW**	**OS**	**LW**	**RE**	**CPW**
Mimosaceae	*Acacia*	*stowardii*				+							
Mimosaceae	*Acacia*	*tetragonophylla*	Kurara		+	+	+				+		+
Myoporaceae	*Eremophila*	*alternifolia*	Poverty Bush		+	+	+						
Myoporaceae	*Eremophila*	*georgei*				+	+						
Myoporaceae	*Eremophila*	*glabra* subsp. *glabra*	Tar Bush		+	+	+						
Myoporaceae	*Eremophila*	*granitica*	Thin-leaved Poverty Bush							+			+
Myoporaceae	*Eremophila*	*interstans*			+		+				+		
Myoporaceae	*Eremophila*	*interstans* subsp. *virgata*			+								
Myoporaceae	*Eremophila*	*latrobei*	Warty Fuschia Bush				+			+			
Myoporaceae	*Eremophila*	*maculata*	Native Fuschia		+		+	+					
Myoporaceae	*Eremophila*	*oldfieldii* subsp. *angustifolia*	Pixie Bush		+	+	+	+	+		+		+
Myoporaceae	*Eremophila*	*oppositifolia* subsp. *angustifolia*	Weeooka		+	+	+	+					+
Myoporaceae	*Eremophila*	*parvifolia* subsp. *auricampa*	Small-leaved Eremophila		+	+							
Myoporaceae	*Eremophila*	*pustulata*	Warted Eremophila		+	+		+	+				+
Myoporaceae	*Eremophila*	*scoparia*	Broom Bush		+	+	+	+	+				+

					Vegetation Types (Codes)								
Family	**Genus**	**Species**	**Common name**	**Status**	**VOW**	**OLW2**	**OLW3**	**LEW**	**OLW**	**OS**	**LW**	**RE**	**CPW**
Myoporaceae	*Eremophila*	sp. Mt Jackson (G.J. Keighery 4372)				+	+	+					
Myrtaceae	*Eucalyptus*	*celastroides* subsp. *celastroides*	Mirret		+	+		+	+				+
Myrtaceae	*Eucalyptus*	*celastroides* subsp. *virella*	Mirret		+		+	+					
Myrtaceae	*Eucalyptus*	*clelandii*	Cleland's Blackbutt		+	+	+	+					+
Myrtaceae	*Eucalyptus*	*ebbanoensis* subsp. *ebbanoensis*	Sandplain Mallee								+		
Myrtaceae	*Eucalyptus*	*flavida*				+	+	+					
Myrtaceae	*Eucalyptus*	*griffithsii*	Griffith's Grey Gum		+	+	+				+		
Myrtaceae	*Eucalyptus*	*ravida*			+	+		+	+				+
Myrtaceae	*Eucalyptus*	*salmonophloia*	Salmon Gum		+		+						+
Myrtaceae	*Eucalyptus*	*transcontinentalis*	Redwood		+			+					+
Myrtaceae	*Eucalyptus*	*yilgarnensis*				+							
Myrtaceae	*Euryomyrtus*	*maidenii*					+						
Myrtaceae	*Melaleuca*	*hamata*				+	+						
Myrtaceae	*Melaleuca*	*leiocarpa*				+							
Myrtaceae	*Thryptomene*	sp.								+			
Papilionaceae	*Medicago*	*minima*	Small Burr Medic	*	+								

					Vegetation Types (Codes)								
Family	**Genus**	**Species**	**Common name**	**Status**	**VOW**	**OLW2**	**OLW3**	**LEW**	**OLW**	**OS**	**LW**	**RE**	**CPW**
Papilionaceae	*Mirbelia*	*depressa*								+			
Papilionaceae	*Swainsona*	*canescens*	Grey Swainsona					+					+
Papilionaceae	*Swainsona*	*purpurea*											
Papilionaceae	*Templetonia*	*sulcata*			+								+
Plantaginaceae	*Plantago*	*drummondii*	Sago Weed		+								
Poaceae	*Austrostipa*	*elegantissima*	Showy Feathergrass										
Poaceae	*Austrostipa*	*nitida*			+	+	+	+					+
Poaceae	*Austrostipa*	sp. (insufficient material)								+			
Poaceae	*Austrostipa*	sp. (insufficient material)						+					
Poaceae	*Eragrostis*	*dielsii*	Mallee Lovegrass		+								+
Poaceae	*Eriachne*	*pulchella* subsp. *pulchella*	Pretty Wanderrie			+							
Primulaceae	*Anagallis*	*arvensis* subsp. *caerulea*	Pimpernel	*				+			+		
Proteaceae	*Grevillea*	*acuaria*			+	+	+	+	+				+
Proteaceae	*Grevillea*	*oligomera*				+							
Proteaceae	*Hakea*	*preissii*	Needle Tree			+							
Rhamnaceae	*Cryptandra*	*aridicola*										+	
Rhamnaceae	*Trymalium*	*myrtillus*				+			+		+		

					Vegetation Types (Codes)								
Family	**Genus**	**Species**	**Common name**	**Status**	**VOW**	**OLW2**	**OLW3**	**LEW**	**OLW**	**OS**	**LW**	**RE**	**CPW**
Rutaceae	*Phebalium*	*canaliculatum*				+							
Rutaceae	*Philotheca*	*brucei* subsp. *brucei*				+	+						
Santalaceae	*Exocarpos*	*asphyllus*	Leafless Ballart		+	+	+	+					
Santalaceae	*Santalum*	*acuminatum*	Quandong		+								+
Santalaceae	*Santalum*	*spicatum*	Sandalwood		+	+	+	+	+		+		+
Sapindaceae	*Dodonaea*	*lobulata*	Bead Hopbush		+	+	+	+	+		+	+	+
Sapindaceae	*Dodonaea*	*microzyga*				+							
Sapindaceae	*Dodonaea*	*microzyga* var. *acrolobata*					+						
Solanaceae	*Solanum*	*hoplopetalum*	Thorny Solanum		+								
Solanaceae	*Solanum*	*lasiophyllum*	Flannel Bush		+	+							
Solanaceae	*Solanum*	*nummularium*	Money-leaved Solanum		+	+							
Sterculiaceae	*Brachychiton*	*gregorii*	Desert Kurrajong				+			+			
Thymelaeaceae	*Pimelea*	*microcephala*	Shrubby Riceflower							+			
Violaceae	*Hybanthus*	*floribundus* subsp. *curvifolius*									+		
Zygophyllaceae	*Zygophyllum*	sp. (insufficient material)											+

* Exotic Species; RE – Range Extension; LS – Locally Significant; P1 – Priority One Flora Species

Appendix C

Fauna

NatureMap Records within 40 km of the Study

Fauna Species Observed within the Study Area

EPBC Act Fauna Conservation Categories

Listed threatened species and ecological communities

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a species listed in any of the following categories:

- extinct in the wild,
- critically endangered,
- endangered, or
- vulnerable.

An action will also require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on an ecological community listed in any of the following categories:

- critically endangered, or
- endangered.

Critically endangered and endangered species

An action has, will have, or is likely to have a significant impact on a critically endangered or endangered species if it does, will, or is likely to:

- lead to a long-term decrease in the size of a population, or
- reduce the area of occupancy of the species, or
- fragment an existing population into two or more populations, or
- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of a population, or
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat+, or
- introduce disease that may cause the species to decline, or
- interfere with the recovery of the species.

**Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a critically endangered or endangered species by direct competition, modification of habitat, or predation.*

Vulnerable species

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

- Lead to a long-term decrease in the size of an important population of a species, or
- reduce the area of occupancy of an important population, or

- fragment an existing important population into two or more populations, or
- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of an important population, or
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species' habitat*, or
- introduce disease that may cause the species to decline, or
- interferes substantially with the recovery of the species.

An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal,
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

*Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a vulnerable species by direct competition, modification of habitat, or predation.

Listed migratory species

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a listed migratory species. Note that some migratory species are also listed as threatened species. The criteria below are relevant to migratory species that are not threatened.

An action has, will have, or is likely to have a significant impact on a migratory species if it does, will, or is likely to:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species, or
- result in invasive species that is harmful to the migratory species becoming established* in an area of important habitat of the migratory species, or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

An area of important habitat is:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, or
- habitat utilised by a migratory species which is at the limit of the species range, or
- habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an ecologically significant proportion of the population varies with the species (each circumstance will need to be evaluated).

*Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a migratory species by direct competition, modification of habitat, or predation.

The Commonwealth marine environment

An action will require approval from the Environment Minister if:

- the action is taken in a Commonwealth marine area and the action has, will have, or is likely to have a significant effect on the environment, or
- the action is taken outside a Commonwealth marine area and the action has, will have, or is likely to have a significant effect on the environment in a Commonwealth marine area.

An action has, will have or is likely to have a significant impact on the environment in a Commonwealth marine area if it does, will, or is likely to:

- result in a known or potential pest species becoming established in the Commonwealth marine area*, or
- modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results, or
- have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (eg breeding, feeding, migration behaviour, and life expectancy) and spatial distribution, or
- result in a substantial change in air quality** or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or
- result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected.

**Translocating or introducing a pest species may result in that species becoming established.*

***The Commonwealth marine area includes any airspace over Commonwealth waters.*

(Department of Environment and Heritage, 2006)

Table 15 NatureMap Records within 40 km of the Study Area

Family	*Species*	Common Name	*EPBC Act*	DEC
Mammals				
Burramyidae	*Cercartetus concinnus*	Western Pygmy-possum, Mundarda		
Dasyuridae	*Antechinomys laniger Kultarr*			
Dasyuridae	*Ningaui ridei Wongai Ningaui*			
Dasyuridae	*Ningaui yvonneae Southern Ningaui*			
Dasyuridae	*Pseudantechinus woolleyae*	Woolley's Pseudantechinus		
Dasyuridae	*Sminthopsis crassicaudata*	Fat-tailed Dunnart		
Dasyuridae	*Sminthopsis dolichura*	Little long-tailed Dunnart		
Dasyuridae	*Sminthopsis gilberti*	Gilbert's Dunnart		
Dasyuridae	*Sminthopsis ooldea*	Ooldea Dunnart		
Molossidae	*Mormopterus planiceps*	Southern Freetail-bat		
Molossidae	*Tadarida australis*	White-striped Freetail-bat		
Muridae	*Mus musculus*	House Mouse		
Muridae	*Pseudomys albocinereus*	Ash-grey Mouse		
Muridae	*Pseudomys bolami*	Bolam's Mouse		
Muridae	*Pseudomys hermannsburgensis*	Sandy Inland Mouse		
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat		
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat		
Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat		
Vespertilionidae	*Nyctophilus timoriensis* subsp. *(central form)*			
Vespertilionidae	*Scotorepens balstoni*	Inland Broad-nosed Bat		
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat		
Birds				
Accipitridae	*Aquila audax*	Wedge-tailed Eagle		
Anhingidae	*Anhinga melanogaster* subsp. *novaehollandiae*			
Cinclosomatidae	*Cinclosoma castanotus*	Chestnut Quail-thrush		
Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater		
Meliphagidae	*Lichenostomus virescens*	Singing Honeyeater		
Megapodiidae	*Leipoa ocellata*	Malleefowl		T

Family	*Species*	Common Name	*EPBC Act*	DEC
Otididae	*Ardeotis australis*	Australian Bustard		P4
Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe		
Rallidae	*Fulica atra* subsp. *australis*			
Reptiles				
Agamidae	*Caimanops amphiboluroides (name not current)*			
Agamidae	*Ctenophorus cristatus*	Bicycle Dragon		
Agamidae	*Ctenophorus fordi*	Mallee Sand Dragon		
Agamidae	*Ctenophorus reticulatus*	Western Netted Dragon		
Agamidae	*Ctenophorus salinarum*	Salt Pan Dragon		
Agamidae	*Ctenophorus scutulatus*			
Agamidae	*Moloch horridus*	Thorny Devil		
Agamidae	*Pogona minor* subsp. *minor*			
Carphodactylidae	*Nephrurus laevissimus*			
Carphodactylidae	*Nephrurus milii*	Barking Gecko		
Carphodactylidae	*Nephrurus vertebralis*			
Diplodactylidae	*Diplodactylus conspicillatus*	Fat-tailed Gecko		
Diplodactylidae	*Diplodactylus granariensis* subsp. *granariensis*			
Diplodactylidae	*Diplodactylus pulcher*			
Diplodactylidae	*Lucasium maini*			
Diplodactylidae	*Oedura reticulata*			
Diplodactylidae	*Rhynchoedura ornata*	Beaked Gecko		
Diplodactylidae	*Strophurus assimilis*	Goldfields Spiny-tailed Gecko		
Diplodactylidae	*Strophurus elderi*			
Elapidae	*Brachyurophis semifasciata*			
Elapidae	*Parasuta gouldii*			
Elapidae	*Parasuta monachus*			
Elapidae	*Pseudechis australis*	Mulga Snake		
Elapidae	*Pseudonaja modesta*	Ringed Brown Snake		
Elapidae	*Pseudonaja nuchalis*	Gwardar		
Elapidae	*Simoselaps bertholdi*	Jan's Banded Snake		
Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe		
Pygopodidae	*Delma australis*			

Family	*Species*	Common Name	*EPBC Act*	DEC
Pygopodidae	*Delma butleri*			
Pygopodidae	*Lialis burtonis*			
Pygopodidae	*Pygopus nigriceps*			
Scincidae	*Cryptoblepharus buchananii*			
Scincidae	*Cryptoblepharus plagiocephalus*			
Scincidae	*Ctenotus atlas*			
Scincidae	*Ctenotus leonhardii*			
Scincidae	*Ctenotus pantherinus* subsp. *ocellifer*			
Scincidae	*Ctenotus schomburgkii*			
Scincidae	*Ctenotus uber* subsp. *uber*			
Scincidae	*Cyclodomorphus melanops* subsp. *elongatus*			
Scincidae	*Egernia depressa*	Pygmy Spiny-tailed Skink		
Scincidae	*Egernia formosa*			
Scincidae	*Egernia inornata*			
Scincidae	*Egernia striata Night Skink*			
Scincidae	*Eremiascincus richardsonii*	Broad-banded Sand Swimmer		
Scincidae	*Hemiergis initialis* subsp. *initialis*			
Scincidae	*Lerista kingi*			
Scincidae	*Lerista macropisthopus* subsp. *macropisthopus*			
Scincidae	*Lerista picturata*			
Scincidae	*Menetia greyii*			
Scincidae	*Morethia adelaidensis*			
Scincidae	*Morethia butleri*			
Typhlopidae	*Ramphotyphlops australis*			
Typhlopidae	*Ramphotyphlops bicolor*			
Typhlopidae	*Ramphotyphlops bituberculatus*			
Typhlopidae	*Ramphotyphlops hamatus*			
Typhlopidae	*Ramphotyphlops waitii*			
Varanidae	*Varanus caudolineatus*			
Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor		
Amphibian				
Limnodynastidae	*Neobatrachus kunapalari*	Kunapalari Frog		

Family	*Species*	Common Name	*EPBC Act*	DEC
Limnodynastidae	*Neobatrachus wilsmorei*	Plonking Frog		
Myobatrachidae	*Pseudophryne occidentalis*	Western Toadlet		

Table 16 Fauna Species Observed within the Study Area – September 2009

Family	Genus	Species	Common Name	Conservation Status	
				EPBC	DEC
Birds					
Acanthzidae	*Acanthiza*	*apicalis*	Inland Thornbill		
Accipitridae	*Accipiter*	*fasciatus*	Brown Goshawk	Migratory/ Marine	
Alcedinidae	*Ocyphaps*	*lophotes*	Crested Pigeon		
Alcedinidae	*Phaps*	*chalcoptera*	Common Bronzewing		
Campephagidae	*Coracina*	*novaehollandiae*	Black-faced Cuckoo-shrike	Marine	
Casuariidae	*Dromaius*	*novaehollandiae*	Emu		
Cinclosomatidae	*Cinclosoma*	*castanotus*	Chestnut Quail-thrush		
Corvidae	*Corvus*	*coronoides*	Australian Raven		
Corvidae	*Corvus*	*orru*	Torresian Crow		
Cracticidae	*Cracticus*	*tibicen*	Australian Magpie		
Cracticidae	*Cracticus*	*torquatus*	Grey Butcherbird		
Cracticidae	*Strepera*	*versicolor*	Grey Currawong		
Cuculidae	*Chrysococcyx*	*osculans*	Black-eared Cuckoo		
Dicruridae	*Grallina*	*cyanoleuca*	Magpie Lark		
Dicruridae	*Rhipidura*	*leucophrys*	Willie Wagtail		
Meliphagidae	*Acanthagenys*	*rufogularis*	Spiny-cheeked Honeyeater		
Meliphagidae	*Anthochaera*	*carunculata*	Red Wattlebird		
Meliphagidae	*Lichmera*	*indistincta*	Brown Honeyeater		
Meliphagidae	*Manorina*	*flavigula*	Yellow-throated Miner		
Neosittidae	*Daphoenositta*	*chrysoptera*	Varied Sittella		
Pachycephalidae	*Colluricincia*	*harmonica*	Grey Shrike-thrush		

Family	Genus	Species	Common Name	Conservation Status	
				EPBC	DEC
Pachycephalidae	*Oreoica*	*gutturalis*	Crested Bellbird		
Pardalotidae	*Pardalotus*	*striatus*	Striated Pardalote		
Petroicidae	*Microeca*	*fascinans*	Jacky Winter		
Petroicidae	*Petroica*	*goodenovii*	Red-capped Robin		
Psittacidae	*Melopsittacus*	*undulatus*	Budgerigar		
Psittacidae	*Platycerus*	*zonarius*	Australian Ringneck		
Psittacidae	*Psephotus*	*varius*	Mulga Parrot		
Zosteropidae	*Zosterops*	*lateralis*	Silvereye		
Reptiles					
Gekkonidae	*Heteronotia*	*binoei*	Bynoe's Gecko		
Gekkonidae	*Underwoodisaurus*	*milii*	Thick-tailed Gecko		
Scincidae	*Tiliqua*	*rugosa*	Shingleback		
Mammals					
Bovidae	*Capra*	*hircus*	Goat*		
Canidae	*Vulpes*	*vulpes*	Red Fox*		
Felidae	*Felis*	*catus*	Cat*		
Leporidae	*Oryctolagus*	*cuniculus*	European Rabbit*		
Macropodidae	*Macropus*	*fuliginosus*	Western Grey Kangaroo		

* Introduced

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0	P. Moonie	J. Foster		A. Napier		19/11/2009

Appendix 7

2018 Annual Malleefowl Survey, Terrestrial Ecosystems

Ref: 2018-0082-004-st
Version 2

12 December 2018

Sheree Blechynden
Graduate Environmental Advisor
Norton Gold Fields
PO Box 1653
Kalgoorlie
WA 6430

Re: Annual Malleefowl Survey – Enterprise, Carbine and Golden Cities

Dear Sheree

Terrestrial Ecosystems is pleased to provide the outcomes of the recent targeted search for Malleefowl (*Leipoa ocellata*) and their mounds at Enterprise, Carbine and Golden Cities (i.e. project areas; Figure 1). This survey was completed to fulfil the requirements of Norton Gold Field's Malleefowl Management Plan and to assist mining development in the region.

Malleefowl

Malleefowl have been found in mallee regions of southern Australia from approximately the 26th parallel of latitude southwards. Malleefowl are now only found throughout these regions in fragmented patches of mostly dense vegetation due to clearing of habitat for agriculture, increased fire frequency, competition with exotic herbivores (sheep, rabbits, cattle, goats) and kangaroos, predation by wild dogs, foxes and cats, inbreeding as a result of fragmentation, and possibly hunting for food.

Mound Profiles

The following six Malleefowl mound profiles (Hopkins nd) are used by the national Malleefowl monitoring program:

Profile 1 (crater rim apparent) – this is the typical mound shape but is inactive and without any accumulated vegetation in the crater.

Profile 2 (mound dug out) – this is a recently fully dug out mound with steep sides to the crater, with the base forming a box like structure with the sides normally 20-30cm deep. Sometimes litter has been raked into windrows in readiness to be placed in the mound

Profile 3 (mound filled if litter) – this mound contains litter in the crater, and is the next construction stage after profile 2. It should be apparent where litter has been raked into the mound.

Profile 4 (active mound with no crater) – this active mound is closed, and dome shaped. Note that some mounds have a dome and no crater but are not active.

Profile 5 (mound with crater and often a peak at the centre) – this is an active mound that is being opened or closed.

Profile 6 (disused or extinct mound) – this mound has not been used for some time and weathering and erosion have 'flattened' the original mound.

Methodology

Dr Margot Oorebeek and Ray Turnbull (Senior Zoologist and Ornithologists, Terrestrial Ecosystems) completed a transect search of all habitat suitable for Malleefowl in the three project areas. Field assistance was provided by Sheree Blechynden and Dylan Martini (Paddington Gold) for a portion of the Golden Cities project area. The transect searching was completed on foot and using an all-terrain vehicle between 16-24 November 2018. Transects were spaced so that all areas could be visually inspected between each pass, and in most cases, this varied between 10-50m.

All mounds were mapped and rated according to the National Malleefowl mound monitoring guidelines (see above: Hopkins nd).

The weather was fine and warm during the site surveys. While every effort was made to detect potential mounds in the survey area, some old and disused mounds could have been missed as they do not have a good mound profile and will not stand out when compared with rabbit diggings and other disturbances.

Results

Carbine

Although 80km of transects were completed, no Malleefowl mounds were recorded in the Carbine project area (Figure 2). The habitat consisted of an open eucalypt woodland with a shrub and chenopod understory and was not considered suitable for Malleefowl (Plates 1-4).

Enterprise

Twelve inactive Malleefowl mounds have been recorded in the Enterprise project area (Table 1; Figure 3) during 192km of transect searches. The transect searches were completed on ATV and on foot and were more detailed than February 2018 and Botanical Consulting (2017). The recorded mounds included the five mounds recorded by Botanica Consulting (2017) and two mounds recorded by Terrestrial Ecosystems (2018a). Five additional inactive mounds were recorded in November 2018. The Malleefowl mound (ENT07) recorded as recently active in February 2018 is now inactive. The Enterprise habitat is shown in Plates 5-8 and the Malleefowl mounds in Plates 9-20.

Golden Cities

Eleven Malleefowl mounds have been recorded in the Federal area (northern portion of Golden Cities) and 11 mounds in the remaining portion (Table 1; Figure 4). One Malleefowl mound was active in each of these areas. In total, 805km of transect searching were completed on ATV and on foot and checks were completed of all previously recorded mounds (Terrestrial Ecosystems 2018b). The habitat is shown in Plates 21-28 and the Malleefowl mounds in Plates 29-50. Mounds recorded as active by Terrestrial Ecosystems (2018a) in February 2018 are no longer active.

Table 1 provides the location and description of all Malleefowl mounds recorded by Terrestrial Ecosystems in February and November 2018 (Terrestrial Ecosystems 2018b, a) and Botanic Consulting (2017).

Summary

This survey and others completed by Terrestrial Ecosystems (2018b, a) and Botanica Consulting (2017) indicate that Malleefowl are still present in the area, however, there is limited evidence of many birds breeding. In other areas of Western Australia Terrestrial Ecosystems has recorded a higher ratio of active to inactive mounds (Thompson et al. 2015). This would indicate that the Malleefowl in the Norton tenements are under breeding stress, and given the lack of broad scale vegetation clearing, this stress it is most likely coming from predation by cats, foxes and wild dogs.

Further exploration drilling and fragmentation of the area will increase the access of feral and pest species (i.e. cats, foxes and wild dogs) into the dense habitats which further exacerbate the predation pressure issue. Terrestrial Ecosystems therefore recommends that Norton considers implementing an annual feral and pest

animal management program to reduce the predation pressure on Malleefowl. It is unlikely that all foxes, cats and wild dogs in the area could be killed in an annual predator reduction program, but such a program should kill sufficient animals to reduce predation pressure, with the possible consequence of an increase in the Malleefowl population.

If mining or exploration is considered in the Golden Cities area, then a minimum 100m buffer should be maintained around the active Malleefowl mounds and 50m buffer around recently active (2016 onwards) mounds. Terrestrial Ecosystems also recommends that if vegetation disturbance is planned within 250m of any active mound that Norton Gold Fields consider the significant impact test as per Significant Impact Guidelines 1.1 published by the Australian Government with respect to the *EPBC Act 1999*.

In addition to the regular surveys of Norton tenements, Terrestrial Ecosystems recommends that:

a) all recently active or active Malleefowl mounds found previously across the Norton tenements are inspected annually to determine breeding success;
b) Norton monitors all active Malleefowl mounds throughout the annual breeding season using camera traps. These camera traps should be set up as soon as possible and remain active until March 2019. The analysis of camera trap data should look at daily usage patterns, presence of breeding activity, nest mound preparation, presence of feral and pest fauna and hatching of chicks. These data will facilitate better management of this conservation significant species in the tenements.

Please do not hesitate in contacting the undersigned (0407 385 239), if you have any queries regarding this letter.

Yours sincerely

Dr Scott Thompson
Partner and Principal Zoologist

References

Botanica Consulting. 2017. Breeding Season Malleefowl Survey 2016-2017. Kalgoorlie.

Hopkins, L. nd. National Manual for the Malleefowl Monitoring System. National Heritage Trust, Canberra.

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Thompson, S., G. Thompson, J. Sackmann, J. Spark, and T. Brown. 2015. Using high-definition aerial photography to search in 3D for malleefowl mounds is a cost-effective alternative to ground searches. Pacific Conservation Biology **21**:208-213.

Table 1. Details for Malleefowl mounds recorded in the Enterprise and Golden Cities (including Federal) project areas

Project	ID	Zone	Easting	Northing	Category	Size	Comments
Enterprise	ENT01	51J	316339	6640205			Old, long unused
Enterprise	ENT02	51J	316028	6639884			Old, long unused
Enterprise	ENT03	51J	316104	6639585			Old, long unused
Enterprise	ENT04	51J	315913	6639834			Old, long unused
Enterprise	ENT05	51J	317986	6638713			Old, long unused
Enterprise	ENT07	51J	315330	6639399	Profile 1		Prominent rim. Mound with shallow crater. Unable to determine activity level due to rain. 5m wide, 70cm high. Active in January but inactive in November 2018
Enterprise	ENT08	51J	316303	6640077	Profile 6		Bushes regrown around edges. Inactive for a long period. Used by rabbits?
Enterprise	ENT09	51J	317469	6638194	Profile 1	2.5x2.5m	Crater 0.4m deep and rim 0.3m high. Appears quite old.
Enterprise	ENT10	51J	315883	6640097	Profile 1	5x4m	Crater 0.3m deep and rim 0.3m high. Has bushes growing in it. Appears quite old.
Enterprise	ENT11	51J	317323	6638031	Profile 6	2.5x2.5x0.3m	Low mound of small stones and soil. Extinct.
Enterprise	ENT12	51J	315961	6639523	Profile 1	3.5x4x0.6m	No leaf litter present. Inactive.
Enterprise	ENT13	51J	315379	6638798	Profile 1	4x4x0.3m	No leaf litter present and small shrubs growing on top of it. Old.
Federal	FED01	51J	346692	6635867	Profile 6		Slightly raised earth mound. Inactive for a long period.
Federal	FED02	51J	347072	6635705	Profile 1		Prominent rim. Mound dug out. Appeared inactive. 6m wide, 40cm high
Federal	FED03	51J	347191	6635830	Profile 6		Stony material. Inactive for a long period.
Federal	FED04	51J	347480	6636620	Profile 6		Stony material. Bushes regrown around edges. Inactive for a long period.
Federal	FED05	51J	347298	6636381	Profile 6		Stony material. Inactive for a long period.
Federal	FED06	51J	347155	6636130	Profile 6		Stony material. Inactive for a long period.
Federal	FED07	51J	347143	6636534	Profile 6		Stony material. Bushes growing on mound. Inactive for a long period.
Federal	FED08	51J	346812	6636593	Profile 6		Stony material. Bushes regrown around edges. Inactive for a long period.
Federal	FED09	51J	346607	6636074	Profile 6		Stony material. Bushes growing on mound. Inactive for a long period.
Federal	FED10	51J	348541	6635863	Profile 4	3x3x0.7m	The mound mostly consists of soil with only a small amount of organic matter. Fresh scrapings all around the base of the mound and a Malleefowl feather at the top. Most likely active.
Federal	FED11	51J	346759	6636460	Profile 6	2.5x3x0.3m	Consisting of lots of white pebbles and bushes growing on top. Extinct.
Golden Cities	GC01	51J	345168	6634038		6x0.5m	Old, long unused
Golden Cities	GC02	51J	347152	6633637		3.5x0.5m	Old, long unused
Golden Cities	GC03	51J	347115	6633275		4x0.5m	Used in 2016 (old egg shell)

Golden Cities	GC04	51J	347031	6633149		3.5x0.5m	Used in 2016 (old egg shell and some scratchings)
Golden Cities	GC05	51J	346232	6632527		4x0.75m	In use in November 2017 (footprints, egg shell, scats). Inactive in November 2018 although there is egg shell in it indicating it was active last breeding season.
Golden Cities	GC06	51J	346638	6632759		5x0.75m	Inactive in 2017, but inactive in November 2018 although there is egg shell in it indicating it was active last breeding season (between assessments).
Golden Cities	GC07	51J	346798	6632934	Profile 6	5x5m	Approximately 0.3m high. Has bushes growing on top. Extinct.
Golden Cities	GC08	51J	346642	6632762	Profile 1	5x6x0.6m	No leaf litter present and soil is compacted. Old.
Golden Cities	GC09	51J	345836	6632669	Profile 4	3.5x3.5x1m	The mound contains a lot of leaf litter and has fresh scratch markings. Most likely active.
Golden Cities	GC10	51J	348544	6633069	Profile 1	3.5x4x0.9m	Has a few small shrubs growing on top of it. Inactive.
Golden Cities	GC11	51J	348259	6633316	Profile 6	2x2x0.2m	Small scatter of white pebbles. Extinct.

Plate 1. Carbine project area

Plate 2. Carbine project area

Plate 3. Carbine project area

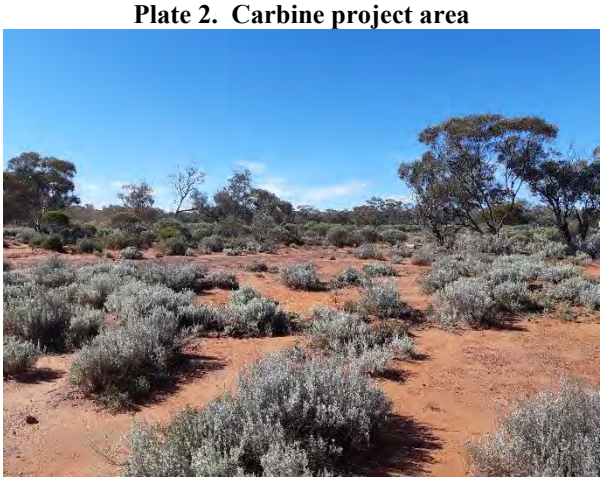


Plate 4. Carbine project area

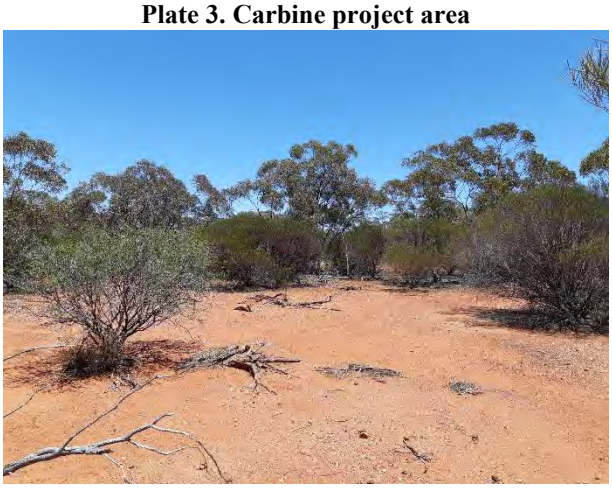


Plate 5. Enterprise project area

Plate 6. Enterprise project area

10 Houston Place, Mt Claremont, Western Australia, Australia 6010
ph: 08 9385 2398, mob: 0407 385 239, email: info@terrestrialecosystems.com
www.terrestrialecosystems.com

Plate 7. Enterprise project area

Plate 8. Enterprise project area

Plate 9. Enterprise mound ENT001

Plate 10. Enterprise mound ENT002

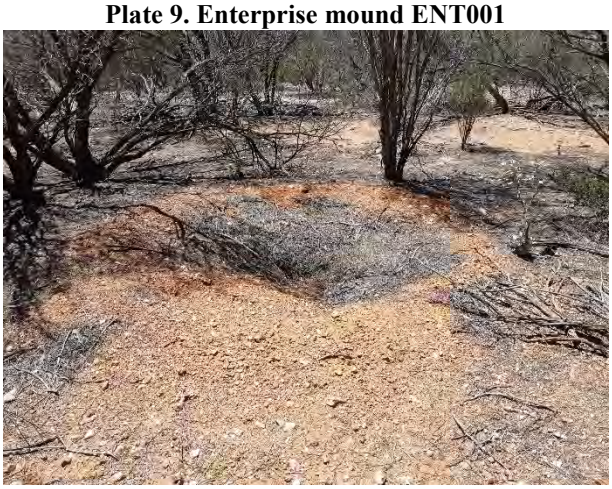


Plate 11. Enterprise mound ENT003

Plate 12. Enterprise mound ENT004

Plate 13. Enterprise mound ENT005

Plate 14. Enterprise mound ENT007

Plate 15. Enterprise mound ENT008

Plate 16. Enterprise mound ENT009

Plate 17. Enterprise mound ENT010

Plate 18. Enterprise mound ENT011

Plate 19. Enterprise mound ENT012

Plate 20. Enterprise mound ENT013

Plate 21. Golden Cities habitat

Plate 22. Golden Cities habitat

Plate 23. Golden Cities habitat

Plate 24. Golden Cities habitat

Plate 25. Golden Cities habitat

Plate 26. Golden Cities habitat

Plate 27. Golden Cities habitat

Plate 28. Golden Cities habitat

Plate 29. Golden Cities Mound FED01

Plate 30. Golden Cities Mound FED02

Plate 31. Golden Cities Mound FED03

Plate 32. Golden Cities Mound FED04

Plate 33. Golden Cities Mound FED05

Plate 34. Golden Cities Mound FED06

Plate 35. Golden Cities Mound FED07

Plate 36. Golden Cities Mound FED08

Plate 37. Golden Cities Mound FED09

Plate 38. Golden Cities Mound FED10

Plate 39. Golden Cities Mound FED11

Plate 40. Golden Cities Mound GC01

Plate 41. Golden Cities Mound GC02

Plate 42. Golden Cities Mound GC03

Plate 43. Golden Cities Mound GC04

Plate 44. Golden Cities Mound GC05

Plate 45. Golden Cities Mound GC06

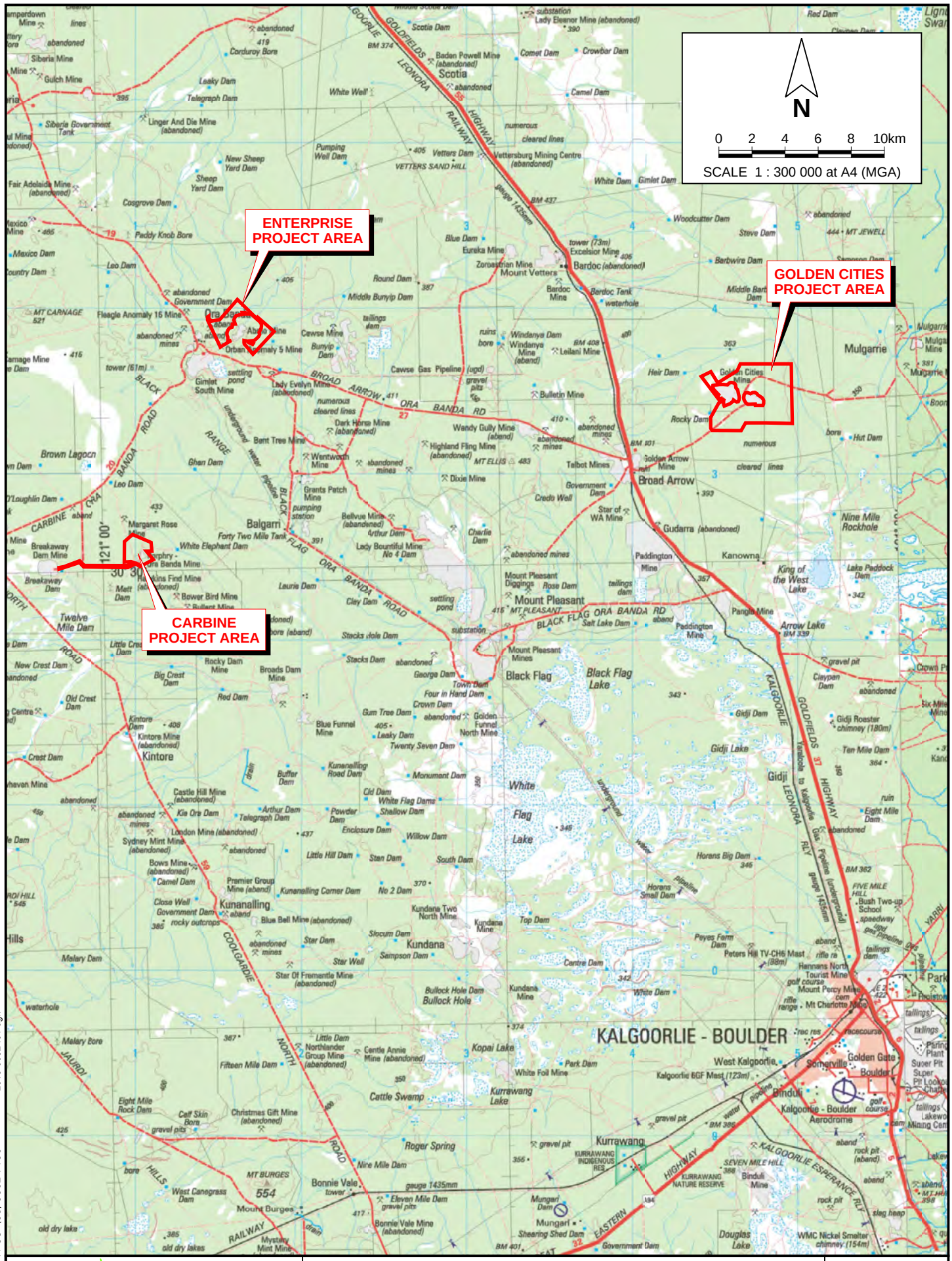
Plate 46. Golden Cities Mound GC07

Plate 47. Golden Cities Mound GC08

Plate 48. Golden Cities Mound GC09

Plate 49. Golden Cities Mound GC10

Plate 50. Golden Cities Mound GC11



PINPOINT CARTOGRAPHICS (08) 9562 7136 2018-0082-f01.dgn

TERRESTRIAL ECOSYSTEMS

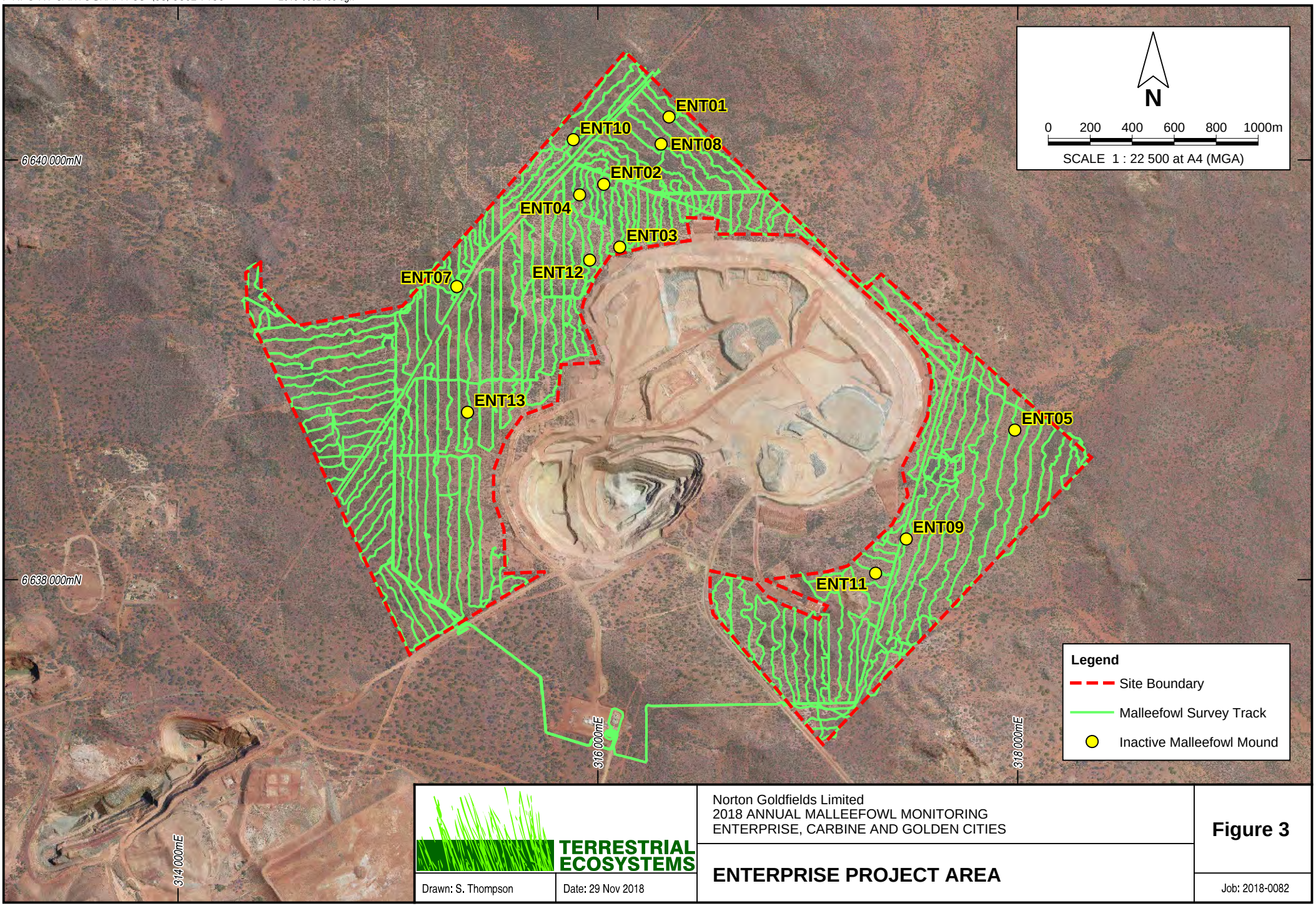
Norton Goldfields Limited
2018 ANNUAL MALLEEFOWL MONITORING
ENTERPRISE, CARBINE AND GOLDEN CITIES

Figure 1

REGIONAL LOCATION

Drawn: S. Thompson | Date: 29 Nov 2018 | Job: 2018-0082

PINPOINT CARTOGRAPHICS (08) 9562 7136 2018-0082-f03.dgn



TERRESTRIAL ECOSYSTEMS

Drawn: S. Thompson | Date: 29 Nov 2018

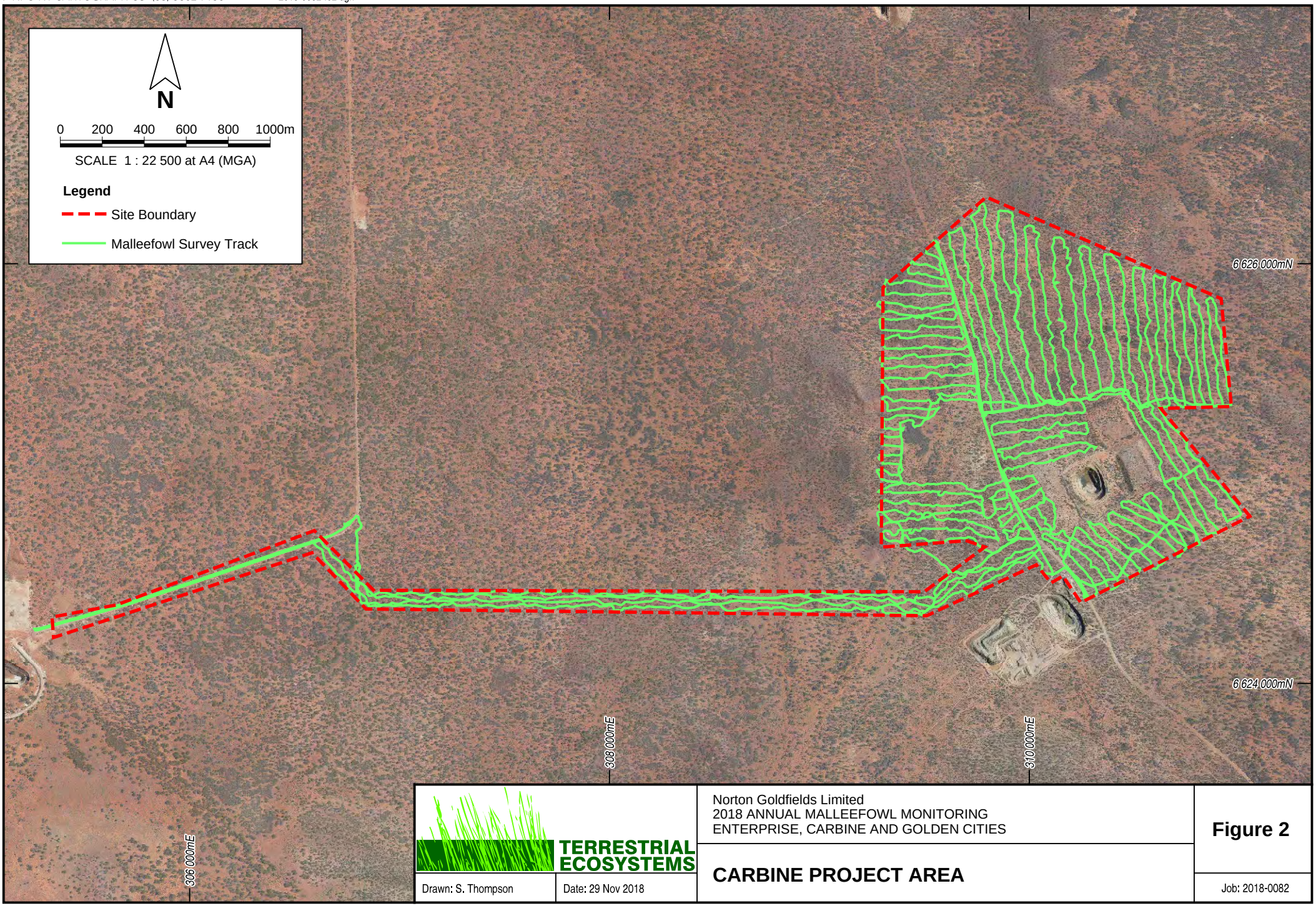
Norton Goldfields Limited
2018 ANNUAL MALLEEFOWL MONITORING
ENTERPRISE, CARBINE AND GOLDEN CITIES

ENTERPRISE PROJECT AREA

Figure 3

Job: 2018-0082

PINPOINT CARTOGRAPHICS (08) 9562 7136 2018-0082-f02.dgn



TERRESTRIAL ECOSYSTEMS

Drawn: S. Thompson | Date: 29 Nov 2018

Norton Goldfields Limited
2018 ANNUAL MALLEEFOWL MONITORING
ENTERPRISE, CARBINE AND GOLDEN CITIES

CARBINE PROJECT AREA

Figure 2

Job: 2018-0082

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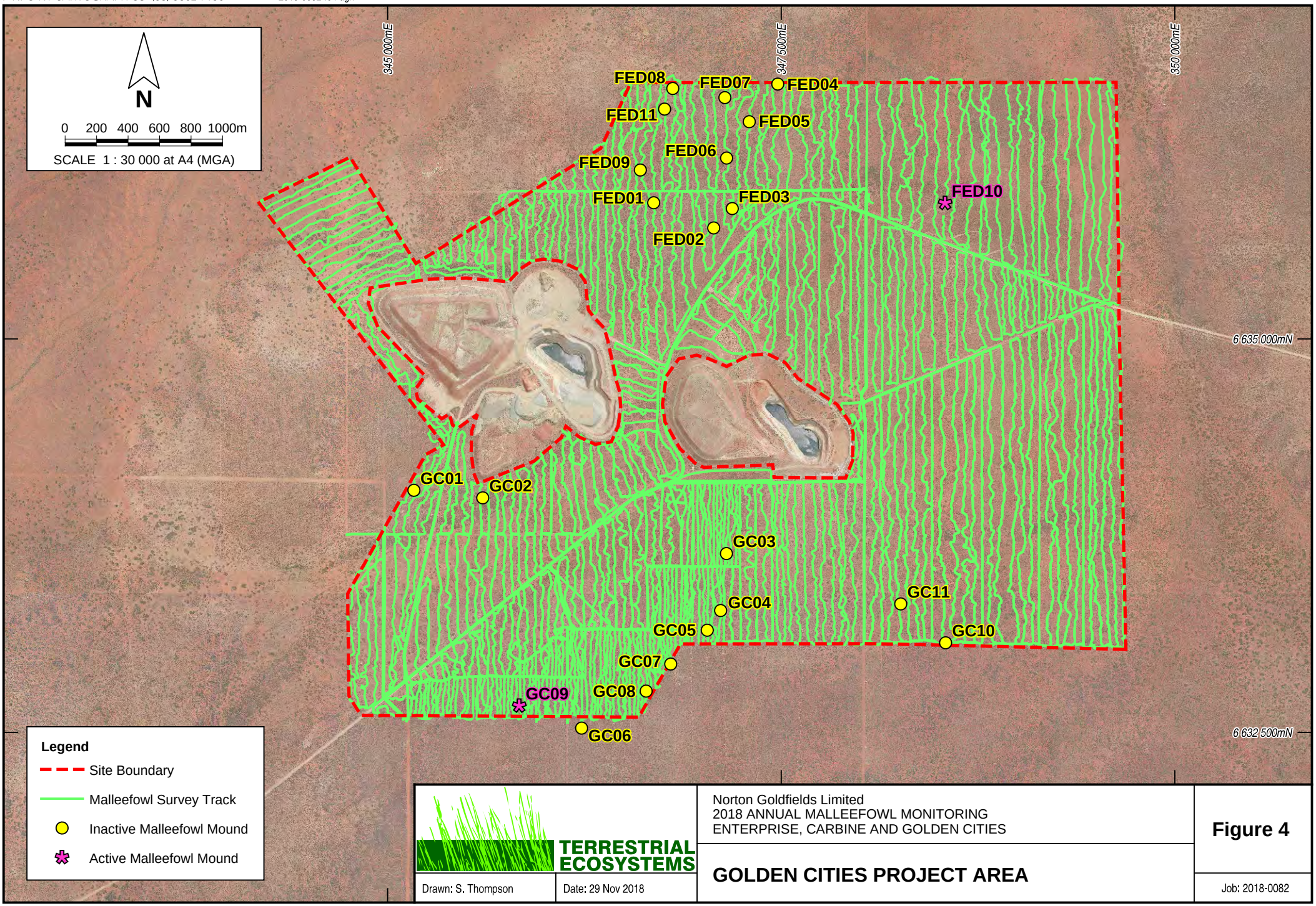

TERRESTRIAL ECOSYSTEMS

Drawn: S. Thompson

Date: 29 Nov 2018

Norton Goldfields Limited
2018 ANNUAL MALLEEFOWL MONITORING
ENTERPRISE, CARBINE AND GOLDEN CITIES

GOLDEN CITIES PROJECT AREA

Figure 4

Job: 2018-0082

Appendix 8

Norton Gold Fields Risk Rating Matrix

TABLE A. CONSEQUENCE OF EVENT (Actual and Potential)

Level	*Descriptor*	Injuries	Environment	Corporate liability	Cost
1	Insignificant	No injuries	No permanent damage to the environment or heritage feature	No corporate liability	<$10,000
2	Minor	First aid treatme nt	Spillage immediately contained; Minor short-term damage to the environment or heritage feature;	Low corporate liability	$10,000 - $50,000
3	Moderate	Minor medical treatme nt	Spillage contained with some difficulty; Significant short-term or minor long-term damage to the environment	Moderate level of corporate liability	$50,000 - $750,000
4	Major	Serious extensiv e injuries	Major short-term or significant long-term damage to the environment or heritage feature	High level of corporate liability.	$750,000 - $3,000,000
5	Catastrophic	Fatality	Major long-term damage to the environment or heritage feature	Very high level of corporate liability	>$3,000,000

TABLE B. LIKELIHOOD OF EVENT OCCURRING

Level	Descriptor	Description
A	Almost Certain	Is expected to occur in most circumstances (ie > once per day)
B	Likely	Will probably occur in most circumstances (ie > once per month but < once per
C	Possible	Should occur at some time (ie > once per year but < once per month)
D	Unlikely	Could occur at some time (ie < once per year)
E	Rare	May occur only in exceptional circumstances (ie unlikely to ever occur)

TABLE C. RISK RANKING

	Consequenc				
	1	**2**	**3**	**4**	**5**
A	15	10	6	3	1
B	19	14	9	5	2
C	22	18	13	8	4
D	24	21	17	12	7
E	25	23	20	16	11

Table D. RISK LEVEL

TYPE	RANKING	ACTION	REPORTING
Extreme risk	1 – 5	• Cease all affected work immediately. • In the event of an incident an ICAM is required.	Area Manager to be notified immediately
High risk	9 – 12	• Consider ceasing all affected work. • In the event of an incident an ICAM is to be considered. • Action/s & responsibilities to be assigned by end of the shift	
Moderate risk	13 – 19	• In the event of an incident an ICAM is to be considered. • Manage by routine procedures.	Area Manager to be notified before the end of shift
Low risk	20 – 25	• Manage by routine procedures.	

Appendix 9

Norton Gold Fields Dust Suppression Procedure

NORTON GOLD FIELDS LIMITED

Paddington Operations

DUST SUPPRESSION PROCEDURE

Document No: NGF-ENV-PRO-06-002B

Revision:	A	B		
Prepared by:	Tari Pawlyk Graduate Environmental Advisor	Kellie Carter Senior Environmental Advisor		
Reviewed by:	Wayne Astill HSE Superintendent	Wayne Astill ECS Superintendent		
Approved by:	Brian Sowden Manager HSE	Brad Daddow Acting General Manager		

SUMMARY OF DOCUMENT REVISIONS			
Rev. No.	Date Revised	Section Revised	Revision Description
A	09/08/2013		Initial Document
B	23/03/2018	Full doc.	Required review. Updated organisational structure, improved grammar, included reference to new EMS documents.

1. PURPOSE

The purpose of this procedure is to outline the process to suppress prevalence of dust during mining activities, whilst avoiding damage to the surrounding environment.

Dust is generated by wind or vehicle movement over areas cleared of vegetation such as haul roads, ROMs, laydown areas, etc. Risks of generated dust may include; contamination with heavy metals or fibrous materials which may cause harm to health if inhaled, obstruction of vision whilst driving and damage to nearby vegetation if dust settles on leaves and impacts ability to photosynthesise light. Dust suppression is therefore required on a regular basis and is generally through the use of stored groundwater via a standpipe and use of a watercart.

The salinity level of the groundwater resources in the Kalgoorlie region is comparable to salinity levels of sea water or greater (hyper-saline), however, it is the most appropriate and readily available water source to use for dust suppression purposes. The spraying of hyper-saline groundwater to control dust generation is necessary but it is important the application of water is controlled in a manner that prevents secondary impact to vegetation and contamination of the surrounding environment via runoff.

2. SCOPE

The scope of the procedure applies to all sites within the NGF Paddington Operations. For specific applications and the related job steps for dust abatement methods on ramps, haul roads, ROM and mine areas please see specific site safe work procedures.

DEFINITIONS AND ACRONYMS

Definitions

- 'Dust suppression' is the spraying or dribbling of water on all trafficable roads to abate the dust that rises as vehicles drive over it.
- 'Raw water' refers to saline and/or hyper-saline water that contains high levels of dissolved salts and is intolerable to most living things.

3. ROLES AND RESPONSIBILITIES

General Manager

Responsible for ensuring sufficient resources are available to implement this Procedure.

Environment, Community and Security Superintendent
Responsible for discussion/review of this procedure and ensures the Procedure complies with site standards.

Area Superintendents
- Responsible for ensuring that staff adhere to procedure; and
- Informing the Environmental Department of any issues arising from dust suppression procedures.

Water-Cart Vehicle Operators
- Responsible for maintaining awareness and ensuring the correct procedure for spraying roads is adhered to, preventing negative impacts to the environment; and
- Reporting any defects associated with the vehicle that may affect the correct application of raw water.

4. PROCEDURE

Dust suppression is required during the operation of a mine where dust can be, or is prevalent, on haul roads and has potential to cause nuisance or present a potential hazard to mine site personnel, operations, or members of the public.

Raw water will be obtained from stand pipes directly to water-carts at various locations on site when needed.

The preferred method of raw water application is via the use of dribble bars as opposed to spray bars. Dribble bars reduce the chance of spraying surrounding vegetation.

Water may be sprayed where adjacent v-drains are in place to capture runoff and prevent spray drifting outside of v-drains, and wind conditions are moderate.

If visible dust is observed, then attempts shall be made to contact an appropriate area shift supervisor, who is to contact the driver of a water cart and organise the application of water in the dusty area. Water is not to be sprayed where any topsoil stripping operations are occurring. If contact cannot be made with either the shift supervisor or water cart driver, the Area Superintendent is to be contacted regarding visible dust.

The use of dust suppression additives is to be assessed via the Hazardous Substances Management Procedure (NGF-SAF-PRO-08-001) if necessary.

Any spills or inappropriate use of hyper-saline water is to be contained where possible and reported to the Environmental Department immediately.

4.1 *Monitoring*

Monitoring is required whilst dust suppression is undertaken to ensure that risks identified are controlled/managed. Dust suppression monitoring includes but is not limited to:

- Daily visual observations; and
- Annual visual audits of road corridors, bunding, v-drains and spoon drains.

5. CONTINGENCY PLAN

In the event of an uncontrolled discharge of raw water onto vegetation, the following measures should be implemented to reduce the risk of further damage to the environment:

- Dust suppression is to stop immediately until the issue has been resolved;
- The Area Superintendent and Environment Department will be notified of the spill or where vegetation is affected to ensure that appropriate remediation measures can be implemented;
- The spill will be contained within earthen bunds or otherwise to prevent further environmental harm; and
- If necessary, contaminated soils should be removed and disposed of from the area.

6. REPORTING

All incidents associated with dust suppression and uncontrolled hypersaline water discharge are classed as reportable incidents by NGF. In the event of an incident, it is required to be entered into Cintellate.

If an incident triggers the criteria within applicable tenement conditions or Section 72 of the Environmental Protection Act 1986, the Environment Department will notify relevant government authorities within the timeframes stipulated within legislation or licence, and to the prescribed standard stipulated within the NGF Incident Reporting and Investigation Procedure.

7. REVIEW

A review shall be carried out to ensure the content of this procedure is still applicable and practicable. A review should take place:

- Whenever the process/equipment changes;
- At a periodic frequency (every two years); and/or
- At incident investigation.

8. LEGISLATION AND STANDARDS

- Environmental Protection Act 1986; and
- Mining Act 1978

9. RELEVANT DOCUMENTATION

- Incident and Investigation Procedure
- Hazardous Substances Management Procedure
- Environmentally Hazardous Substances and Dangerous Goods Management Plan