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CAPITAL RECYCLING

CAPITAL RECYCLING – EPA REFERRAL FOR EXTRACTIVE INDUSTRY

This report describes the proposal for gravel extraction and screening form Lot M1822 and its end use.

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DOCUMENT CONTROL

VERSION	DATE RELEASED	PREPARED BY	APPROVED BY	AUTHORISED SIGNATURE
V1	02.11.2012	Paul Antony	Bruce Bowman	

DOCUMENT DISTRIBUTION

VERSION	TYPE	FORMAT	ISSUED TO	ORGANISATION
V1	Electronic	pdf	Tim Gentle	Environmental Protection Authority

FILE NAME

121102 PA Extractive Industry EPA Referral

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ACRONYMS

AHD	Australian Height Datum
DA	Development Application
BH	Bore Hole
DEC	Department of Environment and Conservation
dia	Diameter
ENV	ENV Australia Pty Ltd
EPA	Environmental Protection Authority
GDA	Geocentric Datum Of Australia
GIS	Geographic Information System
PDWSA	Public Drinking Water Source Area
pH	Potential Hydrogen
PM_{10}	Particulate Matter (measuring less than 10 micro metre)
PPM	Parts per Million
RL	Reduced Levels
TDS	Total Dissolved Solids
UTM	Universal Transverse Mercator
VIPAC	VIPAC Engineers and Scientists

UNITS OF MEASURE

dB(A)	Decibel at a Location
ha	Hectare
km	Kilometre
m	Metre
mm	Millimetre
m^2	Square Metre
m^3	Cubic Metre
mg/L	Milligram per Litre
$\mu g/m^3$	Microgram per Cubic Metre
%	Percent
°C	Degree Celsius

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1 INTRODUCTION

Bowman & Associates has been engaged by Capital Recycling (Proponent) to lodge a referral document with the Environmental Protection Authority (EPA) under Part IV of the Environmental Protection Act 1986 (EP Act) for obtaining licence to operate as a "prescribed premises" classified as category 12 within Schedule 1 of the Environmental Protection Regulations 1987. The proponent proposes to extract gravel from Lot M 1822 on Diagram 8755, Horton Road, Woottating (the Lot) and screen the extracted gravel to meet Main Roads Western Australia specifications. The screened gravel will then be sold to various end users.

2 BACKGROUND

The Proponent wishes to extract gravel from the Lot and replace the excavated area with inert fill. The volume of gravel available to extract is estimated at 212,000 m^3 over an area of 10.50 ha from the Lot, sporadically over a period of 5 to 6 years. The gravel extraction will be divided over two stages, Stage 1 will cover an area of 3 ha and Stage 2 will cover an area of 7.5 ha. Groundwater, surface water, flora and fauna investigations have been carried out by the landowner in 2008 on the western section of the Lot to determine the suitability of the Lot for establishing a composting facility. The investigation reports have been referred in assessing the environmental impacts for to the proposed gravel extraction. The references to the site location in the environmental assessment reports mentioned above are to Lot 13 Horton Road, Woottating which is the property street address for Lot M1822 on Diagram 8755 as shown in Appendix A.

The end use of the extracted gravel will comprise of the following:

- Serve as subgrade on 324 Horton Road, Woottating for developing a composting facility,
- Upgrade of sections of Horton Road, Carter Road and private property, and
- Sale of screened gravel for use as subgrade or landscaping by various end users.

3 LOCATION AND OWNERSHIP

3.1 LOCATION

The proposed facility will be located in the Shire of Northam approximately 55 km east of Perth on Lot M1822 Horton Rd Woottating, WA, 6562. The Lot can also be located by GPS as described in the Table below (Drawing CR-01).

Table 1: GPS Location of the Lot

Latitude and Longitude		UTM Zone 50 Coordinates (GDA94)	
Latitude	Longitude	Easting	Northing
31°50'44"S	116°21'19"E	439,000	6,476,500

3.2 OWNERSHIP

The owners of the Lot are, in quarter shares; Paul Curtis and Sean Curtis, directors of River Nominees Pty Ltd trading as Purearth, and their respective partners Barbara Curtis and Helen Curtis. The Certificate of Title is on Folio 539 in Volume 1034 (Appendix A).

3.2.1 Owner Contact Details

Contact Person:	Paul Curtis
Position:	Managing Director
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Postal Address:	PO Box 95 Bayswater 6053
Website:	www.purearth.com.au

3.3 PROPONENT BACKGROUND

Beginning operation in 1996 as a drainage and earthmoving operation, Capital Recycling soon moved into demolition work. From a number of years in this arena, the company was well positioned to recognise the significant amount of waste generated in the construction industry and the potential this waste had as a reusable commodity.

The corporate philosophy is one of innovation, attention to detail and the pursuit of excellence in all aspects of concrete waste reclamation. Capital Recycling focuses on efficient materials processing.

The maintenance of a clean, safe and innovative work environment contribute to the company's reputation in the industrial waste reclamation industry.

Today the proponent produces a range of high quality, recycled products including crushed concrete road-base, track and drainage material as well as fill sand. On the service side, the proponent offers selected building waste dumping facilities, on-site crushing and screening, selected building waste transportation and site remediation.

3.3.1 Proponent Contact Details

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4 LOCAL ENVIRONMENT

4.1 CLIMATE

The Shire of Northam has a climate comprising cold, wet winters and hot, dry summers. The climate of the region is strongly influenced by high pressure systems year round and in the warmer months by easterly winds. The long term average rainfall is 590.5 mm over 47 years from 1964 to 2011 (based on Bureau of Meteorology Station 010244 Bakers Hill CSIRO), of which approximately 75 per cent usually falls between May and September. Mean summer (December to February) rainfall is 39.2 mm and it is not unusual for there to be extended dry periods during the warmer months. Mean monthly maximum air temperatures range from 31.8 °C in January to 15.1 °C in July (based on 20 years from 1965 to 1985). The average minimum temperatures range from 6.4 °C in August to 16.1 °C in February (based on 20 years from 1965 to 1985).

Winds are predominantly easterly in direction during the warmer summer months. In the cooler months winds are mainly westerlies associated with rain bearing fronts. The average annual evaporation rate based on 47 years from 1964 to 2011 has been estimated to 2,067 mm.

4.2 GEOLOGY AND GEOMORPHOLOGY

The Lot is located on lateritic gravely soils of the Darling Plateau. The geology of the area was mapped by Smurthwaite (1987) for the Geological Survey of Western Australia. The Lot is recorded as being underlain by granite and laterite deposit entering from the south west boundary, as shown in Drawing CR-02. Physical evidence on the Lot indicates that the laterite protrudes well into the western end of the Lot and due to outcrops of granite, may be underlain with granite. The Proponent intends to extract gravel from potential locations in the Lot.

The Lot is characterised by two geomorphological classifications, a narrow, shallow valley floor of fluvial origin and a surface of planation and lateritic uplands of denudational origins. (Reference: Gozzard, J.R., 1989. a*nd* Smurthwaite, A. J. 1987).

The Lot is raised at the west and east boundaries with a valley running approximately south to north through the lot 300 m away from the western boundary. The elevation of the south western and north western corners of the Lot are 290 m and 280 m Australian Height Datum (AHD) respectively. The south eastern and north eastern corners have elevations of 290 m and 305 m AHD respectively. The lowest point on the Lot is approximately 271 m AHD and is located on the watercourse. These details are outlined in Drawing CR-04.

4.3 GROUNDWATER

There is evidence of perched water, below the surface but above the underlying granitic rock throughout the Lot. The perched water table drains into the watercourse running through the Lot.

According to the Department of Water's *Geographic Data Atlas* Lot M1822 is not located within a Public Drinking Water Source Area (PDWSA). The nearest PDWSA is over 3 km to the south near

Great Southern Highway and is a level P2 protection area. Over 3.2 km to the south east is the nearest boundary of a level P1 protection area.

4.3.1 Existing Groundwater Quality

Six exploratory bores were installed on the western section of the Lot in August 2008 by the landowner and groundwater assessment was conducted by Crisalis International Pty. The groundwater assessment report has been enclosed as Appendix E. Unconfined groundwater was found in all bores within 1-2 m of the surface on lower lying ground around the watercourse as anticipated, and 3-5 m below surface on higher ground. Groundwater investigations carried out in September 2008 on six bore holes indicated that the groundwater in the vicinity of the Lot is mostly of good quality, with Total Dissolved Solids (TDS) between 68-451 mg/L, but near the watercourse, TDS increases to over 2,000 mg/L. The surface water in the watercourse itself is of poor quality, with over 2,000 mg/L TDS. The groundwater contains up to 8 mg/L Total Nitrogen, mostly oxidised nitrogen (nitrite plus nitrate), lesser amounts of organic nitrogen and in some areas groundwater contains low concentrations of nutrients. The surface water in the watercourse also shows low concentrations of nitrogen, and no detectable phosphate.

Contoured groundwater levels to the local datum indicated the distribution of the water table across the Lot within the lateritic gravel and weathered basement and in the alluvial sediments near the watercourse.

4.4 SURFACE WATER

Surface water runoff flows towards the valley in the centre of the Lot. In this valley two watercourses merge into one and flow northwards off the Lot. The direction of flow hence is away from the PDWSA catchment areas. The eastern watercourse is named Wooroloo Brook while the other is unnamed (Drawing CR-04). Wooroloo Brook meanders in a west-north westerly direction joining the Swan River in the Walyunga National Park 29 kms from Lot M1822. The watercourses on the Lot are termed as "minor, non-perennial" in the Department of Water's Perth Groundwater Atlas and generally only flow during periods of high winter rain. The Lot has two water catchment dams to the east of Wooroloo Brook, these will be retained and undisturbed.

4.4.1 Existing Surface Water Quality

Report by Crisalis International Pty (Appendix E) stated that the surface watercourse showed consistently high TDS (salinity) in September and October 2008, when reasonable stream flows were noted. Where the surface watercourse flows onto the southern boundary of the property, TDS concentrations of 1960 mg/L were found in September, rising to 2280 mg/L in October. Downstream where the creek leaves the property on the northern boundary, salinities were higher, showing 2250 mg/L in September and 2550 mg/L in October. The increased salinity is considered to arise from accumulated salts in the groundwater discharge zone entering the stream either as direct groundwater discharge (baseflow), or as spring flows or possibly from flushing of accumulated salts in the soils by stream flow around the main discharge area.

It is concluded that the stream has degraded water quality from secondary salinisation consistently throughout the winter period, as this was sampled at the end of the winter period in September and October. The property itself would seem to contribute additional salts to the stream as it flows from east to west across the property.

4.5 SOILS - SOIL PROFILE

Six developed bore holes and four exploratory holes have been drilled on the eastern portion of the Lot. The lithological description of the six bores from the report by Crisalis International Pty Ltd is given in Table 2.

Table 2: Lithological Description of Bore Holes

BORE	DEPTH	LITHOLOGICAL DESCRIPTION
BH1	0 – 1 m	Deep brown lateritic gravel with subrounded fragment to 8 mm, in dominant coarse, dark brown sandy matrix
	1 – 2 m	Fine to coarse brown sand with some lateritic fragments
	2 – 3 m	Light grey clumps of clay with coarse lateritic and weathered granite sandy material.
	3 – 4 m	Light grey and brownish grey clay particles, with coarse quartz and weathered granite sandy particles.
BH3	0 – 1 m	Brown coloured lateritic gravel with subrounded particles to 10 mm, in fine-coarse sand matrix.
	1 – 2 m	Brown lateritic gravel, subrounded fragments to 16 mm, in finer gravel matrix of sandy particles 1-2 mm dia.
BH4	0 – 1 m	Brown lateritic gravel, 50% subrounded fragments to 16 mm in coarse brown sandy matrix
	1 – 2 m	Dark brown fine-coarse sand, minor lateritic gravel fragments to 5 mm dia
	2 – 3 m	Brown lateritic gravel, subrounded fragments, 30% to 10 mm dia, in coarse brown sand with some fine particles.
	3 – 4 m	Coarse light brown sand particles with <10% gravel and minor soft clay particles

BORE	DEPTH	LITHOLOGICAL DESCRIPTION
	4 – 5 m	Coarse light grey crystalline sands (quartz) and red-brown particles with <20% finer sand
	5 – 6 m	Light grey coarse sand and coarse brown laterite in clayey light grey matrix, with some larger soft clay fragments.
BH5	0 – 1 m	Deep brown lateritic soil with 50% lateritic gravel, subrounded fragments to 6 mm, in dark brown coarse sand matrix with some dark clay fragments (soft).
	1 – 2 m	Deep brown lateritic soil, 60-70% lateritic gravel, subrounded to 6 mm dia, in coarse brown sand matrix.
	2 – 3 m	Deep brown laterite, 30% gravel fragments to 8 mm dia, in finecoarse brown sand matrix
BH 6	0 – 1 m	Deep brown fine-coarse alluvial sand, 10% lateritic gravel to 8 mm dia
	1 – 2 m	Deep brown fine-coarse sand with some clay, 10% lateritic gravel
	2 – 3 m	Deep brown fine-coarse alluvial sand with soft clay fragments, 5% lateritic gravel to 5 mm dia.
BH7	0 – 1 m	Brown lateritic gravel ~20% in fine to coarse brown sand matrix.
	1 – 2 m	Light brown, fine to coarse sand, some soft clay fragments
	2 – 3 m	Grey brown fine to coarse sand with some soft clay fragments

On the 10th April 2008 an excavator was used to dig exploratory holes in several locations on the western portion of the Lot. The holes were dug to a depth at which considerable resistance was encountered. Representative samples of the material through the full depth of excavation were taken by Bowman & Associates. The samples were delivered to Qualcon Laboratories for testing. The test results from the samples taken (Appendix B) indicates that holes 1 and 4 have good gravel.

Figure 1: Indication of Gravel on Lot

4.6 SURROUNDING LAND USES

The Lot is in a rural area and all of the surrounding properties are used for cropping, sheep or cattle grazing.

Immediate neighbours to the Lot are:

- The property to the north known as 284 Wariin Road is owned by Alfred and Eileen Boase and is a 284 ha grazing property.
- To the east a 225 ha grazing property is known as 598 Wariin Road and is owned by Peter and Jacqueline Carter.
- To the south the Curtis brothers own the property and are proposing the establishment of a composting facility.
- To the west are several properties owned by Ron Hawkins company Quintal. The property adjacent to the west boundary is known as 4 Great Eastern Highway. These properties are also used for grazing.
- To the south west is a 40 ha property owned by Maurice and Irene Hoyle and used for greenhouse tomato production. The Hoyle residence is 1.2 km south west of the proposed development.

Further afield is the BGC quarry approximately 2.5 km to the south and a Prison approximately 2 km to the north west. There is also an intensive agriculture facility with large greenhouses approximately 1.5 km to the south west of the Lot. This property is owned by Maurice and Irene Hoyle.

4.7 CLOSEST RESIDENCE

The property owned by Alfred and Eileen Boase located 700 m towards the north is the nearest residence. A property owned by Ron Hawkins is 850 m towards the west of the proposed

development. Other residents mentioned above are at least 1.2 km away from the boundary of the Lot (Drawing CR-05).

4.8 BUFFER DISTANCE

The EPA's Guidance Statement No 3, *Separation Distance between Industrial and Sensitive Land Uses* states that the recommended buffer distances between a sensitive land use and an extractive industry with no grinding or milling works is 300 m to 500 m. The recommended buffer distances between a sensitive land use and screening works under category 12 is 500 m. The buffer distance available exceeds the requirements of the EPA.

4.9 ZONING

Lot M1822 Horton Road is zoned "Agricultural – Local" on the Shire of Northam Town Planning Scheme No. 3 Map 1. A planning application has been lodged with the Shire of Northam and is pending decision.

5 GRAVEL EXTRACTION METHODOLOGY

5.1 EXTRACTION AREA

The results of the soil tests from the eastern side of the valley and visual inspection of the remaining area indicate that gravel is available throughout the Lot in isolated pockets. Exploratory holes will be dug at different locations to assess the extent of the gravel available for extraction. The gravel will be extracted from all feasible areas within the Lot at an average depth of 2 m without disturbing the existing vegetation considered of conservation significance (Drawing CR-03).

5.2 BUFFER FROM SURFACE WATERCOURSE

All excavation faces will be 20 m offset from the property boundary and 40 m offset from the banks of the surface watercourse as shown in Drawing CR-BA-08.

5.3 STAGING AND VOLUME OF EXTRACTION

The gravel extraction will be been divided into two stages as shown in Drawing CR-03. The expected volume of extraction from each stage is given below:

Table 3: Volume of Gravel Extraction per Stage

	STAGE 1	STAGE 2(FUTURE)	TOTAL
Area (m^2)	29,100	76,000	105,100
Volume (m^3)	60,000	152,000	212,000

Each extraction stage will be divided into working areas. Working area refers to the area used for gravel extraction, screening and stockpiling at a particular point of time in each stage. The remaining area remains undisturbed until excavation progresses to the next working area. Progressive rehabilitation of the excavated area will be undertaken.

5.4 STOCKPILE LOCATION

The location of material stockpiles will move within the excavation area as the excavation and progressive rehabilitation activity occurs from time to time. The initial stockpile location and future stockpile location have been shown in Drawing CR-BA-13.

5.5 DURATION OF ACTIVITY

The gravel extraction process is expected to happen sporadically. It is estimated that the operation will occur at an average of one week every month over five years. The working hours on an operating day may vary between 8 to 10 hours. The gravel extraction and screening activities are proposed to be carried out during summer months only. The duration for each stage is given in the below table.

Table 4: Operational Duration per Stage

PROCESS	OPERATIONAL DURATION (DAYS)		PERIOD
	STAGE 1	STAGE 2 (FUTURE)	DAYS OVER 5 YEARS
Gravel Extraction	90	160	250

5.6 PROCESS

The process of gravel extraction will involve the following:

- Stripping of the top soil with a grader to a typical depth of 100 mm,
- Stockpiling of the top soil using loader within the Lot,
- Excavation of gravel using a 20 tonne or 30 tonne excavator,
- Screening of excavated gravel to obtain different grades for sale or reuse,
- Stockpiling of screened gravel within the working area,
- Rehabilitation of excavated area with inert fill to original level, and
- Spreading top soil back on to excavated area at a minimum depth of 100 mm maintaining the original topography of the Lot.

5.7 PLANT LIST

Table 5: Plant List

PLANT	NUMBER
20 tonne to 30 tonner Excavator	1
Grader	1
Front End Loader	1
Screening Plant	1
Water Truck	1

Note: The photos of proposed plant is shown in Appendix C

5.8 TRAFFIC VOLUME

Semi-trailers would be used to transport gravel to different end use sites. The estimated traffic volume is 10 trucks and two staff vehicles in and out each day during operating days. The pay load of each semi-trailer is expected to be not more than 24 tonnes.

6 SITE INFRASTRUCTURE AND MANAGEMENT

6.1 SITE OFFICE

An existing building on the western end of the Lot will be used as an office for onsite book keeping and staff contact point.

6.2 ABLUTION BLOCK

A builder's chemical toilet will be provided on site and will be maintained by a licensed septic contractor for effluent final disposal or treatment.

6.3 POWER SUPPLY

A portable diesel generator will be provided onsite for power supply to office during operating periods. This would be rarely used as the site staff would be operating plant most of the time. A single overhead power line passes through the western section of Lot M1822. It is alleged that no other cables or pipelines are known to pass through the Lot. The location of the overhead power line has been enclosed as Drawing CR-BA-12. Western Power has been contacted regarding the proposed excavation activity under the overhead power line and advice has been received on work procedures while working near the power line. All procedures recommended by Western Power will be followed by the proponent while working near the overhead power lines. No relocation of the power line is proposed. Excavation will be carried from the power poles at an offset of 5 m radius.

6.4 FUEL SUPPLY

No fuel will be stored onsite. Refilling of plant, equipment and generator will be done by a mobile refuelling unit.

6.5 WATER SOURCE

Water will be pumped directly into a water truck from the two dams on site. Dams are located on the eastern side of the watercourse and water will be used for dust suppression. The location of dams and watercourses on Lot M1822 and on the neighbouring properties is shown in Drawing CR-BA-09. Additional water requirement will be met by trucking from the Shire of Mundaring.

6.6 FENCE AND GATES

The locations of existing fences and gates, proposed gates and warning signs have been shown in Drawing CR-BA-10 and Drawing CR-BA-14. No additional fences are proposed. All existing fences will be maintained during the life of the facility.

6.7 LOCATION OF EXISTING BUILDING AND WATER SOURCES

The locations of buildings and water sources at the site and on the neighbouring properties are shown on Drawing CR-BA-09. No septage treatment plant, new buildings or water tanks are proposed for the development of the operation.

7 ENVIRONMENTAL IMPACT AND MEASURES

7.1 DUST

Dust emissions may arise during removal of top soil, gravel extraction, screening, stockpiling, remediation, operation of heavy equipment and vehicle movement over gravel roads. The magnitude of impact will depend on the size of the operation, adjacent land use, prevailing wind speed and direction, and distance to the nearest sensitive receptor. The objective of the dust management plan is to prevent generation of airborne particulates (including dust) to ensure no visible dust is discharged beyond the premises boundary.

The proponent proposes to undertake the dust control measures described below.

7.1.1 Dust Suppression Measures

The generation of dust will be minimised by:

- Where possible activities that have a high potential for dust generation such as clearing of topsoil will be confined to early mornings, when winds are typically calmest, particularly during warmer months,
- A water truck will be maintained on site to ensure adequate wetting down during extraction operations,
- The private road on the Lot will be watered as required to minimise dust,
- Extraction and screening activities will be limited during periods of high wind,
- Maintaining a minimum working area,
- Water truck will be used for wetting down during extraction and screening operations,
- Water truck will be used for wetting down during backfilling to rehabilitate the excavated area,
- Exposed stockpiles will be watered down as required to prevent dust generation,
- Trucks delivering back fill material to the site will have their loads covered,
- Trucks hauling the extracted gravel will be adequately covered prior to leaving the site,
- Instruction will be given to all workers on dust minimising measures to be adopted,
- Proactively monitoring of visible dust crossing the premises boundary and ensuring dust is contained within the boundary of the premises,
- Routine maintenance and housekeeping practices to minimise accumulation of litter in and around the premises, and
- Any and all dust complaints will be promptly acted upon, recorded and the record retained together with the measures undertaken to mitigate the dust impact.

These management strategies are in accordance with the EPA's *Guidance for the Assessment of Environmental Factor 18, Prevention of air quality impacts from land development sites*.

Excessive dust could also have an impact on the workers at the site. In accordance with the Department of Commerce, Western Australia's *Occupational Safety and Health Act 1984*, all workers

will have access to appropriate dust masks for use if required and be instructed in the use of dust minimisation equipment.

7.1.2 Frequency for Implementing Dust Suppression Measures

The proposed frequency for conducting dust suppression measures is listed below. The proposed frequency will be reviewed based on performance of the dust suppression measures.

Table 6: Proposed Frequency for Dust Suppression

SUPPRESSION MEASURE	PROPOSED FREQUENCY
Wetting down exposed surface during extraction.	Every four hours during operating day.
Wetting down fresh stockpiles after extraction and screening.	Once during operating day.
Wetting down of non-working faces of stockpiles.	Once during operating day.
Wetting down crushing and screening operations.	Every two hours during crushing and screening operation.
Watering of private roads exposed to traffic movement.	Twice every operation day.
Watering of Horton Road exposed to traffic movement due to operation of the facility.	Twice every operating day.
Covering of loads.	Every truck entering and leaving the premises.

7.1.3 Frequency for Monitoring Programme

The performance of the proposed dust suppression measure will be assessed by monitoring visible dust crossing the premises boundary. The list of monitoring measures proposed for the assessing performance is listed below.

Table 7: Proposed Frequency for Dust Monitoring

PROGRAMME	PROPOSED FREQUENCY
Visual inspection of dust leaving the boundary of the premises.	Continuously during every operating day.
Visual inspection of dust generation on Horton Road.	Regularly reported by truck drivers and other road users.

PROGRAMME	PROPOSED FREQUENCY
Visual inspection of dust generation on private road.	Twice every operating day.
Collection of litter in and around the premises.	Every second operating day.
Maintenance of Water Truck.	As required or in accordance with scheduled maintenance programme.
Maintenance of Plant.	As required or in accordance with scheduled maintenance programme.

7.1.4 Compliance with National Environment Protection Measure

The *National Environment Protection Measure for Ambient Air Quality* (the *'Air NEPM'*) sets national standards for the six key air pollutants to which most Australians are exposed*: carbon monoxide, ozone, sulfur dioxide, nitrogen dioxide, lead and particles.* Under the *Air NEPM*, all Australians have the same level of air quality protection and require the potential air pollutants to be motored by each local jurisdiction based on the following intervals.

Table 8: Six Potential Air Pollutants[1]

POLLUTANT	AVERAGING PERIOD	MAXIMUM (AMBIENT) CONCENTRATION	GOAL WITHIN 10 YEARS (MAXIMUM ALLOWABLE EXCEEDENCES)
Carbon Monoxide	8 hours	9.0 ppm	1 day a year
Nitrogen Dioxide	1 hour	0.12 ppm	1 day a year
	1 year	0.03 ppm	none
Photochemical Oxidants (as ozone)	1 hour	0.10 ppm	1 day a year
	4 hours	0.08 ppm	1 day a year
Sulfur Dioxide	1 hour	0.20 ppm	1 day a year

[1] http://www.environment.gov.au/atmosphere/airquality/standards.html

POLLUTANT	AVERAGING PERIOD	MAXIMUM (AMBIENT) CONCENTRATION	GOAL WITHIN 10 YEARS (MAXIMUM ALLOWABLE EXCEEDENCES)
	1 day	0.08 ppm	1 day a year
	1 year	0.02 ppm	none
Lead	1 year	0.50 µg/m^3	none
Particles as PM_{10}	1 day	50 µg/m^3	5 days a year

The pollutant associated with gravel extraction is only Particles as PM_{10}. The proponent proposes to ensure that dust emissions do not exceed an ambient PM_{10} level of 50 µg/m^3 averaged over a 24 hour period when measured at the premised of the boundary. Measurement of PM_{10} will be conducted during one operational week on an annual basis.

7.1.5 Dust Assessment Outcome

The size of the operation will be limited to different stages and thus will prevent uncontrolled exposure of disturbed soil. The adjacent land uses compliment the proposal and are minimally affected due to the irregular and small nature of the operation. The availability of large buffer distance to the nearest receptor in the north, prevailing wind direction away from the nearest receptor and proposed dust management measures minimise the potential dust impact. The monitoring regime proposed for the dust management measure will enable compliance with the *National Environment Protection Measure for Ambient Air Quality*.

7.2 NOISE

The objective of the noise management plan is to minimise any noise generated during the gravel extraction and screening activity, and be compliant with the Environmental Protection (Noise) Regulations 1997.

Noise will arise during the operation of heavy equipment, movement of vehicles and reversing beepers. The *Environmental Protection (Noise) Regulations 1997 (As Amended)* stipulate the allowable noise levels that can be received at any noise sensitive premises as a result of activities occurring on another premise. The objective is to protect the amenity of nearby residents and other land users from noise impacts resulting from activities associated with the proposal by ensuring that noise levels comply with the *Environmental Protection (Noise) Regulations 1997 (As Amended)*. A noise impact assessment (Appendix F) was carried out by VIPAC Engineers and Scientists (VIPAC) in 2009 on the Lot. The assessment was to determine the impact of commissioning an organics recycling facility on the western section of the Lot. The plant and equipment to be used for the

extraction of gravel (Loader, Excavator, Screening Plant and truck movements) is similar to that of the composting facility. As such the noise modelling will be consistent between the two proposed land uses. An extract from the VIPAC report on the predicted noise levels at 500 m from the Lot rounded to the nearest whole dB is given below:

Table 9: Extract from VIPAC Report on Noise Impact Assessment

Activity /Site Operation	Predicted Noise level, dB (A)	Day – time Noise Criteria, dB (A)	Assessment
Volvo Loader	44	45	Criteria Achieved
Truck loading	24		Criteria Achieved
Mulcher	36		Criteria Achieved
A digger/excavator	33		Criteria Achieved
Screening plant	44		Criteria Achieved

The noise impact assessment by VIPAC can be considered to be a conservative assessment when compared to the proposed sporadic gravel extraction activity. It is to be noted that the nearest noise receptor to the Lot is located 700 m north of the Lot boundary. Hence the proposed gravel extraction activity is not considered to have noise impact on the receptor.

The proponent will implement the following management and mitigation measures to ensure that the proposal complies with the *Environmental Protection (Noise) Regulations 1997 (As Amended)* at all times.

7.2.1 Noise Control Measures

The proposed noise control measures are mentioned below:

- Personnel have access at all times to operational manuals for equipment being utilised and must be familiar with the procedures detailed in the operations manual,
- All workers must wear appropriate hearing protection if in close proximity to machinery for extended periods,
- A Complaints Register is maintained on site to record any complaints received; this register will include the date, nature and resolution action of any complaints,
- Following complaints the source of any excessive noise is identified and work practices modified or rescheduled to reduce or eliminate the risk of future events,
- Road traffic movements will be scheduled to avoid noise sensitive periods i.e. after work hours,
- All mobile plant used on site is regularly maintained including exhaust mufflers, and

- Speed limits are enforced on all site access roads.

7.2.2 Proposed Working Hours During Operating Day

The facility will operate from 7:00 am to 5:00 pm Monday to Saturday during any operational period.

7.2.3 Location of Noise Generating Structures

No plant used for gravel extraction will be located permanently on the site due to the sporadic nature of operation. All plant and equipment will be brought to the site when an operating period commences and will be located close to the excavation area during any particular operating day. In Stage 1, the gravel extraction is proposed to commence from the northern end and will move towards the south.

7.2.4 Proposed Noise Monitoring

The nearest receptor to the site is located 700 m towards the north from the northern boundary. The gravel extraction is proposed to commence from the northern end of Stage 1 and will progress to the southern end of Stage 1. Hence the highest impact of noise generated by gravel extraction activity is expected to occur only during the initial phase of Stage 1. The prosed noise monitoring programme is given below in Table 10.

Table 10: Proposed Noise Monitoring Programme

ACTIVITY /SITE OPERATION	MONITORING LOCATION	MONITORING CONDITIONS	DURATION
Stage 1 gravel extraction and screening located on northern end.	Within 15 m of the nearest receptor	Typical worst case meteorological conditions	1 week from commencement

No noise monitoring is proposed for future gravel extraction activities towards the south of Stage 1 and future areas as they are further away from the nearest receptor.

7.2.5 Reporting

In the event that the noise generated during the gravel extraction activity exceeds the Environmental Protection (Noise) Regulations 1997 requirements, the Shire of Northam and the Department of Environment and Conservation (DEC) will be notified within 7 working days. The reason for noise exceedance and the measures adopted to minimise the impact will be recorded and reported to the DEC on an annual basis.

7.2.6 Noise Assessment Outcome

The adjacent land uses compliment the proposal and are minimally affected due to the irregular nature of the operation. The availability of large buffer distance to the nearest receptor in the north, prevailing wind direction away from the nearest receptor and proposed noise management

measures will minimise any potential noise impact. The monitoring regime proposed for the noise management will enable compliance with the *Environmental Protection (Noise) Regulations 1997*.

7.3 GROUNDWATER

It has been determined that the groundwater drains into the watercourse running through the Lot. The depth of excavation may reach the perched water table at some locations in Stage 1 and hence may pose the risk of groundwater being subject to evapo-transpiration during summer months. This can be managed by exposing such locations to minimum time during excavation activity and thus limiting the impact. The minimum duration of exposure can be achieved by progressive rehabilitation of the excavated area. The Water Management Plan has been prepared to minimise the impact on the groundwater and the surface watercourse during the life of the proposal.

7.3.1 Groundwater Management Measures

The management measures for minimising impact on groundwater are described below:

- No extraction activity will be carried out during winter (calendar months of June, July and August),
- Implement progressive rehabilitation of the site and limit prolonged exposure of excavated areas, and
- Any working area exposed to rainfall during winter or summer will have appropriate drainage and silt management measures.

7.3.2 Groundwater Assessment Outcome

The geology of the Lot together with the proposed groundwater management measures will ensure that the proposal will have minimum impact to the existing groundwater quality.

7.4 STORMWATER DRAINAGE MANAGEMENT

The objective of the stormwater drainage management is to reduce silt sedimentation in the watercourse and control discharge of stormwater collected in the excavated area. The management measures for minimising impact on surface water are described below:

- The excavation activities will not be carried out during winter,
- All excavation and screening will be completed during dry months, with gravel products stockpiled for transport offsite and sale,
- Stormwater will be managed around working areas to prevent erosion,
- Appropriate measures will be undertaken to manage stormwater during unforseen rain events,
- Turbidity and pH measurement at three locations (Refer Figure 2) in surface watercourse will be conducted during winter and compared with background levels,
- Visual inspection of the turbidity in the surface watercourse will be conducted when a flow exists and any concerns will be recorded and reported to the yard supervisor,
- Prior to the first and subsequent lifts of fill being placed during progressive rehabilitation of excavated area, the surface shall be tined to loosen the soil layer and provide an interlocking

bond between successive layers. This will assist in infiltration of surface water through the rehabilitated soil profile, and

- Proposed stormwater management structures are temporary drains, silt traps and stormwater retention pits (Refer Figure 3 and Figure 4).

Figure 2: Surface Water Monitoring Locations

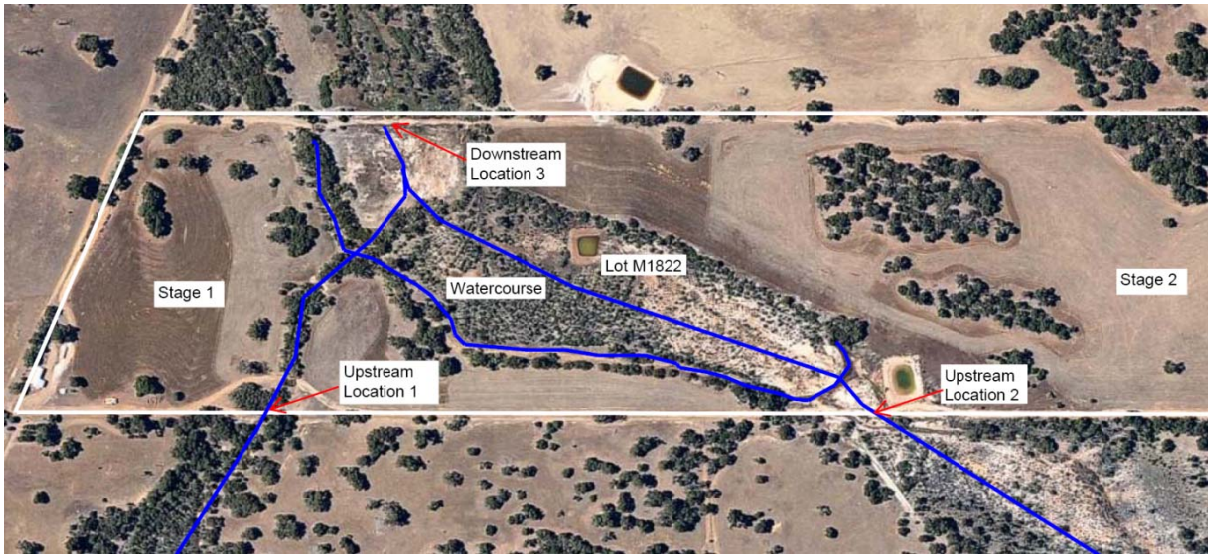
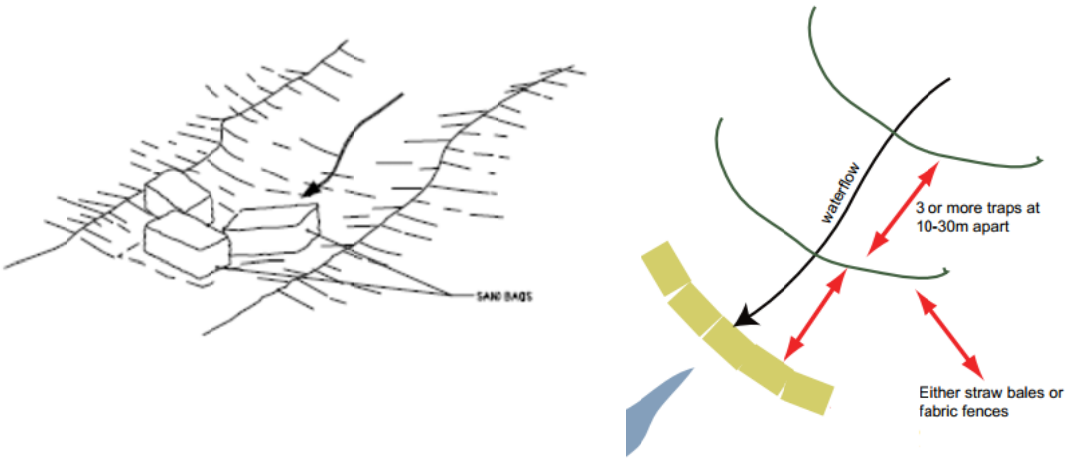
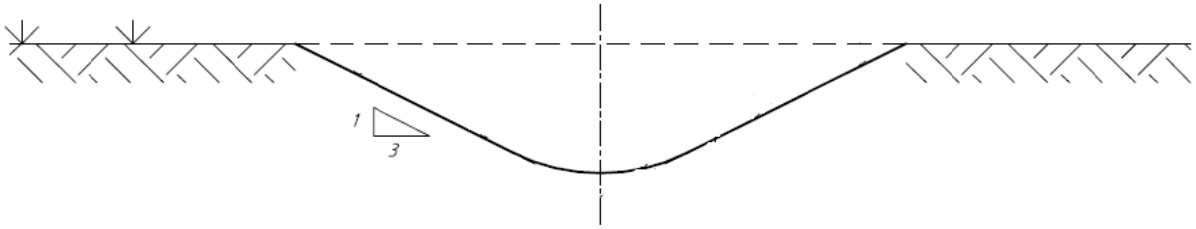


Figure 3: Temporary Drains with Sandbags and Silt Traps



The temporary drain will have sand bags or silt traps in the flow path to retard the flow rate and arrest silt runoff. Reduction in flow rate will allow controlled flow of stormwater runoff to the discharge point. Temporary silt traps will be made out of shade cloth supported across the flow path or straw bales.

Figure 4: Typical Drain



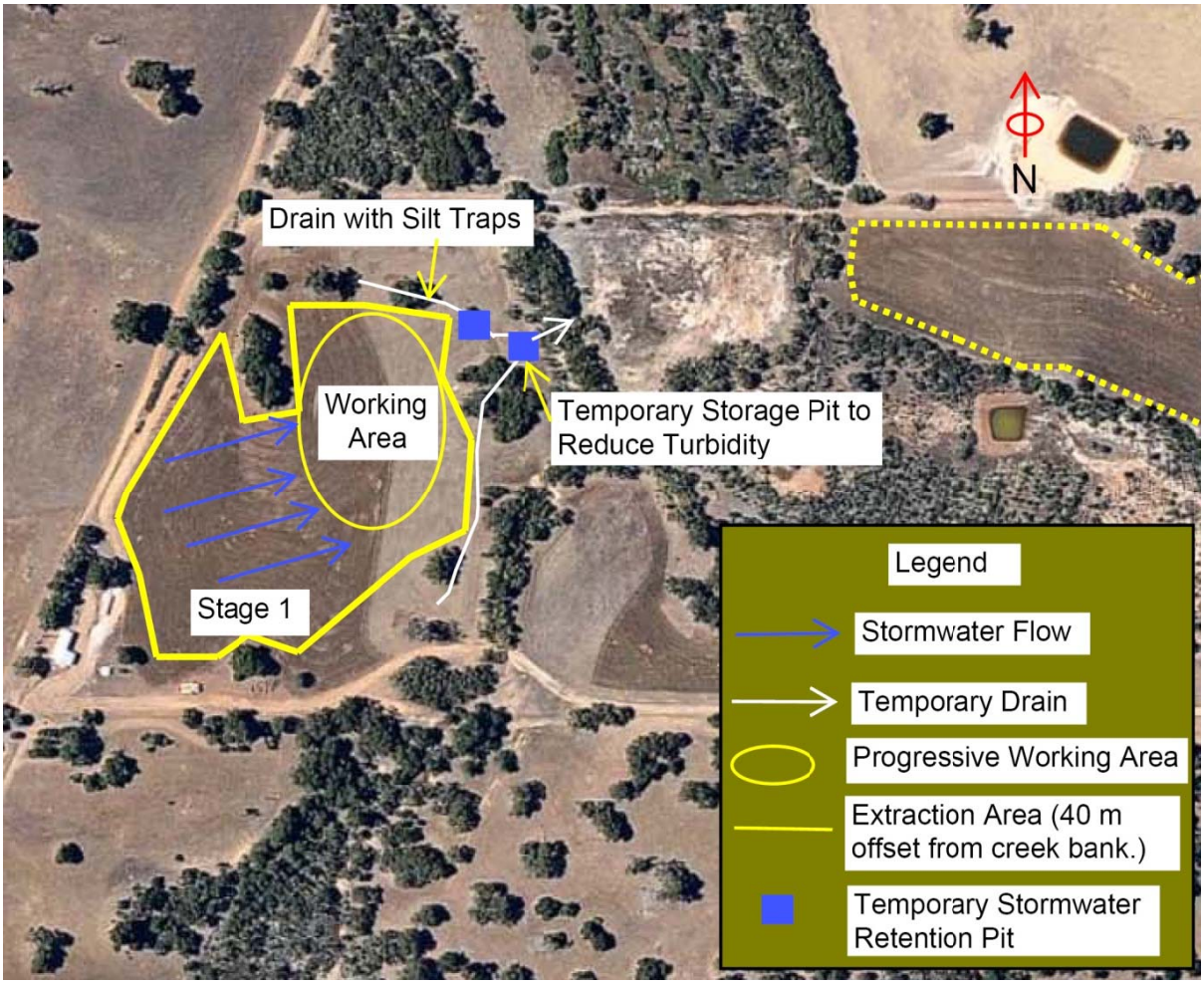
Stormwater retention pits are temporary pits excavated in the subgrade to contain stormwater runoff during high rainfall events and will be located on the drainage flow paths. The stormwater retention pits will increase retention time for stormwater, thus reducing the turbidity of runoff. The size of the stormwater retention pits will depend on the volume of stormwater runoff generated from the working area at a given point of time.

The stormwater drainage strategy for each stage is described below:

7.4.1 Stage 1

Stage 1 is located on the western side of Lot and west of the watercourse. The stormwater flow is towards the north east. A schematic of proposed stormwater management is shown in Figure 5 below.

Figure 5: Stage 1 Stormwater Management

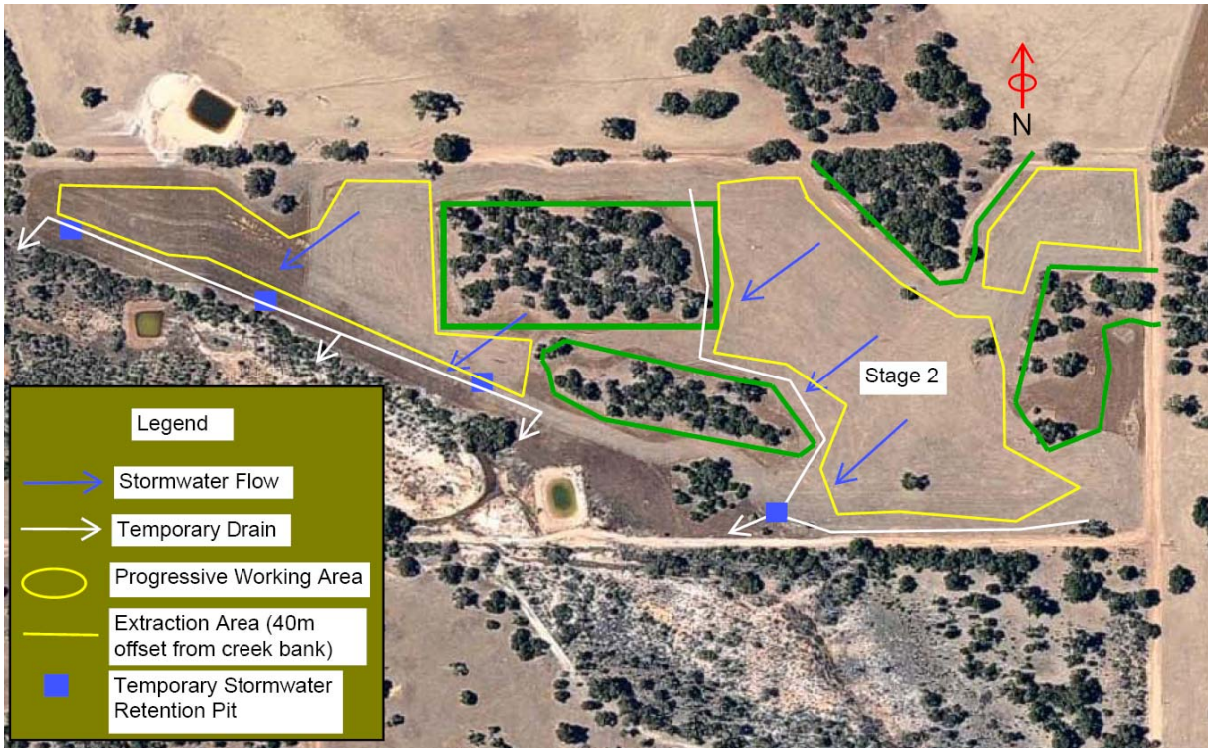


Temporary stormwater drains will be provided along the eastern edge of the working area. The length of the drain will depend on the extent of working area exposed to stormwater. The water collected in the drains will run into temporary stormwater retention pits before being discharged into the watercourse. The stormwater retention pits will allow enough time for settlement of sediments from stormwater runoff and thus prevent silt sedimentation in the watercourse. The depth of the stormwater retention pits will be dependent on the volume of runoff generated from the working area. Stormwater falling outside the working area will free drain into the watercourse along the gradient of the existing landform.

7.4.2 Stage 2

Stage 2 is located on the eastern side of the Lot and is located on the east of the watercourse. The stormwater flow is towards the south west. A schematic proposal of stormwater management is shown in Figure 6 below. Temporary stormwater drains will be provided along the western edges of Stage 2, with the length of the drains depending on the extent of the working area.

Figure 6: Stage 2 Stormwater Management



7.4.3 Erosion

Erosion can occur when vegetation is cleared, reducing the cohesion and stability of the surface material. As the extraction areas are confined to previously cleared cropping and grazing areas within the Lot, no additional erosion is expected to occur. Stormwater drains with retention pits will be excavated down gradient of the working area to prevent any significant erosion occurring as a result of the excavation works.

7.4.4 Surface Water Quality Monitoring

7.4.4.1 Method

The turbidity and pH of the surface watercourse sampled will be measured by grab sampling in accordance with AS/NZS 5667.4 *Water Quality – Sampling – Guidance on Sampling from lakes, natural and man-made.* Turbidity will be measured at three locations as shown in Figure 2. The samples will be submitted to a laboratory with current National Association of Testing Authorities registration for the parameters to be measured. The results would be compared to the background data available listed in Table 11. The turbidity will also be monitored frequently by visual inspection when there is flow in the surface watercourse and outside the grab sampling event.

Table 11: Background Turbidity Measurement

LOCATION	TDS (2008)		pH (2008)	
	4 September	8 October	4 September	8 October
Upstream (close to southern boundary)	1,960	2,280	6.84	6.55
Downstream (close to northern boundary)	2,270	2,250	7.05	6.69

7.4.4.2 Surface Water Monitoring Frequency

The proposed frequency for conducting surface water monitoring is listed below.

Table 12: Proposed Frequency for Surface Water Monitoring

LOCATION	PROPOSED FREQUENCY
Upstream Location 1	Once every winter when there is flow in the surface watercourse.
Upstream Location 2	Once every winter when there is flow in the surface watercourse.
Downstream Location 3	Once every winter when there is flow in the surface watercourse.

7.4.4.3 Review of Stormwater Management Measures

The results of the monitoring parameters will be compared to the baseline data available and if required more silt traps and retention pits will be installed to limit any impact on the surface watercourse due to the operation of the facility.

7.4.5 Reporting

The lab results would be forwarded to the Department of Water on an annual basis. The Department of Water, Shire of Northam and DEC will be notified of any event that had an impact on the surface watercourse and the action undertaken to minimise the impact.

7.5 FLORA AND FAUNA

The Lot has been mostly cleared of native vegetation except for some remaining stands of native trees. There is no understorey due to grazing, with the only other vegetation identified on the Lot as grasses and weeds. ENV Australia Pty Ltd (ENV) was engaged to conduct fauna and flora assessment in 2009 on the western section of the Lot.

7.5.1 Flora

The flora and vegetation assessment for the Western side of Lot was done in spring by ENV. The report summarised that no Endangered or Vulnerable species under the Environment Protection and Biodiversity Conservation Act 1999, Declared Rare Flora species under the Wildlife Conservation Act 1950 or Priority Flora listed by the DEC were recorded within the project area. The western section of the Lot is in Degraded to Completely Degraded condition and consists of a cleared paddock with a few patches of mature trees *(Eucalyptus marginata* and *Corymbia calophylla*).

The vegetation on the eastern side of the watercourse is of similar nature. The proposed gravel extraction activity will be limited to the cleared paddock areas on the Lot and hence the proposal is not considered to impact on existing flora.

7.5.2 Fauna

The assessment concluded that there are three habitat types in the project area: Open Forest, Creek Bed, and Pastoral (Refer Appendix D). Of these, the Open Forest and Creek Bed are considered to be of the highest value as fauna habitat, as they provide a range of microhabitats and support several species of fauna of conservation significance like the Carnaby's Black-cockatoo (*Calyptorhynchus latirostris*), and Chuditch (*Dasyurus geoffroii*). Additionally the Baudin's Black-cockatoo (*Calyptorhynchus baudinii*) was recorded in this habitat type during the survey.

The Pastoral habitat type is considered to be of low value as fauna habitat. This habitat has been cleared, and has previously been used for agriculture. No animals of conservation significance are supported by this habitat, as it provides no suitable microhabitats or food sources. Of all the habitat types, the Pastoral has the greatest representation in the project area, and will be most affected by the proposed extraction activity. It was stated by ENV in the report that the region was examined during the Regional Forest Agreement process and was mapped as the Cooke, Yalanbee 5 and Pinalup vegetation complexes (Mattiske and Havel, 1998). None of these vegetation complexes were listed in Review of Management Options for Poorly Represented Vegetation Complexes (Havel and Mattiske, 1998) and are therefore not considered to be high priority for conservation.

The Lot is completely fenced and there is no evidence of kangaroos or other large native fauna occupying or visiting the Lot. No Open Forest or Creek Bed vegetation will be disturbed during the proposed extraction activity. The proposed gravel extraction will be carried out only on the Pastoral habitat which is considered of no conservation significance and hence is not expected to have any impact on existing fauna.

8 REHABILITATION PLAN

The objective of the rehabilitation plan is to restore the excavated area to a safe and stable landform to the original ground levels. The proponent will rehabilitate the site to a landform suitable to be used as a crop land or farmland as per the owner's requirement. The proposed rehabilitation plan has been prepared to be consistent with the Shire of Northam *Extractive Industries Local Law 2008*. A schematic diagram for the proposed excavation and rehabilitation cross section is enclosed as Drawing CR-BA-06.

8.1 GRAVEL EXTRACTION METHODOLOGY

8.1.1 Removal of Top Soil

Top soil will be stripped to a depth of 100 mm within the working area in Stage 1 using a grader. The remaining area in Stage 1 remains undisturbed until excavation progresses to the next working area. Progressive rehabilitation of the excavated area will be undertaken. Any weed infested top soil would be stockpiled separately and later buried during rehabilitation activity. The location of the buried weed infested top soil will be recorded and made available for future reference. The site will be maintained during the life of the project to remain weed free and suitable for cropping. The stripped stockpile will be located adjacent to the excavation area. A concept plan for stockpile location has been enclosed as Drawing CR-BA-13. Stripped top soil during site preparation will be spread directly onto progressively backfilled landform at a depth of 100 mm. Stockpiled top soil will be used for rehabilitation within 2 years to retain the soil's biodata.

8.1.2 Removal of Gravel

Gravel is anticipated to a typical depth of 2 m across Stage 1 area. The gravel will be extracted using a 20 tonne or 30 tonne excavator and stockpiled within the excavation area. The extracted gravel will be screened to different grades and individually stockpiled within the excavation area. The screened stockpile will be loaded onto trucks using a front end loader and transported off site for various end uses.

8.1.3 Slope Stability

Across the base of the pit the excavation will be carried out at a maximum 1:2.5 slope. An access ramp will developed at one corner for truck access into the excavated area. The access ramps will be maintained at a maximum slope of 1:4 and will have a minimum track width of 4 m. The internal side batters of the pit will have a maximum slope of 1:2.5 and are considered to be stable. Any unstable section identified on the internal batter during the excavation activity will be reinstated by removing loose material and reducing the slope.

8.1.4 Progressive Rehabilitation

The restoration of the excavation area will be undertaken progressively. The excavated area will be backfilled using inert fill to return the landform to original levels. The inert fill will comprise of clayey soil, overburden and top soils collected from various earthworks sites across Perth, WA. The backfilled levels will be 100 mm below the existing landform survey levels. The backfill will be

compacted in 300 mm layers to 95% standard compaction using a pad foot roller. Prior to the first and subsequent lifts of fill being placed during progressive rehabilitation of excavated area, the surface shall be tined to loosen the soil layer and provide an interlocking bond between successive layers. This will assist in infiltration of surface water through the rehabilitated soil profile. Top soil will be spread directly over the backfilled landform at a depth of 100 mm to achieve the levels of the original landform.

8.1.5 Erosion Control

Erosion from stormwater runoff is unlikely to be a problem on the finished surface as the proposed landform will follow the natural gentle slope towards the watercourse. The finished surface will be left loose and slightly undulating to assist in reduction of surface flow rate and increase the seepage of water into the ground. The erosion control during gravel extraction activity is included in the Water Management Plan.

8.2 DECOMMISSIONING ACTIVITY

The existing building serving as site office will be retained after the excavation activities. The decommissioning activity will involve the following:

- Chemical toilet and any mobile infrastructure such as plant and equipment will be removed from the site to another operation centre,
- Any remaining stockpiles unsuitable as top soil would be removed from the rehabilitated site,
- Exploratory holes will be securely plugged using backfill and made safe,
- All temporary fences and table drains will be removed to bring the site to original condition, and
- Disturbed surfaces outside the excavation area such as roads and operations areas will be rehabilitated by ripping the surface, spreading with gravel and topsoil.

8.2.1 Maintenance of Rehabilitated Area

The progressively rehabilitated areas will be checked for free draining and non-eroding ability. Any ponding or eroding surface will be reinstated by placing gravel or top soil. During excavation and rehabilitation phases the remainder of the Lot will be used for cropping and managed as a crop farm. The maintenance activity for a rehabilitated area will be conducted for a period of 12 months.

8.2.2 Proposed After Use

The gravel extraction is limited to cleared area and hence no rehabilitation of site by planting of trees and shrubs is anticipated. The restored landform will be available for use as grazing or cropping by the landowner. The progressive rehabilitation of the excavated area will make the land available for desired end use during the period of the proposal.

8.3 COMPLETION AND HANDOVER

When sufficient evidence can be provided that the rehabilitated area is stable and free draining, the proponent may seek to complete all obligations by submitting to the Shire of Northam and the

landowner a certified statement of completion to the effect that site rehabilitation work has been completed and further environmental management of the premises is not required.

Generally, this statement will be expected to show that:

- Rehabilitated levels are consistent with original landform survey levels,
- No evidence of ponding or erosion, and
- All excess material has been removed from site.

Once the Shire of Northam has approved the certified statement of completion, the proponent can cease the maintenance of the site.

9 CONCLUSION

The proposal is considered appropriate for the following reasons:

- The proposed development is outside drinking water catchment areas,
- The Lot is located in relatively isolated area ensuring minimal (if any) impact on surround land uses,
- The proposal is in accordance with the objectives and policy requirements of the relevant State planning policies and EPA buffer requirements,
- The proposal will facilitate employment for at least two staff,
- Rehabilitation of the site will allow sustainable reuse of the Lot, and
- Establishment of such a facility will provide basic raw materials such as gravel for the construction and housing industry in the local area.

10 REFERENCES

AS/NZS 5667.4 Water Quality – Sampling – Guidance on Sampling from lakes, natural and man-made (1998) by Australia/New Zealand Standards.

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ENV Australia Pty Ltd, 2009. *Flora and Vegetation of Western Side of Lot M1822 Horton Road, Woottating and 5m of Each Side of Horton Road.*

ENV Australia Pty Ltd, 2009. *Fauna and Habitat assessment of the Western Side Of Lot M1822 Horton Road, Woottating and 5m of Each Side of Horton Road.*Gozzard, J.R., 1989. A Practical Guide for Interpreting the Environmental Geology Map Series. Geological Survey of Western Australia, Record 1989/10.

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Smurthwaite, A. J. 1987. Mundaring, Environmental Geology Series. Geological Survey of Western Australia, Department of Minerals and Energy, Perth, Western Australia.

VIPAC Engineers and Scientists, 2009. *Purearth Organics Facility – Environmental Noise Assessment.*

Guidance for the Assessment of Environmental Factor 18: Prevention of Air Quality Impacts from Land Development Sites (2000) by Environmental Protection Authority, WA.

National Environment Protection Measure for Ambient Air Quality – Common Wealth Monitoring Plan (2001) by Department of Sustainability, Environment, Water, Population and Communities.

Category 12: Extractive Industries Sand and Limestone Extraction from Guidance Statement No 3: Separation Distance between Industrial and Sensitive Land Uses (2005) by Environmental Protection Authority, WA.

Extractive Industries Local Law 2008, Shire of Northam, WA.

11 ATTACHMENTS

11.1 APPENDICES

REGISTER NUMBER	
M1822/D8755	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	**2/4/2008**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

VOLUME **1034** FOLIO **539**

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT M 1822 ON DIAGRAM 8755

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

SEAN THADEUS CURTIS OF 17C JACQUELINE STREET, BAYSWATER
PAUL GUY CURTIS OF 11 EMPIRE ROAD, CARMEL
AS JOINT TENANTS IN 2/4 SHARE
SEAN THADEUS CURTIS
HELEN JOSEPHINE CURTIS
BOTH OF 17C JACQUELINE STREET, BAYSWATER
AS JOINT TENANTS IN 1/4 SHARE
PAUL GUY CURTIS
BARBARA ELLEN CURTIS
BOTH OF 11 EMPIRE ROAD, CARMEL
AS JOINT TENANTS IN 1/4 SHARE
AS TENANTS IN COMMON

(T K615147) REGISTERED 4 JUNE 2008

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. SAVE AND EXCEPT ALL THE RIGHT TITLE ESTATE AND INTEREST IN AND TO ALL THE MINERALS ON OR BELOW THE SURFACE OF THE SAID LAND WHICH SAID MINERALS HAVE BECOME THE PROPERTY OF THE CROWN PURSUANT TO THE PROVISIONS OF THE GOVERNMENT RAILWAYS ACT 54 OF 1965
2. *K615148 MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 4.6.2008.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 1034-539 (M 1822/D8755).

END OF PAGE 1 - CONTINUED OVER

RECORD OF CERTIFICATE OF TITLE

REGISTER NUMBER: M1822/D8755 VOLUME/FOLIO: 1034-539 PAGE 2

PREVIOUS TITLE: 48-13.
PROPERTY STREET ADDRESS: LOT 13 HORTON RD, WOOTTATING.
LOCAL GOVERNMENT AREA: SHIRE OF NORTHAM.

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING K615148

1006/33

TRANSFER 4140 VOL. 1933 48 , FOL. 13.

ORIGINAL

REGISTER BOOK.

Vol. 1034 Fol. 539

INDEXED

WESTERN AUSTRALIA.

CT 1034 0539 F

Certificate of Title

under "The Transfer of Land Act, 1893" (Sch. 5, 56 Vict., 14.)

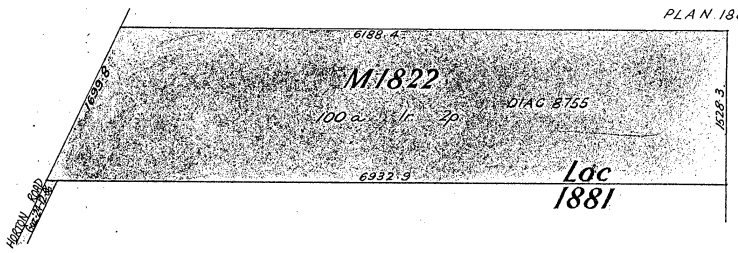
Atherton Thomas Crosse of Beechina Poultry Farmer

is now the sole proprietor

of an estate in fee simple in possession subject to the easements and encumbrances notified hereunder in ALL that piece of land delineated and coloured green on the map hereon, containing one hundred acres one rood and two perches or thereabouts, being portion of Avon Location 1881 the subject of diagram 8755 and thereon numbered Lot M1822.

Except and reserving unto the Midland Railway Company of Western Australia Limited and its transferees all mines of copper tin lead coal ironstone phosphatic rock and other metals ores or minerals whatsoever and all substances containing minerals or phosphates and all gems and precious stones and mineral oil in upon and under the said land with full liberty at all times to search dig mine bore for and carry away the same and for that purpose to enter upon the said land or any part thereof and that without paying to the said Atherton Thomas Crosse or his transferees any compensation therefor.

PLAN 1889 SHEET I



Scale: 10 Chains to an Inch

Dated the Second day of August One thousand nine hundred and thirty-three

Assistant Registrar of Titles.

Transfer 16473/1948. Transferred to His Majesty King George the Sixth. Registered 3rd December 1948 at 12oc

ASSISTANT REGISTRAR OF TITLES

Transfer A191579 to Arlis Clement Ellies Dentist and Jacqueline Margaret Ellies Married Woman both of 22 Kintyre Crescent, Floreat Park, as tenants in common. Registered 17th July 1969 at 9-46 o'c.

ASSISTANT REGISTRAR OF TITLES

Transfer B 870163 to Jacqueline Margaret Ellies of 22 Kintyre Crescent, Floreat Park, Single Woman. Registered 25th February 1980 at 335 o'c.

Transfer B 870164 to Peter William Johnston of 7 Barkling Crescent, Bateman, Farmer. Registered 25th February 1980 at 3.36 o'c.

W 6972/20*

For encumbrances and other matters affecting the land see back.

Superseded - Copy for Sketch Only

EASEMENTS AND ENCUMBRANCES REFERRED TO.

Caveat B 199166. Lodged 12.8.1926 at 2.07 o/c.

WITHDRAWN

Withdrawal B 870162 of Caveat B 199166. Lodged 25th February 1980 at 3.35 o/c.

CT 1034 0539 B

CERTIFICATE OF TITLE.

Registered Vol.....Fol.....

Bowman & Associates Pty Ltd

ABN: 22 112 399 514

Phone 0402 373 582
Fax 9457 6277
PO Box 2059
ROSSMOYNE WA 6148

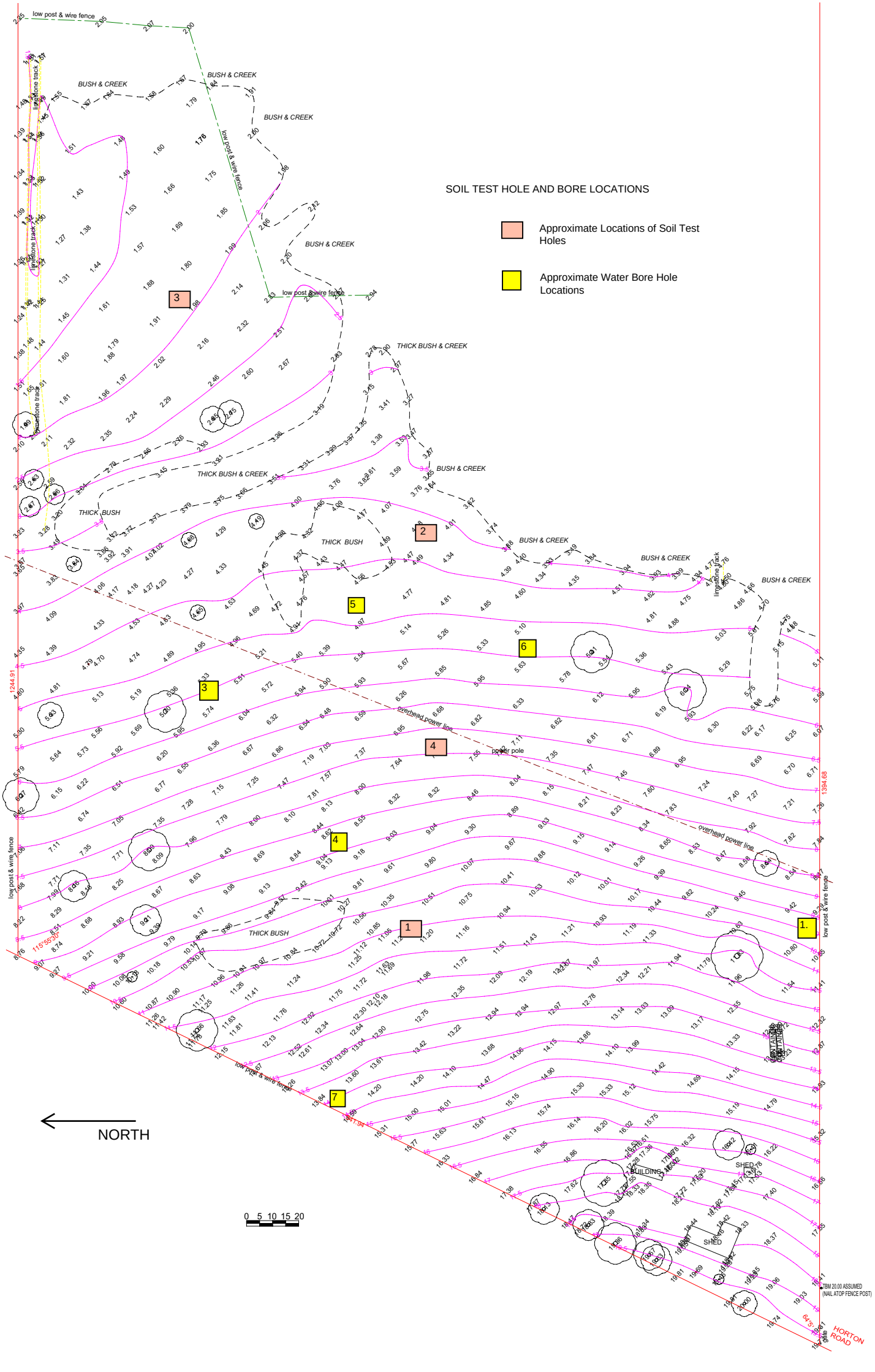
WOOROLOO BROOK FARM

SOIL INVESTIGATION RESULTS

APRIL 2008

LOCATION:
LOT M1822 HORTON ROAD
WOOTTATING

METHODOLOGY:
On the 10 April 2008 a 20 Tonne excavator was used to dig exploratory holes in several locations on the western portion of Lot M1822 Horton Road Woottating. The holes were dug to a depth at which considerable resistance was encountered. Representative samples of the material through the full depth of excavation were taken by Bowman & Associates. The samples were delivered to Qualcon Laboratories for testing. This document summarises the test results from the samples taken and provides an indication of the location of each test hole.


SOIL TEST HOLE AND BORE LOCATIONS
Approximate Locations of Soil Test Holes
Approximate Water Bore Hole Locations
low post & wire fence
BUSH & CREEK
THICK BUSH & CREEK
THICK BUSH
limestone track
overhead power line
power pole
SHED
BUILDINGS
NORTH
0 5 10 15 20
HORTON ROAD
TBM 20.00 ASSUMED (NAIL ATOP FENCE POST)

Bowman & Associates Pty Ltd

ABN: 22 112 399 514

PO Box 2059
ROSSMOYNE WA 6148
Phone: 0402 373 582
Fax: 08 9457 6277
Email: bruce@bowmanassociates.com.au

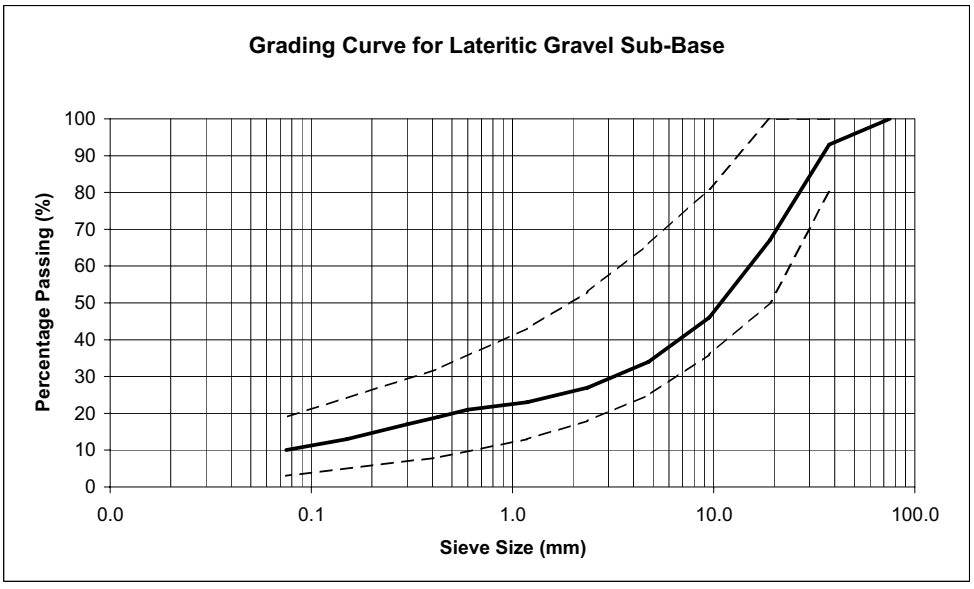
Raw Materials Test Summary

Client	**Purearth**	**Date of Sample**	10/04/2008
Project	**Woottating**	**Date of Test**	
Material ID	**Test # 2969**	**Testing Laboratory**	Qualcon
Location	**Woottating**	**Laboratory ID**	
Description	**Hole #1 - Clayey Sandy Gravel**		

Particle Size Distribution	
Specification	MRWA: 501 Table 501B1
Sieve Size (mm)	**Percentage Passing**
75.0	100
37.5	93
26.5	
19.0	67
13.2	
9.5	46
6.7	
4.75	34
2.36	27
1.18	23
0.600	21
0.425	19
0.300	17
0.150	13
0.075	10
0.0135	

Atterberg Limits	
Specification	MRWA: 501 Table 501.14
Test	**Result**
Liquid Limit (<25%)	34.0
Plastic Limit (%)	19.0
Plasticity Index (%)	12.0
Linear Shrinkage (<2%)	5.0

Material Compaction	
Test Method	AS1289.5.2.1
Test	**Result**
SMDD t/m³	2.07
OMC %	9.5
>19mm %	33.0



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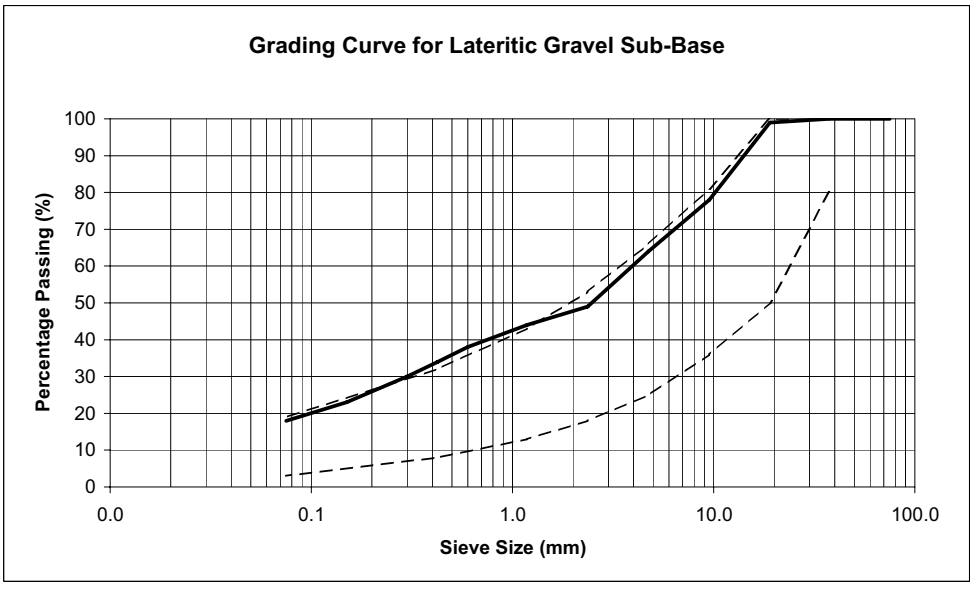
Raw Materials Test Summary

Client	**Purearth**	**Date of Sample**	10/04/2008
Project		**Date of Test**	
Material ID	**Test # 2970**	**Testing Laboratory**	Qualcon
Location	**Woottating**	**Laboratory ID**	
Description	**Hole #2 - Clayey Gravel**		

Particle Size Distribution	
Test Method	MRWA: 501 Table 501B1
Sieve Size (mm)	**Percentage Passing**
75.0	100
37.5	100
26.5	
19.0	99
13.2	
9.5	78
6.7	
4.75	64
2.36	49
1.18	44
0.600	38
0.425	34
0.300	30
0.150	23
0.075	18
0.0135	

Atterberg Limits	
Test Method	MRWA: 501 Table 501.14
Test	**Result**
Liquid Limit (<25%)	38.0
Plastic Limit (%)	17.0
Plasticity Index (%)	21.0
Linear Shrinkage (<2%)	7.0

Material Compaction	
Test Method	MRWA: 110.1, 110.2
Test	**Result**
SMDD t/m³	2.15
OMC %	9.5
>19mm %	1.0



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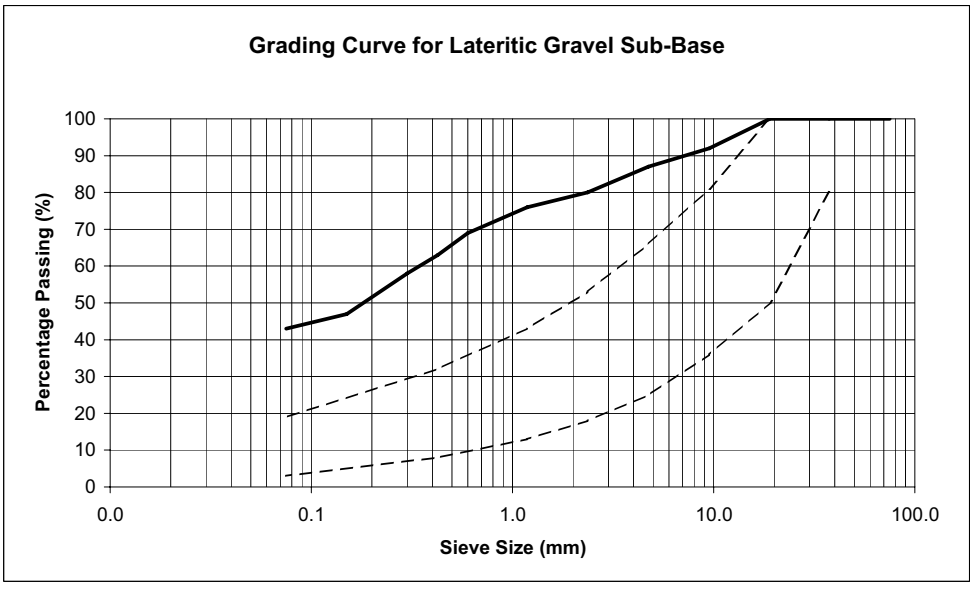
Raw Materials Test Summary

Client	**Purearth**	**Date of Sample**	10/04/2008
Project		**Date of Test**	
Material ID	**Test # 2971**	**Testing Laboratory**	Qualcon
Location	**Woottating**	**Laboratory ID**	
Description	**Hole #3 - Gravelly Clayey Sand**		

Particle Size Distribution	
Test Method	MRWA: 501 Table 501B1
Sieve Size (mm)	**Percentage Passing**
75.0	100
37.5	100
26.5	
19.0	100
13.2	
9.5	92
6.7	
4.75	87
2.36	80
1.18	76
0.600	69
0.425	63
0.300	58
0.150	47
0.075	43
0.0135	

Atterberg Limits	
Test Method	MRWA: 501 Table 501.14
Test	**Result**
Liquid Limit (<25%)	44.0
Plastic Limit (%)	18.0
Plasticity Index (%)	26.0
Linear Shrinkage (<2%)	8.5

Material Compaction	
Test Method	MRWA: 110.1, 110.2
Test	**Result**
SMDD t/m³	1.89
OMC %	16.5
>19mm %	0.0



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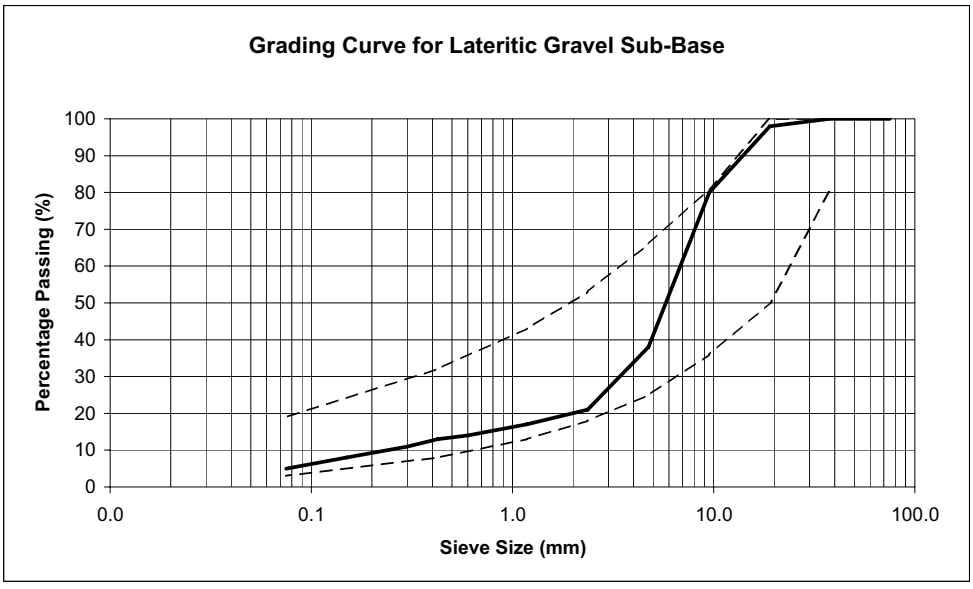
Raw Materials Test Summary

Client	**Purearth**	**Date of Sample**	10/04/2008
Project		**Date of Test**	
Material ID	**Test # 2972**	**Testing Laboratory**	Qualcon
Location	**Woottating**	**Laboratory ID**	
Description	**Hole #4 - Sandy Gravel**		

Particle Size Distribution	
Specification	MRWA: 501 Table 501B1
Sieve Size (mm)	**Percentage Passing**
75.0	100
37.5	100
26.5	
19.0	98
13.2	
9.5	80
6.7	
4.75	38
2.36	21
1.18	17
0.600	14
0.425	13
0.300	11
0.150	8
0.075	5
0.0135	

Atterberg Limits	
Specification	MRWA: 501 Table 501.14
Test	**Result**
Liquid Limit (<25%)	23.0
Plastic Limit (%)	20.0
Plasticity Index (%)	3.0
Linear Shrinkage (<2%)	1.5

Material Compaction	
Test Method	AS1289.5.2.1
Test	**Result**
SMDD t/m³	2.12
OMC %	8.0
>19mm %	2.0



APPENDIX C: PICTURES OF PROPOSED PLANT

Front-End Loader

Semi-trailer

Excavator

Screening Plant

FLORA AND VEGETATION OF

WESTERN SIDE OF LOT M 1822 HORTON ROAD, WOOTTATING AND 5M OF EACH SIDE OF HORTON ROAD

Prepared for

PUREARTH

Job No:08.314

Report No: RP001

Australia

FLORA AND VEGETATION OF WESTERN SIDE OF LOT M 1822 HORTON ROAD, WOOTTATING AND 5M OF EACH SIDE OF HORTON ROAD

Prepared for

Purearth

Prepared by

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Status:	*Final*
QA Review:	*Teresa Gepp*
Technical Review:	*Rachael Pratt*
Content Review:	*Teresa Gepp*
Date:	*29 January 2009*

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STATEMENT OF LIMITATIONS

Scope of Services

This environmental site assessment report ('the report') has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and ENV.Australia Pty Ltd (ENV) ('scope of services'). In some circumstances the scope of services may have been limited by factors such as time, budget, access and/or site disturbance constraints.

Reliance on Data

In preparing the report, ENV has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ('the data'). Except as otherwise stated in the report, ENV has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. ENV will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to ENV.

Environmental Conclusions

In accordance with the scope of services, ENV has relied on the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, express or implied, is made.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and for no other party. ENV assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of ENV or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions, and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

ENV will not be liable to update or revise the report to take into account any events or circumstances occurring or facts becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report, nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

EXECUTIVE SUMMARY

ENV.Australia Pty Ltd (ENV) was commissioned by Bowman and Associates on behalf of Purearth in September 2008 to undertake a Spring flora and vegetation assessment for the Western side of Lot M 1822 Horton Road, Woottating and 5m either side of Horton Road. The purpose of the survey is to produce a detailed flora and vegetation report to accompany referral documents that will be submitted to the Environmental Protection Authority (EPA) with the aim of developing the site as a compost facility and related widening of the access road.

The project area is both sides of Horton Road to a width of 5m, to allow for the widening of 2m either side, and the western end of Lot M 1822 west of the drainage line. Horton Road is approximately 3.6km long and is mainly an unsealed road and the site for the proposed compost facility is approximately 0.6ha in size and is land used for grazing with pockets of trees and a few shrubs around the boundary fences.

Thirty-four families, 84 genera and 131 taxa were recorded in the survey area (126 native flora taxa and 5 introduced). No Endangered or Vulnerable species under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999, Declared Rare Flora species under the Western Australian Wildlife Conservation Act 1950 or Priority Flora listed by the Department of Environment were recorded within the project area.

The database search determined that there are no Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) are known to occur in the area.

The majority of the vegetation along Horton Road is in Excellent condition (85%) with approximately 5% in Very Good condition and 10% in Degraded to Completely Degraded condition. Lot M 1822 Horton Road is in Degraded to Completely Degraded condition and consists of a cleared paddock with a few patches of mature trees *(Eucalyptus marginata* and *Corymbia calophylla*) that have no native understorey species.

Due to the location of the site there is limited information on the conservation significance of vegetation at the community level. Therefore the process of inferring the Floristic Community Types within the site to determine the presence of any TECs does not apply, however, there are no known occurrences of TECs within the surrounding area and so it is unlikely that any occur within the site.

Currently there is also limited information on the remaining Pre-European extent of vegetation complexes outside of the Swan Coastal Plain, however, by converting Beard's vegetation complex mapping codes to those used in the *Native Vegetation in Western Australia, Extent, Type and Status* (Shepherd et. al., 2002) report, its Pre-European extent can be established.

Lot M 1822 Horton Road is outside of the PMR and so the 30% Pre-European Extent retention target is recommended, Horton Road is located within the PMR and therefore

the 10% retention target applies. Beard (1974) mapped the area as e^2_3Mc – Jarrah (*Eucalyptus marginata*) – Marri (*Corymbia calophylla*) Forest vegetation complex which has been estimated as having 72.1% of its Pre-European extent remaining. This complex has a higher percentage than the recommended retention for areas both outside and inside the PMR.

ENV believes that if the road widening is kept to the minimum width and disturbance to bordering vegetation is avoided then the road widening will have a minimal impact on the flora and vegetation within the project area. Due to the degraded condition of the vegetation on Lot M 1822 ENV believes it will not pose a constraint to the proposal.

ENV.Australia makes the following recommendations:

- Clearing of vegetation should be kept to a minimum and undertaken in a systematic way. All onsite contractors should be made aware that no disturbance to bordering vegetation outside of the necessary clearing width should be disturbed
- Locally endemic species should be used where rehabilitation or landscaping is to be undertaken.
- A buffer should be established to protect the drainage lines that dissect the lot and a hard barrier should be erected (such as fencing) to ensure this.

1 INTRODUCTION

ENV.Australia Pty Ltd (ENV) was commissioned by Bowman and Associates on behalf of Purearth in September 2008 to undertake a spring flora and vegetation assessment for the western side of Lot M 1822 Horton Road, Woottating and 5m either side of Horton Road. The purpose of the survey is to produce a detailed flora and vegetation report to accompany referral documents that will be submitted to the Environmental Protection Authority (EPA) with the aim of developing the site as a compost facility and related widening of the access road.

The project area is both sides of Horton Road to a width of 5m, to allow for the desired widening of 2m either side and allowing a buffer for machinery operations (e.g. reversing, turning around) and the western end of Lot M 1822 west of the drainage line. Horton Road is approximately 3.6km long and is mainly an unsealed road and the site for the proposed compost facility is understood to be approximately 0.6ha in size and is land used for grazing with pockets of trees and a few shrubs around the boundary fences.

ENV is aware the site for the compost facility is adjacent to a drainage line but has been informed that it will not be disturbed by the proposed development and so did not need to be surveyed.

1.1 LOCATION

Horton Road and Lot M 1822 Horton Road, Woottating are approximately 55km east of Perth in the Shire of Northam. The site is adjacent to private property, BGC owned land and land zoned for Parks and Recreation (restricted) (Figure 1).

The site is in the Southwest Province of Western Australia, within the Northern Jarrah Forest Subregion in the Dale Botanical Subdistrict (Beard 1990). The Dale Botanical Subdistrict consists mainly of the following vegetation communities:

- *Eucalytpus marginata* forest on Ironstone gravels; and
- *Corymbia calophylla – Eucalyptus wandoo* woodlands on loamy soils; with
- Sclerophyll understoreys. (Beard 1990).

The climate of this region is Warm Mediterranean and is somewhat drier than the Southern Jarrah Forest which has winter precipitation of 600-1200mm, with 5-6 dry months a year (Beard 1990; Bureau of Meteorology 2008).

1.2 REGIONAL SOILS, LANDFORMS AND VEGETATION

For a development proposal to be assessed in terms of the flora and vegetation values that may be impacted upon, an understanding of the vegetation communities at the site in question is required. In Western Australia, there are various floristic reports that detail a region's botanical values.

A widely-used vegetation classification system that maps and describes vegetation communities in south-west Western Australia is *Vegetation of the Darling System* in the *Atlas of Natural Resources, Darling System, Western Australia* (Heddle *et al.* 1980). This document describes vegetation communities as vegetation complexes, and maps the distribution of each complex.

Vegetation complexes are defined as a combination of distinct site vegetation types, usually associated with a particular geomorphic, climatic, floristic and vegetation structural association. Vegetation complexes are based on the pattern of vegetation at a regional scale, as it reflects the underlying key determining factors of landforms, climate and soils.

The soils and landform unit, as well as the vegetation complex the site supports, are described below:

1.2.1 Soils and Landforms

The site occurs on the Darling Plateau portion of the Darling System (Churchward & McArthur 1978). The Darling Plateau consists of lateritic uplands with minor and major valleys and scarps: specifically the site is on:

- Cook: Hills rising above general plateau level; mainly mantled by laterite but with some rock outcrops.
- Yalanbee: Gently undulating landscape dominated by fine gravels; some duricrust on ridges.
- Pindalup: Valleys of the central part of the plateau; gravelly duplex soils on slopes; some rock outcrop; grey sands, duplex soils and orange earths in broad floors.

1.2.2 Vegetation Complex Mapping

Heddle *et al.* (1980) mapped the area as containing three Darling Plateau vegetation complexes which are related to the underlying soil profile:

- Cook Complex: Vegetation ranges from open forest of *Eucalyptus marginata – Corymbia calophylla* (Formally *Eucalyptus calophylla*) on deep soils through heath and herbland to lichens on granite rocks.

- Yalanbee and Dwellingup Complex in Low rainfall: Mixture of open forest of *Eucalyptus marginata – Corymbia calophylla* and woodland of *Eucalyptus wandoo – Corymbia calophylla*.
- Pindalup and Yarragil Complex in Low to Medium rainfall: Open forest of *Eucalyptus marginata – Corymbia calophylla* on slopes and open woodland of *Eucalyptus wandoo* with some *Eucalyptus patens* in the lower gullies.

Beard (1974) mapped the area as e^2_3Mc – Jarrah (*Eucalyptus marginata*) – Marri (*Corymbia calophylla*) Forest vegetation complex.

The region was also examined during the Regional Forest Agreement process and was mapped as the Cooke, Yalanbee 5 and Pinalup vegetation complexes (Mattiske and Havel, 1998). None of these vegetation complexes were listed in Review of Management Options for Poorly Represented Vegetation Complexes (Havel and Mattiske, 1998).

Currently there is limited information publicly available on the remaining Pre-European extent of vegetation complexes outside of the Swan Coastal Plain, however, by converting Beard's vegetation complex mapping codes to those used in the Native Vegetation in Western Australia, Extent, Type and Status (Shepherd et. al., 2002) report, an estimate of the scarcity of each complex can be determined. The report states that the Beard vegetation complex that is present within the site has 72.1% Pre-European extent remaining.

The EPA recognises vegetation complexes that are not well represented in reserves as being significant. Vegetation complexes which have 10%-30% remaining may be considered regionally significant. Proposals that would impact on a vegetation complex with 10% (within the PMR) or less remaining are likely to be formally assessed by the EPA (EPA 2006).

1.3 PROTECTION OF FLORA AND VEGETATION

Flora species are protected formally and informally by various legislative and non-legislative measures, which are as follows:-

Legislative Protection

- Environment Protection and Biodiversity Conservation Act 1999 (Cth): a Federal Act;
- Wildlife Conservation Act 1950 (WA): a State Act; and
- Environmental Protection Act 1986 (WA): a State Act.

Non-Legislative Protection

- Western Australian Department of Environment and Conservation ('DEC') Priority lists for flora and vegetation; and
- informal recognition of locally significant populations

A short description of these Acts is given below, and definitions of the species conservation codes and ecological community categories they use, and those used by the DEC, are provided in Appendix A.

Environment Protection and Biodiversity Conservation Act 1999 (Cth)

The Environment Protection and Biodiversity Conservation Act 1999 (Cth) ('the EPBC Act') aims to protect matters of national environmental significance, which are detailed in Appendix A.

Under the EPBC Act, the Commonwealth Department of Environment, Water, Heritage and the Arts ('DEWHA') lists threatened species and Threatened Ecological Communities in certain categories determined by criteria set out in the Act (*www.environment.gov.au/epbc/index.html*).

The Act provides for substantial penalties for any unauthorised actions likely to adversely affect matters of national environmental significance. It also provides for a national environmental assessment and approvals process for proposed actions likely to affect the prescribed matters of national environmental significance. If a proposed action is approved subject to certain conditions, the proponent of the action does not contravene the Act if the action is carried out in accordance with the conditions imposed.

Projects likely to cause impacts on matters of national environmental significance (as defined in the EPBC Act – see Appendix A) should be referred to the DEWHA for assessment under the EPBC Act. Although the time taken for a proposal to be assessed may be considerable, there is considerable risk in not referring a project likely to affect matters of national environmental significance, as the Act provides for substantial penalties for unauthorised actions.

Wildlife Conservation Act 1950 (WA*)*

The Western Australian Department of Environment and Conservation ('DEC'), (previously Department of Conservation and Land Management (CALM)) lists flora taxa under the provisions of the Wildlife Conservation Act 1950 (WA*)* ('WC Act') as protected according to its need for protection (see Appendix A).

Flora species are given Declared Rare status when their populations are geographically restricted or are threatened by local processes. In addition, under

the WC Act, by Notice in the Western Australian Government Gazette of 9 October 1987, all native flora (spermatophytes, pteridophytes, bryophytes and thallophytes) is protected throughout the State.

The Act makes it an offence to 'take' threatened species without an appropriate licence. There are financial penalties for contravening the Act.

Environmental Protection Act 1986 (WA)

Declared Rare Flora (DRF) and Threatened Ecological Communities ('TECs') are given special consideration in environmental impact assessment, and areas containing DRF or TECs have special status as Environmentally Sensitive Areas (ESAs) under the Environmental Protection Act and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004.

The protection of DRF and TECs is a 'clearing principle' for assessing applications for permits to clear native vegetation. As ESAs exemptions for a clearing permit do not apply. There are substantial penalties (financial and/or imprisonment) for unlawfully damaging ESAs.

DEC Priority lists

The DEC lists 'Priority' flora species that have not been assigned statutory protection under the WC Act, but which are under consideration for declaration as 'Rare Flora' under the Act. Species assessed as Priorities 1-3 are in urgent need of further survey, whilst Priority 4 species require monitoring every 5-10 years (see Appendix A for definitions).

In addition, the DEC maintains a list of Priority Ecological Communities which identifies those communities that need further investigation before possible nomination for TEC status.

Although DEC Priority species and communities have no formal legal protection, they are under consideration. Sensitivities to harm for an increased level of protection under the WC Act and/or EP Act can therefore be expected to be heightened, and the adverse effects of impacting them may include negative publicity (with the prospect of damage to the proponent's public image and possible adverse consequences for future projects) and local opposition to proposals.

Informal Recognition of Threatened Flora and Vegetation

Certain populations or communities may be of local significance or interest because of their patterns of distribution and abundance. For example, flora may be locally significant because they are range extensions to the previously-known distribution or are newly-discovered taxa (and therefore have the potential to be

of more than local significance). In addition, many species are in decline as a result of threatening processes (primarily land clearing), and relict populations of such species assume local importance.

Despite the lack of any formal protection for species in this category, project proponents are strongly advised to be aware of and to be sensitive to community concerns as to locally significant species or communities.

1.4 INTRODUCED SPECIES

The Environmental Weed Strategy for Western Australia (CALM 1999) contains criteria for the assessment and ranking of weeds in terms of their environmental impact on biodiversity, Details of the definitions of these categories are provided in Appendix B. The Strategy defines environmental weeds as 'plants that establish themselves in natural ecosystems and proceed to modify natural processes, usually adversely, resulting in the decline of the communities they invade.'

Plants may also be 'Declared' by the Agriculture Protection Board under the Agriculture and Related Resources Protection Act 1979 (WA) ('ARRP Act'). Declared Plants are gazetted under five categories (P1-P5), which define the action required. Details of the definitions of these categories are provided in Appendix B. A declaration may apply to the whole State, to districts, individual properties or even to single paddocks. If a plant is Declared, landholders are obliged to control that plant on their properties (Department of Agriculture 2008).

2 SCOPE OF WORK

The flora and vegetation survey focused on determining the vegetation communities present, locating Declared Rare and Priority Flora and Threatened Ecological Communities, as well as conducting a condition assessment of the existing vegetation. Specifically the survey comprised of:

- a database search for Rare, Priority and Endangered Flora species, TECs and PECs that may occur in the area, by reference to government databases;
- a spring flora and vegetation field survey;
- identification of the different vegetation communities on site and their boundaries;
- a search for Rare, Priority and Endangered Flora contained within the defined area;
- identification of any TECs and PECs;
- the review of data collected against criteria established in State and Federal processes for species conservation;
- the production of aerial photography with vegetation mapping and condition overlaid; and
- a final report that describes the results from the above, the potential constraints that may be posed by the vegetation given the available information and management recommendations for protection of flora.

3 METHODS

All flora surveys undertaken by ENV are designed to be compliant with the Environmental Protection Authority ('EPA') requirements for the environmental surveying and reporting of flora surveys in Western Australia, as set out in the following documents:

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

ENV then assesses and reports the results of its surveys with particular regard to the provisions of the following Commonwealth and State legislation:

- the EPBC Act 1999 (Cth)';
- the WC Act 1950 (WA); and
- the EP Act 1986 (WA).

The methodology for the work involved the following key steps:

PHASE 1

On 23 September a request for a database search was submitted to the DEC to obtain a list of Declared Rare and Priority Flora species and TECs in the surrounding area of Lot M 1822 Horton Road, Woottating and Horton Road. The search was within coordinates -31.853925, 116.33624167 and -31.8732556, 116.37393333 (GDA94).

PHASE 2

On 2nd and 3rd October an ENV botanist visited the project area and conducted a vegetation survey by traversing the site on foot. Data was collected from relévés[1] and quadrats in the survey area, and geographic coordinates noted for changes in vegetation type[2]. The sampling intensity was selected in consideration of the

[1] For the purposes of this flora and vegetation assessment, a ***relévé*** is defined as an unconfined survey area in which a general statement about the floristic composition of the location can be made.

[2] For the purposes of this flora and vegetation assessment, a vegetation unit is described on a fine scale (intra-locality).

landforms, habitat, vegetation structure, diversity and seasonality. Nine relévés and three 10m x 10m quadrats were surveyed. At each site a photograph was taken, the vegetation unit was described and a condition statement made. During the field survey, potential Declared Rare and Priority Flora populations were described and their geographic coordinates noted.

PHASE 3

Where field identification of plant taxa was not possible, specimens were collected systematically for later identification at the Western Australian Herbarium by comparison with the reference collection and use of identification keys.

Vegetation unit descriptions were then tabulated, and these communities were mapped. Due to the location of the site there is limited information on the conservation significance of vegetation communities in the area for data comparison. To try and establish the significance of the vegetation of the site, vegetation complex mapping was used along with regional mapping. For this reason it is very difficult to establish the presence of TECs however, there are no known occurrences within the surrounding area.

3.1 FLORA SURVEY LIMITATIONS AND CONSTRAINTS

It is important to note the specific constraints imposed on individual surveys. Constraints are often difficult to predict, as is the extent to which they influence survey effort. Survey constraints of the flora and vegetation survey are detailed in Table 2.

Table 1: Limitations and Constraints Associated with the Flora and Vegetation Survey

Variable	Impact on Survey Outcomes
Access Problems	No access problems were encountered
Experience levels	The botanists who executed these surveys were practitioners suitably qualified in their respective fields. • Coordinating Botanist: Narelle Whittington (Senior Environmental Scientist - Botanist); • Field Staff: Narelle Whittington; • Taxonomy: Beverly Koch (Taxonimist); • Data Interpretation: Narelle Whittington;

Variable	Impact on Survey Outcomes
Timing[3], weather, season.	The survey was undertaken in Spring on 2 and 3 October. The area had received 495.5 millimetres of rain in the year to date (Jan-Sept; Bureau of Meteorology 2008). Flora composition changes over time, with flora species having specific growing periods, especially annuals and ephemerals (some plants lasting for a markedly brief time, some only a day or two). Therefore the results of future botanical surveys in this location may differ from the results of this survey.
Completeness	Species that were insufficiently mature or dead were identified in the field to genus or family level only (where possible). A comprehensive species list has not been prepared for areas that do not constitute a natural vegetation area, such as gardens or areas that have been totally cleared.
Determination	The taxonomy and conservation status of the Western Australian flora are dynamic. This report was prepared in reliance on taxonomy and conservation current at the time, but it should be noted this may change.

3.2 PERMITS

Specimens collected during the survey were taken by permit of and subject to the conditions of the following licences issued under sections 23C and 23F of the WC Act 1950:

- SL008012 and 19-0708 Narelle Whittington.

[3] EPA Guidance Statement 51 (2004) stipulates that flora and vegetation surveys should be undertaken following the season that contributes the greatest rainfall in the region. In the Northern Province, this is after summer. In the Eremaean Province, rainfall is sporadic, and in the South-west Province the main rain is in winter, requiring surveys to be undertaken in spring. Short-term variations in normal weather patterns (e.g. drought) may necessitate supplementary survey work at other times of year or in later years to take into account temporal changes in diversity.

4 RESULTS

4.1 DATABASE SEARCH

A database search of the area resulted in 12 Declared Rare or Priority Flora species being identified as potentially occurring in the area. For a comprehensive list of species found during the database search, please refer to Appendix C.

The database search determined that there are no Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) known to occur in the area.

4.2 FIELD SURVEY

4.2.1 Flora

Thirty-four families, 84 genera and 131 taxa were recorded in the survey area (126 native flora taxa and five introduced): refer to Appendix D for the flora species list.

The plant families most frequently recorded from the survey were as follows:

- Cyperaceae 10 species;
- Papilionaceae 15 species; and
- Proteaceae 20 species.

4.2.2 Protected Flora

No Endangered or Vulnerable species pursuant to the EPBC Act were located during the survey.

No plant taxa gazetted as Declared Rare pursuant to the WC Act were located in the survey area.

No Priority Flora species were located in the survey area.

4.2.3 Vegetation

The site consisted of seven vegetation units (see Figure 2 for vegetation map and Appendix E for species vs vegetation unit matrix and Appendix F for photos):

AfEm Woodland of *Allocasuarina fraseriana, Eucalyptus marginata* over *Hibbertia hypericoides, Tetraria octandra, Banksia sessilis, Lepidosperma leptostachyum, Lepidosperma obtusum* and *Hemiandra pungens.*

Ew Open Forest of *Eucalyptus wandoo*, *Eucalyptus marginata* and *Corymbia calophylla* over *Xanthorrhoea preissii, Allocasuarina humilis, Hibbertia hypericoides, Calothamnus sanguineus, Banksia dallanneyi* var. *dallanneyi, Tetraria capillaris, Petrophile striata, Lepidosperma leptostachyum* and *Lepidosperma obtusum.*

EmCc Open Forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Hibbertia hypericoides. Banksia sessilis, Lechenaultia biloba, Lepidosperma leptostachyum, Tetraria octandra, Mesomelaena tetragona* and *Anigozanthos manglesii* with patchy occurrences of *Xanthorrhoea spp., Banksia armata, Leptospermum erubescens* and *Banksia grandis.*

Ah Open Heath of *Allocasuarina humilis* with *Banksia squarrosa, Hibbertia hypericoides, Calothamnus sanguineus, Hakea ruscifolia, Conospermum stoechadis* subsp. *Sclerophyllum, Beaufortia macrostemon, Lepidosperma leptostachyum, Lepidosperma obtusum* and *Mesomelaena tetragona* with *scattered Eucalyptus marginata* and *Corymbia calophylla.*

Em/Cc Isolated mature *Eucalyptus marginata* and/or *Corymbia calophylla.*

Le Rows of *Leptospermum erubescens.*

Ne Isolated Non-endemic trees.

For further discussion and interpretation of the site floristics, refer to Section 5.

4.2.4 Vegetation Significance

Due to the location of the site there is limited information on the conservation significance of vegetation at the community level. Therefore the process of inferring the Floristic Community Types within the site to determine the presence of any TECs does not apply, however, there are no known occurrences of TECs within the surrounding area and so it is unlikely that any occur within the site.

Currently there is also limited publicly available information on the remaining Pre-European extent of vegetation complexes outside of the Swan Coastal Plain, however, by converting Beard's vegetation complex mapping codes to those used in the Native Vegetation in Western Australia, Extent, Type and Status (Shepherd et. al., 2002) report, an estimate of the scarcity of each complex can be determined. The report states that the vegetation complex that is present within the site has 72.1% Pre-European extent remaining. (EPA 2006).

4.2.5 Vegetation Condition

The majority of the verge along Horton Road site is vegetated with the only cleared/ Completely Degraded areas being where BGC has cleared up to their fence line (length of approximately 800m) and where the vegetation has been historically cleared and now consists of grass weeds with a few isolated mature trees. The vegetation is also fragmented slightly by property access drive ways, however this is only a minor disturbance. The majority of the vegetation is in Excellent condition (85%) with approximately 5% in Very Good condition and 10% in Degraded to Completely Degraded condition (see Figure 3).

Lot M 1822 Horton Road is in Degraded to Completely Degraded condition and consists of a cleared paddock with a few patches of mature trees *(Eucalyptus marginata* and *Corymbia calophylla*) that have no native understorey species. There are also two rows of *Leptospermum erubescens* along a short distance of the access track (north west edge) (see Appendix F, photo 5), however they are also isolated and not associated with any other native species. One of the patches of *Eucalyptus marginata* and *Corymbia calophylla* has had a pile of laterite rocks dumped amongst it as well as car body parts (see Appendix F, photo 6).

The condition scale commonly used in the Perth metropolitan area and Bush Forever (Government of Western Australia 2000), was used for this assessment. The definition of the condition scales are in Appendix G.

4.2.6 Introduced Flora

The table below contains the five weed species identified during the field survey, with their ratings and criteria according to the Environmental Weed Strategy for Western Australia (refer to Appendix B for the criteria used for ranking).

Table 2: Dominant Weed Species Identified

Taxon	Common Name	Criteria			
		Rating	Invasiveness	Distribution	Impacts
**Arctotheca calendula*	Cape weed	Moderate	Yes	Yes	-
**Avena barbata*	Bearded Oat	Moderate	Yes	Yes	-
**Ehrharta calycina*	Perennial veldt grass	High	Yes	Yes	Yes
**Hypochaeris glabra*	Flat weed	Moderate	Yes	Yes	-
**Romulea rosea*	Guildford grass	High	Yes	Yes	Yes

No Declared Plant species were found in the study area.

5 DISCUSSION

Flora

During the survey, a total of 131 taxa, from 34 families and 84 genera were recorded within the survey area (126 native flora taxa and five introduced taxa).

A database search of the area resulted in 12 Declared Rare Endangered or Priority Flora species being identified as potentially occurring in the area. No Endangered or Vulnerable species under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999, Declared Rare Flora species under the Western Australian Wildlife Conservation Act 1950 or Priority Flora listed by the DEC were recorded within the project area during the field survey.

ENV considers that the potential for the site to contain Declared Rare or Priority Flora to is low. This is because the survey was undertaken in the middle of spring at peak flowering time and due to the thin (5m width on each side) linear shape of the survey site the entire area was able to be extensively traversed on foot. If any significant flora species were present on site they would have been easily located. ENV, therefore, considers the number of flora taxa reported here to be an accurate representation of what occurs on Lot M 1822 Horton Road and within the five metre boundary of Horton Road.

Introduced Flora

Only five weed species were identified during the survey, this is due to weeds not being targeted. Only dominant weeds amongst the native vegetation communities were recorded. Weeds that occurred within Lot M 1822 (paddock) were not recorded as well as minor occurrences along Horton Road due to them not influencing the condition rating of the vegetation community they occurred in, nor contributing to the overall community structure.

The recording of only five dominant weed species also reflects the excellent condition of the vegetation along Horton Road.

There were no declared weeds recorded Pursuant to Section 37 of the *Agriculture and Related Resources Protection Act 1976* (WA).

Vegetation Condition

The condition of the project area varied between Completely Degraded to Excellent. The Completely Degraded and Degraded areas are within the first 1km of the project area from the northern boundary (inclusive of Lot M 1822 and 800m of Horton Road), with the majority of the remaining area being in Very Good to Excellent condition. Given the close proximity of the vegetation to the

road (5m maximum), the disturbance level is very minimal in regards to weed infestation, erosion and human disturbances.

Floristic Community Types

The floristic communities present at the site could not be compared to any existing floristic survey results because none have been undertaken on the Darling Plateau. Due to the location of the site there is limited information on the conservation significance of vegetation in the area at the community level. Therefore the process of inferring the Floristic Community Types within the site to determine the presence of any TECs has not been applied, however, there are no known occurrences of TECs within the surrounding area and so it is unlikely that any occur within the site.

Vegetation Complexes and Regional Significance of Vegetation

When assessing the potential for vegetation clearing constraints of a particular site it is also important to understand the regional significance of the vegetation complex on the site. Vegetation complexes are defined by Heddle et al. (1980) in relation to the landform with soil units determined by Churchward and McArthur (1978). Vegetation complexes have also been mapped by Beard (1974) and by the RFA project (1998). The delineation of vegetation complexes is based on the concept of a series of plant communities forming regularly repeating complexes associated with a particular soil unit.

After assessment of vegetation, a decision can be made using Federal and State clearing policies as to whether clearing may be allowed. Current EPA guidance uses a standard level of native vegetation retention of at least 30% of the pre-clearing extent of the ecological communities within the state. These levels have been recognised in the National Objectives and Targets for Biodiversity Conservation 2001-2005 (Commonwealth of Australia 2001), which recognises that the retention of 30% or more of the pre-clearing extent of each ecological community is generally necessary if Australia's biological diversity is to be protected. This is also consistent with targets set in the EPA's Position Statement No. 2 Environmental Protection of Native Vegetation in Western Australia (EPA, 2000).

This percentage is however, modified for the Swan Coastal Plain (SCP) portion of the Perth Metropolitan Region (PMR). The objective is to seek to retain at least 10% of the pre-clearing extent of the ecological community remaining on the SCP, or retain all remaining areas of each Ecological Community in the PMR where 10% or <10% of the ecological community remains (Government of Western Australia 2000b).

Lot M 1822 Horton Road is outside of the PMR and so the 30% retention target is recommended to apply, Horton Road is located within the PMR and therefore the 10% retention target applies.

Currently there is also limited information on the remaining Pre-European extent of vegetation complexes outside of the Swan Coastal Plain, however, by converting Beard's vegetation complex mapping codes to those used in the *Native Vegetation in Western Australia, Extent, Type and Status* (Shepherd et. al., 2002) report, an estimate of the scarcity of each complex can be determined. The report states that the vegetation complex that is present within the site has 72.1% Pre-European extent remaining.

The region was also examined during the Regional Forest Agreement process and was mapped as the Cooke, Yalanbee 5 and Pinalup vegetation complexes (Mattiske and Havel, 1998). None of these vegetation complexes were listed in Review of Management Options for Poorly Represented Vegetation Complexes (Havel and Mattiske, 1998) and are therefore not considered to be high priority for conservation.

The vegetation within the study area is therefore not of conservation significance and does not need to be retained in order to meet recommended retention targets.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 SUMMARY OF FINDINGS

The flora and vegetation survey undertaken by ENV.Australia determined that:

- A total of 131 taxa, from 34 families and 84 genera were recorded within the survey area (126 native flora taxa and 5 introduced taxa).
- No Endangered or Vulnerable species under the Environment Protection and Biodiversity Conservation Act 1999, Declared Rare Flora species under the Wildlife Conservation Act 1950 or Priority Flora listed by the DEC were recorded within the project area.
- The majority of the vegetation along Horton Road is in Excellent condition (85%) with approximately 5% in Very Good condition and 10% in Degraded to Completely Degraded condition.
- Lot M 1822 Horton Road is in Degraded to Completely Degraded condition and consists of a cleared paddock with a few patches of mature trees *(Eucalyptus marginata* and *Corymbia calophylla*).
- Only five weed species were identified during the survey.
- There were no declared weeds recorded Pursuant to Section 37 of the *Agriculture and Related Resources Protection Act 1976* (WA).
- Beard (1974) mapped the area as e^{2}_{3}Mc – Jarrah (*Eucalyptus marginata*) – Marri (*Corymbia calophylla*) Forest vegetation complex which has been estimated as having 72.1% of its Pre-European extent remaining. This complex has a higher percentage than the recommended retention for areas both outside and inside the PMR.

6.2 RECOMMENDATIONS

ENV.Australia makes the following recommendations:

- Clearing of vegetation should be kept to a minimum and undertaken in a systematic way. All onsite contractors should be made aware that no disturbance to bordering vegetation outside of the necessary clearing width should be disturbed
- Locally endemic species should be used where rehabilitation or landscaping is to be undertaken.

- A buffer should, be established to protect the drainage lines that dissect the lot and a hard barrier should be erected (such as fencing) to ensure this.

6.3 CONCLUSION

ENV believes that if the road widening is kept to the minimum width and disturbance to bordering vegetation is avoided then the road widening will have a minimal impact on the flora and vegetation within the project area. Due to the degraded condition of the vegetation on Lot M 1822 ENV believes it will not pose a constraint to the proposal.

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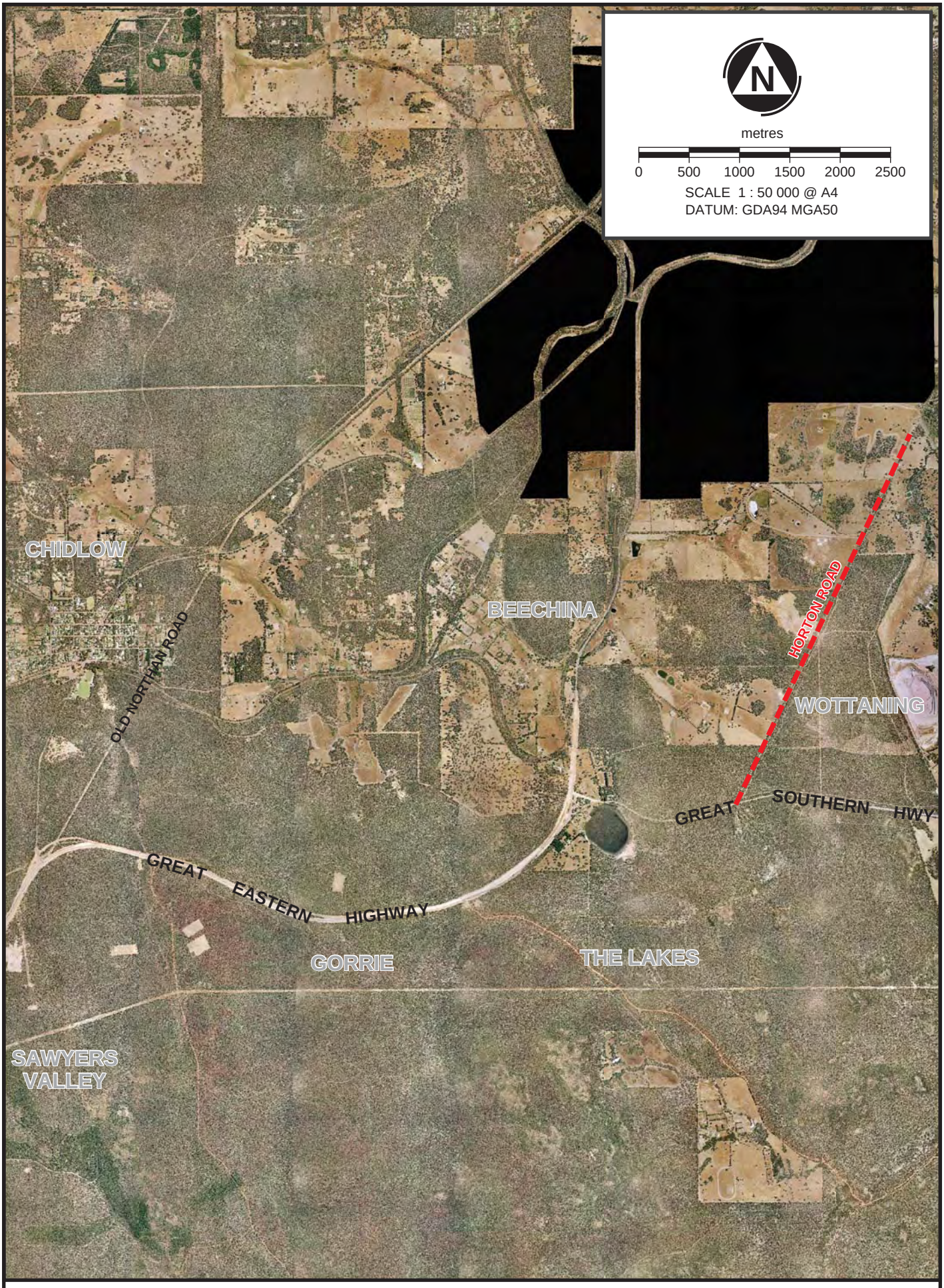
FIGURES



PRINTED: Thu 29 Jan 09

DRAWN: TE 17-12-08 AUTHOR: NW 17-12-08

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Purearth

FLORA AND VEGETATION OF WESTERN SIDE OF LOT M 1822 HORTON ROAD AND HORTON ROAD, WOOTTATING

REGIONAL LOCATION

FIGURE 1

Aerial supplied by Landgate

env Australia

N

metres

0 50 100 150 200 250

SCALE 1 : 5 000 @ A3
DATUM: GDA94 MGA 50

LEGEND

+ Q1 Quadrat Location (Not on this figure)

VEGETATION UNITS

AfEm Woodland of *Allocasuarina fraseriana, Eucalyptus marginata* over *Hibbertia hypericoides, Tetraria octandra, Banksia sessilis, Lepidosperma leptostachyum, Lepidosperma obtusum* and *Hemiandra pungens.*

Ew Open Forest of *Eucalyptus wandoo, Eucalyptus marginata* and *Corymbia calophylla* over *Xanthorrhoea preissii, Allocasuarina humilis, Hibbertia hypericoides, Calothamnus sanguineus, Banksia dallanneyi* var. *dallanneyi, Tetraria capillaris, Petrophile striata, Lepidosperma leptostachyum* and *Lepidosperma obtusum.*

EmCc Open Forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Hibbertia hypericoides Banksia sessilis, Lechenaultia biloba, Lepidosperma leptostachyum, Tetraria octandra, Mesomelaena tetragona* and *Anigozanthos manglesii* with patchy occurrences of *Xanthorrhoea* spp., *Banksia armata, Leptospermum erubescens* and *Banksia grandis.*

Ah Open heath of *Allocasuarina humilis* with *Banksia squarrosa, Hibbertia hypericoides, Calothamnus sanguineus, Hakea ruscifolia, Conospermum stoechadis* subsp. *sclerophyllum Beaufortia macrostemon, Lepidosperma leptostachyum, Lepidosperma obtusum* and *Mesomelaena tetragona* with scattered *Eucalyptus marginata* and *Corymbia calophylla.*

Em/Cc Isolated mature *Eucalyptus marginata* and/or *Corymbia calophylla.*

Le Rows of *Leptospermum erubescens.*

Ne Isolated Non-endemic trees.

Em/Cc
Ne
Em/Cc
Le
Em/Cc
Em/Cc
EmCc
EmCc
Ah
OVERLAP TO SHEET 2b

Aerial supplied by Landgate

FIGURE 2a

Purearth
FLORA AND VEGETATION OF WESTERN SIDE OF
LOT M 1822 HORTON ROAD AND HORTON ROAD, WOOTTATING
VEGETATION AND QUADRAT LOCATIONS
FIGURE 2a

env Australia

N

metres

0 50 100 150 200 250

SCALE 1 : 5 000 @ A3

DATUM: GDA94 MGA 50

LEGEND

+ Q1 Quadrat Location

VEGETATION UNITS

AfEm Woodland of *Allocasuarina fraseriana, Eucalyptus marginata* over *Hibbertia hypericoides, Tetraria octandra, Banksia sessilis, Lepidosperma leptostachyum, Lepidosperma obtusum* and *Hemiandra pungens.*

Ew Open Forest of *Eucalyptus wandoo, Eucalyptus marginata* and *Corymbia calophylla* over *Xanthorrhoea preissii, Allocasuarina humilis, Hibbertia hypericoides, Calothamnus sanguineus, Banksia dallanneyi* var. *dallanneyi, Tetraria capillaris, Petrophile striata, Lepidosperma leptostachyum* and *Lepidosperma obtusum.*

EmCc Open Forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Hibbertia hypericoides Banksia sessilis, Lechenaultia biloba, Lepidosperma leptostachyum, Tetraria octandra, Mesomelaena tetragona* and *Anigozanthos manglesii* with patchy occurrences of *Xanthorrhoea* spp., *Banksia armata, Leptospermum erubescens* and *Banksia grandis.*

Ah Open heath of *Allocasuarina humilis* with *Banksia squarrosa, Hibbertia hypericoides, Calothamnus sanguineus, Hakea ruscifolia, Conospermum stoechadis* subsp. *sclerophyllum Beaufortia macrostemon, Lepidosperma leptostachyum, Lepidosperma obtusum* and *Mesomelaena tetragona* with scattered *Eucalyptus marginata* and *Corymbia calophylla.*

Em/Cc Isolated mature *Eucalyptus marginata* and/or *Corymbia calophylla.*

Le Rows of *Leptospermum erubescens.*

Ne Isolated Non-endemic trees.

OVERLAP TO SHEET 2a

Ah

EmCc

Q1

Ew

AfEm

Q2

AfEm

EmCc

Q3

EmCc

GREAT SOUTHERN HIGHWAY

Aerial supplied by Landgate

FIGURE 2b

Purearth

FLORA AND VEGETATION OF WESTERN SIDE OF LOT M 1822 HORTON ROAD AND HORTON ROAD, WOOTTATING

VEGETATION AND QUADRAT LOCATIONS

FIGURE 2b

env Australia

N

metres

0 50 100 150 200 250

SCALE 1 : 1 000 @ A3

DATUM: GDA94 MGA 50

LEGEND

VEGETATION CONDITION

(Legend Source: BUSH FOREVER Govt. of W.A.)

P	Pristine. (Not Applicable)
Ex	Excellent.
VG	Very Good.
G	Good.
D	Degraded.
CD	Completely Degraded.

NOTE: For full description see text.

D-CD

D

E

E

VG

E

OVERLAP TO SHEET 2b

Aerial supplied by Landgate

FIGURE 3a

Purearth

FLORA AND VEGETATION OF WESTERN SIDE OF LOT M 1822 HORTON ROAD AND HORTON ROAD, WOOTTATING

CONDITION

FIGURE 3a

env Australia

N

metres

0 50 100 150 200 250

SCALE 1 : 5 000 @ A3

DATUM: GDA94 MGA 50

LEGEND

VEGETATION CONDITION

(Legend Source: BUSH FOREVER Govt. of W.A.)

P	Pristine. (Not Applicable)
Ex	Excellent.
VG	Very Good.
G	Good.
D	Degraded.
CD	Completely Degraded.

NOTE: For full description see text.

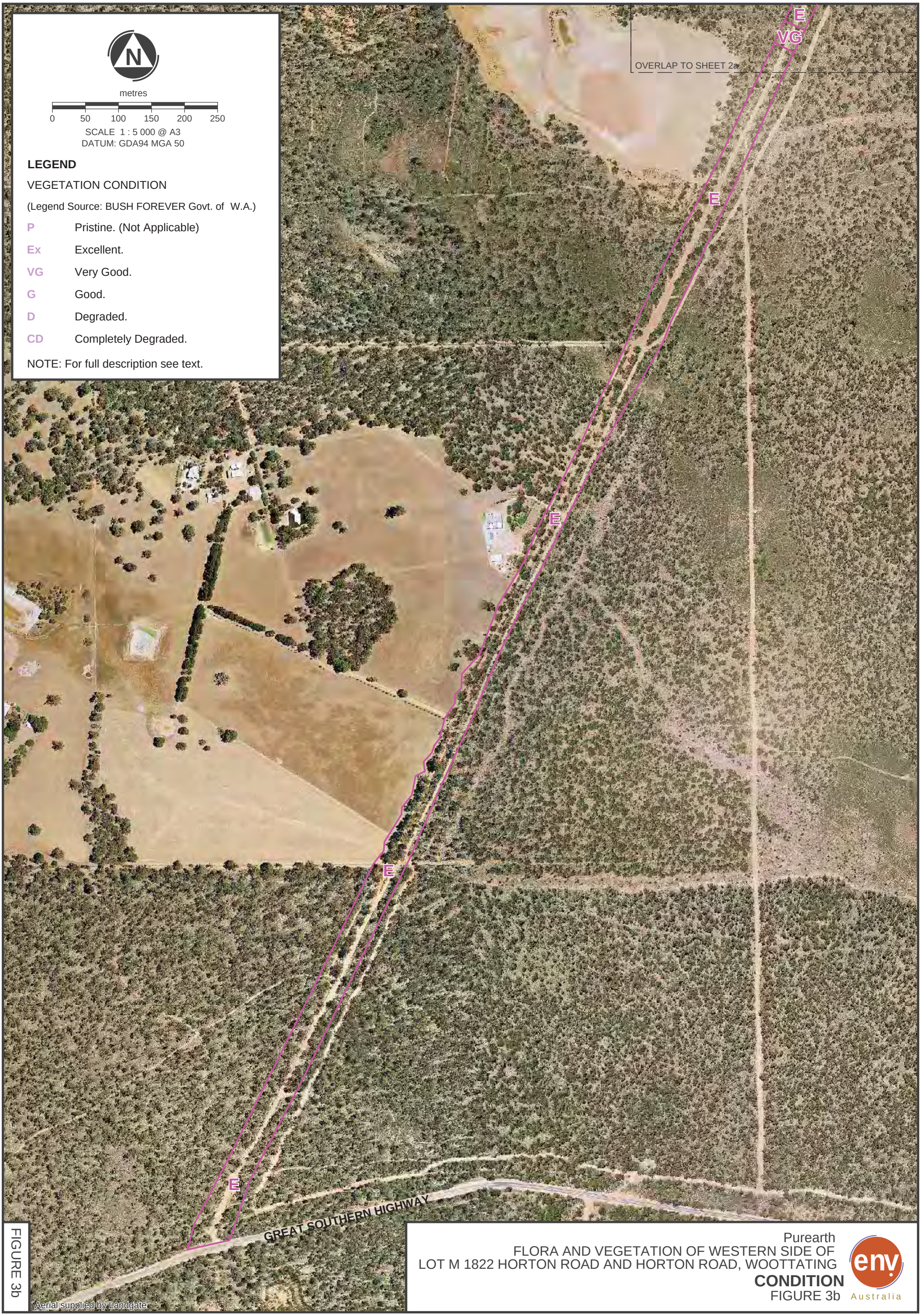

FIGURE 3b

Aerial supplied by Landgate

Purearth

FLORA AND VEGETATION OF WESTERN SIDE OF LOT M 1822 HORTON ROAD AND HORTON ROAD, WOOTTATING

CONDITION

FIGURE 3b

env Australia

08-315 sheet 1.dgn DRAWN: TE 7-10-08 AUTHOR: DB 7-10-08 PRINTED: Tue 07 Oct 08

N

metres

0 20 40 60 80 100

SCALE 1 : 2 000 @ A3

DATUM: MGA 50

437 400 E

437 500 E

437 600 E

437 700 E

6 473 600 N

6 473 500 N

6 473 400 N

6 473 300 N

6 473 200 N

Horton Road

GREAT SOUTHERN HIGHWAY

SHEET 1

AERIAL SOURCE: DLI

LOT M 1822 HORTON ROAD
SHIRE OF NORTHAM AND MUNDARING
FAUNA SURVEY

BASE MAPPING

FIGURE 1

env Australia

LOT M 1822 HORTON ROAD
SHIRE OF NORTHAM AND MUNDARING
FAUNA SURVEY

BASE MAPPING

FIGURE 1

env Australia

08-315 sheet 3.dgn DRAWN: TE 7-10-08 AUTHOR: DB 7-10-08 PRINTED: Tue 07 Oct 08

SHEET 3

LOT M 1822 HORTON ROAD
SHIRE OF NORTHAM AND MUNDARING
FAUNA SURVEY

BASE MAPPING

FIGURE 1

env Australia


N
metres
0 20 40 60 80 100
SCALE 1 : 2 000 @ A3
DATUM: MGA 50
438 300 E
438 400 E
438 500 E
438 600 E
6 475 600 N
6 475 500 N
6 475 400 N
6 475 300 N
6 475 200 N
6 475 100 N
Horton Road
SHEET 4
AERIAL SOURCE: DLI
Joins Sheet 3
LOT M 1822 HORTON ROAD
SHIRE OF NORTHAM AND MUNDARING
FAUNA SURVEY
BASE MAPPING
FIGURE 1
env Australia

APPENDIX A

DEFINITIONS OF DECLAREDRARE AND PRIORITY FLORA AND THREATENED/ PRIORITY ECOLOGICAL COMMUNITIES

FLORA AND VEGETATION ASSESSMENT

APPENDIX A

DEFINITIONS OF DECLARED REARE AND PRIORITY FLORA AND THREATENED / PRIORITY ECOLOGICAL COMMUNITIES

Appendix A1: Environment Protection and Biodiversity Conservation Act 1999 (Cth): Threatened Species and Threatened Ecological Communities Codes

The EPBC Act prescribes seven matters of national environmental significance:-

- World Heritage properties
- National Heritage places
- Wetlands of international importance
- Threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- Nuclear actions (including uranium mining)

Species in the categories ExW, CE, E and V (see below), and Threatened Ecological Communities in the CE and E categories are protected as matters of national environmental significance under the EPBC Act.

Category Code	Category
Ex	**Extinct** Taxa for which there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa known to survive only in cultivation, in captivity or as a naturalised population well outside its past range; or not recorded in its known and/or expected habitat at appropriate seasons anywhere in its past range despite exhaustive surveys over a timeframe appropriate to its life cycle and form.
CE	**Critically Endangered** Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** Taxa not critically endangered and facing a very high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Category Code	Category
V	**Vulnerable** Taxa not critically endangered or endangered and facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria**.**
CD	**Conservation Dependent** Taxa which are the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within five years.

Appendix A2 - Definition of Rare and Priority Flora Species (Department of Environment and Conservation)

Conservation Code	Category
X	**Declared Rare Flora - Presumed Extinct Taxa** 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.
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 known from one or a few (generally <5) populations which are under threat, either because of 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 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 urgently need further survey.
P3	**Priority Three - Poorly Known Taxa** Taxa known from several populations, and not believed to be under immediate threat (i.e. not currently endangered), either because of 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 - Rare Taxa** Taxa 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.

Appendix A3: Definition of Threatened Ecological Communities

(Department of Environment and Conservation 2007)

Presumed Totally Destroyed (PD)

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):

A) records within the last 50 years have not been confirmed despite thorough searches or known or likely habitats;

B) all occurrences recorded within the last 50 years have since been destroyed.

Critically Endangered (CR)

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):

A) the estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii):

   i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 5 years);
   ii) modification throughout its range is continuing such that in the immediate future (within approximately 5 years) the community is unlikely to be capable of being substantially rehabilitated.

B) current distribution is limited, and one or more of the following apply (i, ii or iii):

   i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 5 years);
   ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;
   iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.

C) the ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the immediate future (within approximately 5 years).

Endangered (EN)

An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):

A) the estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 70% and either or both of the following apply (i or ii):

i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term (within approximately 10 years);
ii) modification throughout its range is continuing such that in the short term future (within approximately 10 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) current distribution is limited, and one or more of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 10 years);
ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;
iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.

C) the ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the short term future (within approximately 10 years).

Vulnerable (VU)

An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction in the medium to long term future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):

A) the ecological community exists largely as modified occurrences which are likely to be capable of being substantially restored or rehabilitated;

B) the ecological community can be modified or destroyed and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations;

C) the ecological community may still be widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Appendix A4: Definition of Priority Ecological Communities
(Department of Environment and Conservation 2007)

Priority One (P1) Poorly known ecological communities:

Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two (P2) Poorly known ecological communities:

Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three (P3) Poorly known ecological communities:

(i) communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:
(ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
(iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four (P4) Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring:

(a) Rare: ecological communities known from few occurrences 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 communities are usually represented on conservation lands.

(b) Near Threatened: ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

(c) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five (P5) Conservation dependent ecological communities:

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX B

STANDARD MEANINGS OF ENVIRONMENTAL WEED AND DECLARED PLANT CATEGORIES AND CRITERIA USED FOR RANKING ENVIRONMENTAL WEEDS

APPENDIX B

STANDARD MEANINGS OF DECLARED PLANT CATEGORIES

P1

Prohibits movement.

The movement of plants or their seeds is prohibited within the State.

This prohibits the movement of contaminated machinery and produce including livestock and fodder.

P2

Aim is to eradicate infestation.

Treat all plants 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

Aims to control infestation by reducing area and/or density of infestation.

The infested area must be managed 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:

* Within 50m inside of the boundaries of the infestation;

* within 50m of roads and high water mark on waterways;

* within 50m of sheds, stock yards and houses.

Treatment must be done prior to seed set each year.

Properties with less than 20ha of infestation must treat the entire infestation.

Additional areas may be ordered to be treated.

P4

Aims to prevent infestation spreading beyond existing boundaries of infestation

The infested area must be managed 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:

* within 50m inside of the boundaries of the infested property for one-leaf and 20m for two-leaf;

* within 50m of roads and high water mark on waterways;

* within 50m of sheds, stock yards and houses.

Treatment must be done prior to seed set each year. Properties with less than 20ha of infestation must treat the entire infestation.

Additional areas may be ordered to be treated.

Special considerations.

In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas.

P5

Aims to control infestations on public lands.

APPENDIX C

DEC DATABASE SEARCH RESULTS

APPENDIX C

DEC DATABASE SEARCH RESULTS

pTaxa	State Conservation Code	Commonwealth Conservation Code
Acacia oncinophylla subsp. *oncinophylla*	P3	
Adenanthos cygnorum subsp. *chamaephyton*	P3	
Anthocercis gracilis	R	Vulnerable
Banksia micrantha	P3	
Cyanicula ixioides subsp. *candida*	P2	
Cyanicula ixioides subsp. *ixioides*	P4	
Eucalyptus loxophleba x *wandoo*	P4	
Grevillea manglesii subsp. *ornithopoda*	P2	
Grevillea pimeleoides	P4	
Senecio leucoglossus	P4	
Synaphea diabolica	P3	
Templetonia drummondii	P4	

APPENDIX D
FLORA SPECIES LIST

APPENDIX D
FLORA SPECIES LIST

POACEAE		Amphipogon	amphipogonoides
	*	Avena	barbata
	*	Ehrharta	calycina
		Neurachne	alopecuroidea
CYPERACEAE		Gahnia	aristata
		Lepidosperma	leptostachyum
		Lepidosperma	obtusum
		Lepidosperma	squamatum
		Lepidosperma	tenue
		Mesomelaena	graciliceps
		Mesomelaena	pseudostygia
		Mesomelaena	tetragona
		Tetraria	capillaris
		Tetraria	octandra
RESTIONACEAE		Desmocladus	fasciculatus
		Lepidobolus	preissianus subsp. preissianus
DASYPOGONACEAE		Lomandra	hermaphrodita
		Lomandra	preissii
		Lomandra	purpurea
		Lomandra	spartea
XANTHORRHOEACEAE		Xanthorrhoea	gracilis
		Xanthorrhoea	preissii
PHORMIACEAE		Dianella	revoluta
ANTHERICACEAE		Borya	sphaerocephala
		Laxmannia	grandiflora subsp. grandiflora
HAEMODORACEAE		Anigozanthos	manglesii
		Conostylis	serrulata
		Conostylis	setigera
		Conostylis	setosa
		Corymbia	calophylla
		Haemodorum	sp.
IRIDACEAE		Patersonia	juncea
		Patersonia	occidentalis
		Patersonia	pygmaea
	*	Romulea	rosea
ORCHIDACEAE		Caladenia	flava
		Elythranthera	brunonis
		Microtis	media subsp. media
		Pterostylis	recurva
		Thelymitra	crinita
CASUARINACEAE		Allocasuarina	fraseriana
		Allocasuarina	humilis
PROTEACEAE		Adenanthos	barbiger
		Adenanthos	cygnorum subsp. cygnorum
		Banksia	bipinnatifida subsp. bipinnatifida

APPENDIX D
FLORA SPECIES LIST

	Banksia	dallanneyi var. dallanneyi
	Banksia	grandis
	Banksia	sessilis
	Banksia	squarrosa
	Conospermum	stoechadis subsp. sclerophyllum
	Grevillea	quercifolia
	Grevillea	synapheae subsp. synapheae
	Hakea	costata
	Hakea	incrassata
	Hakea	lissocarpha
	Hakea	ruscifolia
	Hakea	stenocarpa
	Hakea	undulata
	Isopogon	sp. Darling Range (F. Hort 1662)
	Petrophile	striata
	Stirlingia	latifolia
	Synaphea	decorticans
AMARANTHACEAE	Ptilotus	polystachyus
DROSERACEAE	Drosera	erythrorhiza
	Drosera	pallida
	Drosera	stolonifera
MIMOSACEAE	Acacia	barbinervis subsp. barbinervis
	Acacia	nervosa
	Acacia	stenoptera
CAESALPINIACEAE	Labichea	punctata
PAPILIONACEAE	Bossiaea	ornata
	Daviesia	decurrens
	Daviesia	hakeoides subsp. subnuda
	Daviesia	preissii
	Daviesia	rhombifolia
	Dillwynia	laxiflora
	Gastrolobium	retusum
	Gastrolobium	villosum
	Gompholobium	knightianum
	Gompholobium	marginatum
	Gompholobium	preissii
	Gompholobium	tomentosum
	Hovea	chorizemifolia
	Jacksonia	floribunda
	Kennedia	coccinea
RUTACEAE	Boronia	ramosa subsp. anethifolia
TREMANDRACEAE	Tetratheca	hirsuta
POLYGALACEAE	Comesperma	ciliatum
EUPHORBIACEAE	Monotaxis	grandiflora var. grandiflora
	Phyllanthus	calycinus
	Poranthera	ericoides

APPENDIX D
FLORA SPECIES LIST

STERCULIACEAE	Thomasia	grandiflora
DILLENIACEAE	Hibbertia	? sp. Gnangara (J. R. Wheeler 2329)
	Hibbertia	hypericoides
	Hibbertia	lasiopus
THYMELAEACEAE	Pimelea	preissii
	Pimelea	suaveolens subsp. suaveolens
MYRTACEAE	Baeckea	camphorosmae
	Beaufortia	macrostemon
	Calothamnus	sanguineus
	Calytrix	variabilis
	Eucalyptus	marginata
	Eucalyptus	wandoo subsp. wandoo
	Leptospermum	erubescens
HALORAGACEAE	Glischrocaryon	aureum
	Gonocarpus	cordiger
APIACEAE	Pentapeltis	peltigera
	Trachymene	pilosa
	Xanthosia	candida
EPACRIDACEAE	Astroloma	ciliatum
	Astroloma	pallidum
	Leucopogon	nutans
	Leucopogon	pulchellus
	Styphelia	tenuifolia
LOGANIACEAE	Logania	micrantha
LAMIACEAE	Hemiandra	pungens
RUBIACEAE	Opercularia	vaginata
GOODENIACEAE	Dampiera	alata
	Dampiera	linearis
	Lechenaultia	biloba
STYLIDIACEAE	Levenhookia	pusilla
	Stylidium	amoenum
	Stylidium	brunonianum
	Stylidium	junceum
	Stylidium	piliferum
ASTERACEAE	* Arctotheca	calendula
	Hyalosperma	cotula
	* Hypochaeris	glabra
	Pterochaeta	paniculata
	Trichocline	spathulata
	Ursinia	anthemoides

APPENDIX E
SPECIES VS VEGETATION UNIT MATRIX

APPENDIX E
SPECIES vs VEGETATION UNIT MATRIX

	Vegetation Units			
Taxa	**AfEm**	**Ah**	**EmCc**	**Ew**
Acacia barbinervis subsp. *barbinervis*			+	
Acacia nervosa			+	
Acacia stenoptera	+			
Adenanthos barbiger	+			
Adenanthos cygnorum subsp. *cygnorum*			+	
Allocasuarina fraseriana	+		+	
Allocasuarina humilis		+	+	+
Amphipogon amphipogonoides			+	
Anigozanthos manglesii			+	
Arctotheca calendula			+	
Astroloma ciliatum				+
Astroloma pallidum			+	+
**Avena barbata*			+	
Baeckea camphorosmae		+	+	
Banksia armata	+	+	+	
Banksia bipinnatifida subsp. *bipinnatifida*			+	
Banksia dallanneyi var. *dallanneyi*	+		+	+
Banksia grandis	+		+	
Banksia sessilis	+		+	
Beaufortia macrostemon		+		+
Boronia ramosa subsp. *anethifolia*			+	
Borya sphaerocephala	+	+		
Bossiaea ornata	+		+	+
Caladenia flava			+	+
Calothamnus sanguineus		+	+	+
Calytrix variabilis			+	
Comesperma ciliatum				+
Conospermum stoechadis subsp. *sclerophyllum*	+	+	+	
Conostylis serrulata			+	+
Conostylis setigera	+		+	+
Conostylis setosa			+	
Corymbia calophylla		+	+	+
Dampiera alata		+	+	
Dampiera linearis	+		++	+
Daviesia decurrens		+	+	+
Daviesia hakeoides subsp. *subnuda*			+	
Daviesia preissii	+		+	
Daviesia rhombifolia	+		+	
Desmocladus fascicularis			+	
Desmocladus fasciculatus			+	+
Dianella revoluta			+	
Dillwynia laxiflora	+		+	
Drosera erythrorhiza			+	
Drosera pallida			+	
Drosera stolonifera	+		+	
**Ehrharta calycina*			+	
Elythranthera brunonis			+	
Eucalyptus marginata	+	+	+	+
Eucalyptus wandoo subsp. *wandoo*				+
Gahnia aristata				+
Gastrolobium retusum				+
Gastrolobium villosum				+
Glischrocaryon aureum	+	+	+	

APPENDIX E
SPECIES vs VEGETATION UNIT MATRIX

	Vegetation Units			
Taxa	**AfEm**	**Ah**	**EmCc**	**Ew**
Gompholobium knightianum	+		+	
Gompholobium marginatum	+		+	+
Gompholobium preissii			+	+
Gompholobium tomentosum			+	
Gonocarpus cordiger			+	+
Grevillea quercifolia			+	
Grevillea synapheae subsp. *synapheae*	+		+	
Haemodorum sp.			+	+
Hakea costata			+	
Hakea incrassata				+
Hakea lissocarpha	+		+	+
Hakea ruscifolia	+	+	+	
Hakea stenocarpa			+	+
Hakea undulata				+
Hemiandra pungens	+		+	
Hibbertia ? sp. Gnangara (J. R. Wheeler 2329)	+		+	
Hibbertia hypericoides	+	+	+	+
Hibbertia lasiopus	+		+	+
Hovea chorizemifolia	+		+	
Hyalosperma cotula			+	
**Hypochaeris glabra*			+	
Isopogon sp. Darling Range (F. Hort 1662)	+			
Jacksonia floribunda		+		
Kennedia coccinea			+	
Labichea punctata	+		+	
Laxmannia grandiflora subsp. *grandiflora*	+		+	
Lechenaultia biloba	+		+	
Lepidobolus preissianus subsp. *preissianus*			+	
Lepidosperma leptostachyum	+	+	+	+
Lepidosperma obtusum	+	+	+	+
Lepidosperma squamatum			+	
Lepidosperma tenue	+		+	
Leptospermum erubescens		+	+	
Leucopogon nutans	+	+	+	
Leucopogon pulchellus				+
Levenhookia pusilla			+	
Logania micrantha		+		
Lomandra hermaphrodita	+		+	
Lomandra preissii			+	
Lomandra purpurea	+		+	
Lomandra spartea				+
Mesomelaena graciliceps			+	
Mesomelaena pseudostygia			+	
Mesomelaena tetragona		+	+	
Microtis media subsp. *media*				+
Monotaxis grandiflora var. *grandiflora*			+	
Neurachne alopecuroidea	+	+	+	+
Opercularia vaginata	+		+	
Patersonia juncea			+	
Patersonia occidentalis	+		+	+
Patersonia pygmaea				+
Pentapeltis peltigera	+		+	
Petrophile striata			+	+

APPENDIX E
SPECIES vs VEGETATION UNIT MATRIX

	Vegetation Units			
Taxa	**AfEm**	**Ah**	**EmCc**	**Ew**
Phyllanthus calycinus	+			
Pimelea preissii			+	
Pimelea suaveolens subsp. *suaveolens*			+	
Poranthera ericoides	+		+	
Pterochaeta paniculata	+		+	
Pterostylis recurva			+	+
Ptilotus polystachyus			+	
**Romulea rosea*			+	
Stirlingia latifolia	+		+	
Stylidium amoenum	+			+
Stylidium brunonianum	+		+	+
Stylidium junceum	+		+	
Stylidium piliferum			+	
Styphelia tenuifolia			+	+
Synaphea decorticans	+		+	
Tetraria capillaris	+			+
Tetraria octandra	+	+	+	+
Tetratheca hirsuta			+	+
Thelymitra crinita	+		+	+
Thomasia grandiflora				+
Trachymene pilosa			+	
Trichocline spathulata	+		+	+
Ursinia anthemoides			+	
Xanthorrhoea gracilis	+		+	
Xanthorrhoea preissii			+	+
Xanthosia candida	+		+	

APPENDIX F
SITE PHOTOGRAPHS

APPENDIX F

SITE PHOTOGRAPHS

Photo 1: Quadrat 1 – Vegetation Unit Ew

Photo 2: Quadrat 2 – Vegetation Unit AfEm

Photo 3: Quadrat 3 – Vegetation Unit EmCc

Photo 4: Vegetation Unit Ah

Photo 5: Lot M 1822 - Rows of *Leptospermum erubescens* on side of track.

Photo 6: Isolated clump of *Eucalyptus marginata* and *Corymbia calophyla* in the middle of Lot M 1822, used for stockpiling laterite boulders and car parts

APPENDIX G
BUSH FOREVER CONDITION SCALES

APPENDIX G

Bush Forever Condition Scales

Condition scale used in BUSH FOREVER VOL 2, from Keighery BJ (1994)	Condition scale used to derive Keighery BJ (1994) and Connell (1995) after Trudgen (1991)	Condition scale used in PEP MAPPING after Connell (1995)
Pristine (1) Pristine or nearly so, no obvious signs of disturbance	**Excellent (E)** Pristine or nearly so, no obvious signs of damage caused by the activities of European man.	No equivalent unit.
Excellent (2) Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.	**Very Good (VG)** Some relatively slight signs of damage caused by the activities of European man. For example, some signs of damage to tree trunks caused by repeated fires and the presence of some relatively non-aggressive weeds such as *Ursinia anthemoides* or *Briza* species, or occasional vehicle tracks.	**Very Good (VG)** Evidence of localised low level damage to otherwise healthy bush. Seedling recruitment and generally healthy population size (age/stage) structure apparent. Weed and grazing damage is confined (<20% of area). Some modification to vegetation structure due to changes in fire regimes may be apparent. Evidence of logging or firewood collection may be found. High likelihood that vegetation structure and species richness can be maintained.
Very Good (3) 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 (G)** More obvious signs of damage caused by the activities of European man, including some obvious impact on the vegetation structure such as caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones.	**Good (g)** Evidence of localised high level damage to otherwise low level damaged bush. Recruitment is localised and the populations of some species may be senescent. Weed and grazing damage is apparent in 20-50% of the area. Modification to vegetation structure due to changes in fire regimes may be apparent. Localised gall and parasitic plant damage may be apparent. Evidence of logging or firewood collection. Moderate likelihood that vegetation structure and species richness can be maintained.
Good (4) Vegetation structure significantly altered by very obvious signs of multiple disturbance. 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.	**Poor (P)** Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of activities of European man such as grazing or partial clearing (chaining) or very frequent fires. Weeds as above, probably plus some more aggressive ones such as *Ehrharto* species.	**Poor (p)** Widespread high level damage. Recruitment is disrupted and most woody species appear senescent. Weed and grazing damage may be apparent throughout >50% of the area. Modification to vegetation structure due to changes in fire regimes may be apparent. Locally some vertical strata are absent. Gall and mistletoe damage apparent. Evidence of logging or firewood collection. Low likelihood that vegetation structure and species richness can be maintained or re-established.
Degraded (5) 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 very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	**Very Poor (VP)** Severely impacted by grazing, fire, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species including aggressive species.	**Very Poor (p)** Widespread high level damage. Recruitment is disrupted and most species appear senescent. Weed and grazing damage apparent throughout the area. Modification to vegetation structure due to changes in fire regimes apparent. Widespread loss of vertical strata. Gall and mistletoe damage apparent. Evidence of logging or firewood collection. Little to no likelihood that vegetation structure and species richness can be re-established.
Completely Degraded (6) 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.	**Completely Degraded (D)** Area that are completely or almost completely without native species in the structure of their vegetation, i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.	Not used – does not apply to bushland.

FAUNA AND HABITAT ASSESMENT OF THE WESTERN SIDE OF LOT M 1822 HORTON ROAD, WOOTTATING, AND 5 M EACH SIDE OF HORTON ROAD

Prepared for

PUREARTH

Job No: 08.315

Report No: RP002

Australia

FAUNA AND HABITAT ASSESMENT OF THE WESTERN SIDE OF LOT M 1822 HORTON ROAD, WOOTTATING, AND 5 M EACH SIDE OF HORTON ROAD

Prepared for

PUREARTH

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Content Review:	*Teresa Gepp*
Date:	*29 January 2009*

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STATEMENT OF LIMITATIONS

Scope of Services

This environmental site assessment report ('the report') has been prepared in accordance with the scope of services set out in the contract or as otherwise agreed between the Client and ENV.Australia Pty Ltd (ENV) (the 'scope of services'). In some circumstances the scope of services may have been limited by factors such as time, budget, access and/or site disturbance constraints.

Reliance on Data

In preparing the report, ENV has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations ('the data'), most of which are referred to in the report. Except as otherwise stated in the report, ENV has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ('conclusions') are based in whole or in part on the data, those conclusions are dependent on the accuracy and completeness of the data. ENV will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, unavailable, withheld, unavailable, misrepresented or otherwise not fully disclosed to ENV.

Environmental Conclusions

In accordance with the scope of services, ENV has relied on the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, express or implied, is made.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and for no other party. ENV assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of ENV or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report). Other parties should not rely on the report or the accuracy or completeness of any conclusions, and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

ENV will not be liable to update or revise the report to take into account any events occurring, or circumstances or facts becoming apparent, after the date of the report.

EXECUTIVE SUMMARY

ENV.Australia Pty Ltd was commissioned in September 2008 to undertake a biological assessment survey of the western side of Lot M 1822 Horton Road, Woottating, and five metres either side of Horton Road. The purpose of the survey was to produce a detailed fauna and habitat report to accompany referral documents that will be submitted to the Environmental Protection Authority, with the aim of developing the site as a compost facility and widening the access road.

Five habitat types were identified on the landforms in the project area: Open Forest, Woodland, Open Heath, Pastoral and Creek Bed. These habitat types were assessed for their value as fauna habitats and for the conservation-significant fauna they may support.

Of the five habitat types, the Open Forest and Minor Drainage are considered of the highest value as fauna habitat. Woodland and Open Heath are considered of medium value, while the Pastoral habitat is considered to be of the lowest value.

Of the 195 fauna species assessed as potentially occurring in the area, 37 were recorded in the project area during the fauna survey, comprising eight mammal species, five reptile species, three amphibian species and 21 bird species.

Of seven native mammal species recorded during the survey, one - the Quenda (*Isoodon obesulus fusciventer*) - is of conservation significance (Department of Environment and Conservation Priority 5).

Of the five species of reptiles recorded in the project area, none are of conservation significance.

No recorded species of amphibians in the project area are of conservation significance.

Of the 102 bird species that potentially occur in the project area, five are protected by the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act); four are listed under the Wildlife Conservation Act; three are listed as Priority taxa by the Department of Environment and Conservation; and three are regarded as being of local significance.

Four species of bird listed under the EPBC Act 1999 potentially occur in the project area: Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Muir's Corella (*Cacatua pastinator pastinator*), the Forked-tailed Swift (*Apus pacificus*) and the Rainbow Bee-eater (*Merops ornatus*).

Four birds are listed under the Wildlife Conservation Act 1950: the Peregrine Falcon (*Falco peregrinus*), Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*), and Muir's Corella (*Cacatua pastinator pastinator)*. Three birds that potentially occur in the project area are listed as Priority species by the DEC: the Barking Owl (*Ninox connivens connivens*), the Masked Owl (*Tyto*

novaehollandiae novaehollandiae) and the south-western subspecies of the Crested Shrike-tit (*Falcunculus frontatus leucogaster*).

Additionally, a search was undertaken for the *Gauis species* of trapdoor spider. No records of the spider were made during the survey, however suitable habitat was present and it is possible that it occurs in small parts of the project area.

Analysis of the results of the fauna survey indicates that the project area has some habitat value for certain conservation-significant fauna taxa, some of which are protected by State and/or Commonwealth legislation. In ENV's view the presence of these species constrains, but will not necessarily prohibit, the proposal. This report includes recommendations for measures to manage and mitigate possible adverse effects of the proposed development on these taxa.

Given the presence of fauna species of State and Federal significance in the project area, the proposal may require referrals under State and Federal environmental approvals processes. ENV recommends that discussions with the relevant agencies be commenced as early as possible in relation to the findings of the fauna survey and the likelihood of additional assessment being required.

1 INTRODUCTION

1.1 THE PROJECT

1.1.1 Objectives

ENV.Australia Pty Ltd ('ENV') was commissioned in September 2008 by Bowman and Associates Pty Ltd on behalf of Purearth to undertake a biological assessment survey of the western side of Lot M 1822 Horton Road, Woottating, and the Horton Road corridor ('the project area'). The purpose of the survey was to produce a detailed fauna and habitat report to accompany referral documents that will be submitted to the Environmental Protection Authority ('EPA'). Purearth seek to develop the site as a compost facility and also to widen the access road.

This biological assessment comprises the findings of a Level One flora survey (ENV 2008) and a Level One fauna survey (reported here) in accordance with *Guidance Statements No. 51* and *56* (EPA 2004a, b). The fauna component includes:

- a database search for Threatened and Specially Protected Fauna that may occur in the area;
- an assessment of land forms and associated vegetation communities that may comprise fauna habitats of conservation significance;
- a search for Threatened and Specially Protected Fauna including invertebrate fauna contained within the defined area as identified during the approval process for the BGC Voyager Quarry expansion;
- a final report that describes the results from the above, the potential constraints that may be posed by the fauna given the available information and management recommendations for protection of fauna.

1.1.2 Location

Horton Road and Lot M 1822 Horton Road, Woottating is approximately 55 km east of Perth, in the Shire of Northam(Figure 1). The site is adjacent to private property, BGC-owned land and land zoned Parks and Recreation (restricted).

1.2 PHYSICAL ENVIRONMENT

1.2.1 Climate

The project area is in the Darling System of Western Australia (Churchward & McArthur 1978). This region has a temperate climate with four seasons. The area experiences a wide range of temperatures throughout the year, with an average

temperature of 24.5°C. During summer, maximum temperatures may reach a high of 44.0°C, while in winter minimum temperatures may be as low as 0.0°C (Bureau of Meteorology [BoM] 2008).

Rainfall in the Darling System occurs primarily in the winter. Northam, approximately 30 km away, has average annual rainfall of 429 mm (Figure 2).

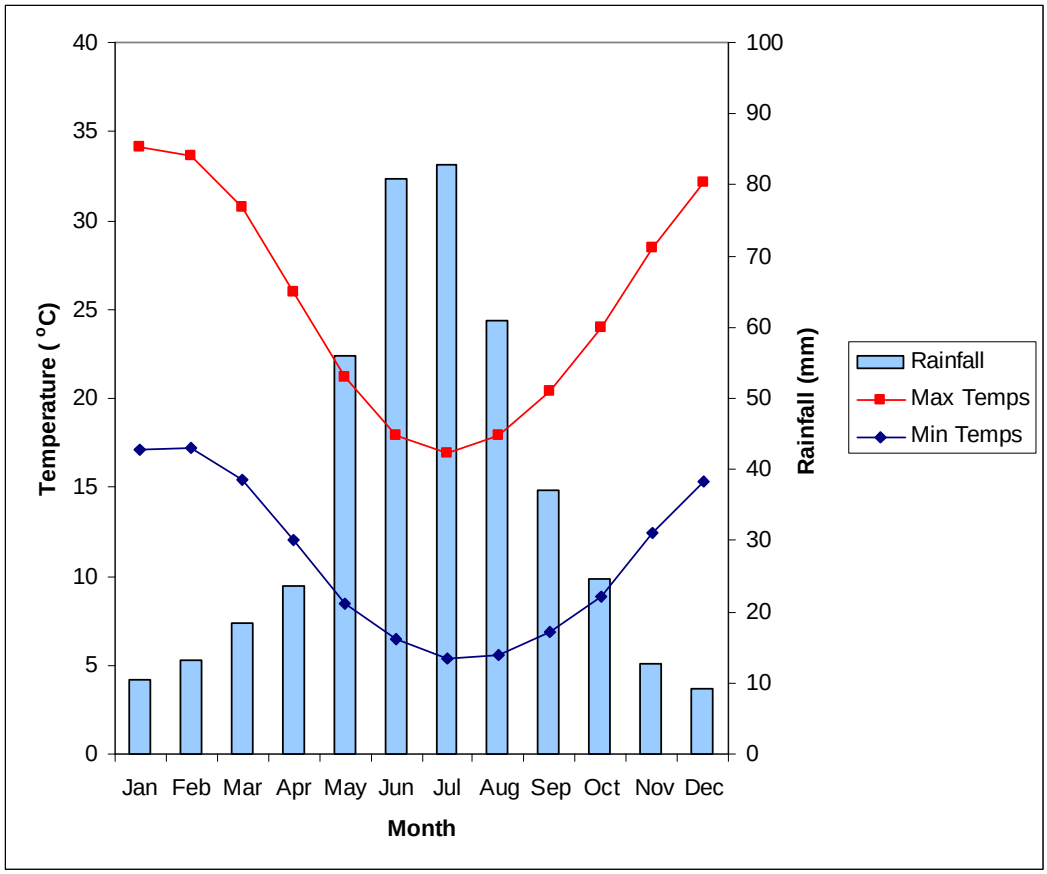

Figure 2: Average monthly rainfall and maximum and minimum temperatures for Northam (BoM 2008).

1.2.2 Biogeography

The site occurs on the Darling Plateau portion of the Darling System (Churchward & McArthur 1978). The Darling Plateau consists of lateritic uplands with minor and major valleys and scarps. Specifically, the site comprises the following land systems:

- Cook: Hills rising above general plateau level; mainly mantled by laterite but with some rock outcrops.
- Yalanbee: Gently undulating landscape dominated by fine gravels; some duricrust on ridges.

- Pindalup: Valleys of the central part of the plateau; gravely duplex soils on slopes; some rock outcrop; grey sands, duplex soils and orange earths in broad floors.

1.2.3 Vegetation Complex Mapping

Heddle *et al.* (1980) mapped the area as containing three Darling Plateau vegetation complexes, which are related to the underlying soil profile:

- Cook Complex: Vegetation ranges from open forest of *Eucalyptus marginata – Corymbia calophylla* on deep soils through heath and herbland to lichens on granite rocks.

- Yalanbee and Dwellingup Complex in Low rainfall: Mixture of open forest of *Eucalyptus marginata – Corymbia calophylla* and woodland of *Eucalyptus wandoo – Corymbia calophylla*.

- Pindalup and Yarragil Complex in Low to Medium rainfall: Open forest of *Eucalyptus marginata – Corymbia calophylla* on slopes and open woodland of *Eucalyptus wandoo* with some *Eucalyptus patens* in the lower gullies.

Beard (1975) mapped the area as e^{2}_{3}Mc – Jarrah (*Eucalyptus marginata*) – Marri (*Corymbia calophylla*) Forest vegetation complex.

The region was also examined during the Regional Forest Agreement process and was mapped as the Cooke, Yalanbee 5 and Pindalup vegetation complexes (Mattiske and Havel, 1998).

2 METHODOLOGY

2.1 BACKGROUND TO SURVEY METHODOLOGY

2.1.1 State and Federal Legislation

All fauna surveys undertaken by ENV are designed to be compliant with the Environmental Protection Authority (EPA) requirements for the environmental surveying and reporting of fauna surveys in Western Australia, as set out in the following documents:

- *Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3* (EPA 2002); and
- *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 56* (EPA 2004b).

ENV then assesses and reports the results of its surveys with particular regard to the provisions of the following Commonwealth and State legislation:

- the Environment Protection and Biodiversity Conservation Act 1999 (Cth) ('EPBC Act');
- the Wildlife Conservation Act 1950 (WA) ('WC Act'); and
- the Environmental Protection Act 1986 (WA).

2.1.2 EPA Guidance Statement No. 56

A baseline field fauna survey for an Environmental Impact Assessment should provide a comprehensive list of species within a given area. There are two levels of fauna survey, as delineated by the EPA:

- ***Level One:*** 'desktop' study to collate historical knowledge, in conjunction with a reconnaissance survey (site inspection).
- ***Level Two:*** trapping and opportunistic field survey to characterise the fauna present, combined with a Level One survey.

Where the scale and nature of the proposed impact is moderate to high, a Level Two survey will be required in most areas of the State, and is typically required for resource development projects. The expectations of the EPA are delineated in *Guidance Statement No. 56* (EPA 2004b). Specifically, it details the extent, design and intensity of field surveys for environmental assessments in Western Australia.

As per the Scope of Work in ENV's proposal of 16 September 2008, ENV undertook a series of tasks which constituted a Level One fauna assessment. This low-intensity form of assessment was considered appropriate, as the survey area is relatively small and has been subject to disturbance by clearing.

2.1.3 Fauna of Conservation Significance

Species are protected formally and informally by various legislative and non-legislative measures, which are as follows:

Legislative Protection

- EPBC Act 1999 (Cth): a federal Act;
- WC Act 1950 (WA): a State Act; and
- EPA Act 1986 (WA): a State Act.

Non-Legislative Protection

- DEC Priority lists; and
- informal recognition of locally significant populations

A short description of these Acts is given below, and definitions of the species conservation codes and ecological community categories they use, and those used by the DEC, are provided in Appendix A.

Environment Protection and Biodiversity Conservation Act 1999 (Cth)

The Environment Protection and Biodiversity Conservation Act 1999 (Cth) ('the EPBC Act') aims to protect matters of national environmental significance, which are detailed in Appendix A. Under the EPBC Act, the Commonwealth Department of Environment, Water, Heritage and the Arts ('DEWHA') lists threatened species and Threatened Ecological Communities in certain categories determined by criteria set out in the Act (*www.environment.gov.au/epbc/index.html*).

Species are considered conservation-significant if they are listed as Threatened (ie, Vulnerable, Endangered etc), or Migratory under the EPBC Act. Marine-listed species are considered conservation-significant only when a proposed development occurs in a Commonwealth area (i.e. Commonwealth Marine Protected Area).

The Act provides for substantial penalties for any unauthorised actions likely to adversely affect matters of national environmental significance. It also provides for a national environmental assessment and approvals process for proposed actions likely to affect the prescribed matters of national environmental

significance. If a proposed action is approved subject to certain conditions, the proponent of the action does not contravene the Act if the action is carried out in accordance with the conditions imposed.

Projects likely to cause impacts on matters of national environmental significance (as defined in the EPBC Act – see Appendix A) should be referred to the DEWHA for assessment under the EPBC Act. Although the time taken for a proposal to be assessed may be considerable, there is considerable risk in not referring a project likely to affect matters of national environmental significance, as the Act provides for substantial penalties for unauthorised actions.

Wildlife Conservation Act 1950 (WA)

The DEC lists taxa under the provisions of the WC Act as protected and are classified as Schedule 1-Schedule 4 according to their need for protection (see Appendix A).

The Act makes it an offence to 'take' threatened species without an appropriate licence. There are financial penalties for contravening the Act.

DEC Priority Lists

The DEC produces a list of Priority species that have not been assigned statutory protection under the WC Act. Priority Fauna are under consideration as 'Scheduled' fauna, but are in urgent need for further survey or require regular monitoring, and although not currently threatened, may become so. See Appendix A for definitions of Priority codes.

In addition, the DEC maintains a list of Priority Ecological Communities (PEC), which identifies those communities that need further investigation before possible nomination for Threatened Ecological Community ('TEC') status (see below).

Although DEC Priority species and communities have no formal legal protection, they are under consideration for protection. Sensitivities to harm can therefore be expected to be heightened, and the adverse effects of harming Priority species or communities may include negative publicity (with the prospect of damage to the proponent's public image and possible adverse consequences for future projects) and local opposition to proposals.

Informal Recognition of Threatened Fauna

Certain populations or communities may be of local significance or interest because of their patterns of distribution and abundance. For example, fauna may be locally significant because they are range extensions to the previously-known distribution or are newly-discovered taxa (and therefore have the potential to be of more than local significance). In addition, many species are in decline as a

result of threatening processes (primarily land clearing), and relict populations of such species assume local importance.

Despite the lack of any formal protection for species in this category, project proponents are strongly advised to be aware of and to be sensitive to community concerns as to locally significant species or communities.

2.2 SURVEY METHODOLOGY

2.2.1 Desktop Survey

The purpose of a desktop survey is to gather background information on the project area and the fauna that it may support. This involves a search of literature, data, aerial photographs and maps for information pertaining to habitats likely to be found in the area. A search of the Western Australia Museum FaunaBase was undertaken to generate a list of fauna species previously recorded in the area. In addition, a review of literature was conducted, and collectively, these sources were used to compile a list of species that could plausibly use the habitats that appear to occur in the project area, based on the desktop assessment.

Field Survey

The purpose of the field survey was to verify the accuracy of the desktop survey and further delineate and characterise the fauna and faunal assemblages in the project area. The fauna field survey was undertaken from 8-9 October 2008, and consisted of a fauna habitat assessment, opportunistic searches, ornithological census and acoustic bat recordings.

Habitat Assessment

The EPA recognises vegetation complexes that are not well represented in reserves as being significant. Vegetation complexes which have 10%-30% remaining may be considered regionally significant. Proposals that would impact on a vegetation complex with 10% (within the PMR) or less remaining are likely to be formally assessed by the EPA (EPA 2006). The project area was assessed for poorly represented vegetation complexes as a means to determine poorly represented, and therefore, conservation significant fauna habitat.

The habitat assessment was also carried out to target the preferred habitats of listed (under the relevant Federal and State Acts) threatened vertebrate species potentially occurring in the general area. The aim of the habitat assessment was to determine the likelihood of any threatened species utilising the areas that will be impacted upon by the proposed works.

During the field survey, the vegetation communities and landforms present were used to refine the desktop habitat assessment. These fauna habitats were assessed for specific habitat components, such as significant trees with hollows, loose bark, fallen hollow logs, and leaf litter, to determine the potential of these habitats to support threatened species. The list of species potentially occurring based on the desktop habitat assessment was then refined and reduced based on the field habitat assessment.

In addition to assessing these habitats for the likely occurrence of threatened fauna species, the habitat types were also assessed for their complexity and the presence of microhabitats. Fauna habitats were then given a value of high, medium or low, according to the quality of habitat, based on their complexity and the microhabitats they provide for a wider suite of fauna species. This information was used in context with defining habitats of conservation significance as previously detailed

Opportunistic Searches

Opportunistic area searches of major habitats in the project area were undertaken to locate fauna or secondary evidence of fauna. Searches included investigating burrows, rock crevices, scats, tracks and other traces, splitting exfoliating rock, turning rocks and fallen timber, opening standing timber crevices, and raking leaf litter. Nocturnal road cruising and searches were also conducted to target nocturnal fauna, helping to provide a more complete assessment of fauna species in the project area.

Ornithological Census

Ornithological diurnal and nocturnal surveys were undertaken throughout the project area, documenting bird species observed. Census locations were not specifically limited to site locations, but rather all habitats were surveyed across the entire site. The ornithologist specifically targeted habitats likely to support threatened species, and unique or poorly represented habitat, to record species not previously recorded in the area.

Bat Recordings

Acoustic echolocation bat recordings were undertaken at dusk and in early evening using AnaBat II recording units to document bat species in the area. The detectors convert ultrasonic echolocation signals produced by bats into audible electronic signals, which are later analysed for species-specific calls. In addition, AnaBat units were also set in areas that may be utilised by bats for foraging (i.e. gullies and drainage lines). AnaBat data is presented in Appendix C.

Targeted Searches

Searches were done of suitable habitat that could potentially support fauna of conservation significance. This included searches for invertebrates like land snails and the *Gauis sp* of trapdoor spider. The conservation significance of this spider species is yet to be determined. The searches consisted of sifting through leaf litter, for snails and trapdoor burrows; and searching for signs of Carnaby's and Baudin's Black-cockatoo. In addition, the entire length of Horton Road was walked while examining the roadside for burrows and other indications of protected fauna.

2.2.2 Taxonomic Identification

Where field identification of the species was not possible, specimens were collected systematically for later identification by expert taxonomists from the Western Australian Museum Collections and Research Facility.

3 FAUNA

3.1 FAUNA SURVEY CONSTRAINTS

It is important to note the specific constraints imposed on individual surveys. Constraints are often difficult to predict, as is the extent to which they influence survey outcomes. Survey constraints of the Horton Road project area fauna survey are detailed in Table 1.

Table 1: Constraints Associated with the Fauna Survey

Variable	Impact on Survey Outcomes
Experience levels/ Resources	The biologist who executed this survey were practitioners suitably qualified in their respective fields: • Mr Mike Brown – Zoologist • Mr Dale Broun – Biologist • Mr Brad Maryan - Taxonomist
Scope: sampling methods/ Intensity	The survey carried out was a Level One survey, comprising a desktop survey and a site visit that included a habitat assessment and opportunistic observations.
Proportion of fauna recorded/ Completeness	The field survey recorded 37 taxa, which is 19% of the 195 expected fauna for the project area This is a reflection of the small survey area size, the large percentage of the project area cleared for agriculture, and the fact that the survey was a Level One survey, which focuses more on habitat assessment and does not include a trapping regime.
Sources of Information	BGC (Australia) Pty Ltd has previously surveyed Avon Loc 1881 and Lots 11 and 14 Horton Road, adjacent to the project area, for a Public Environmental Review (URS Australia Pty Ltd 2003).
Proportion of task completed	The field survey was completed adequately, with the habitat assessment and opportunistic searches carried out to a sufficient level.
Timing, weather, season.	The survey was undertaken in October. The area had received 185.6 mm of rainfall in the three months preceding the survey, with a large amount of this occurring in the month of July (BoM 2008). The day temperatures were in the mid 20s, with night temperatures just below 10^{o}C (BoM 2008). These weather conditions were not likely to limit the activity of any faunal group.
Disturbances	Lot M 1822 Horton Road has been cleared and used as pastoral land. Approximately 90% of the area has been cleared, with only disturbed native vegetation occurring in the remaining 10%. Vegetation bordering

Variable	Impact on Survey Outcomes
	Horton road is generally in good condition with some areas, approximately 25% being disturbed due to adjacent farmland.
Access problems	All of the Project Area was able to be accessed adequately.

3.2 HABITAT ASSESSMENT

The western end of Lot M 1822 Horton Road is primarily pastoral land, with undulating lateritic hills dominating the project area. The project area is defined by the creek line in the east and the property boundary in the west. Development is proposed to take place west of the drainage line, which is to remain undisturbed. Five habitat types (in seven different areas) were identified on the landforms in the project area, and they are listed in Table 2 and illustrated in Figure 2.

Table 2: Major Habitat Types for Western Side of Lot M 1822 Horton Road, Woottating, and 5 m each side of Horton Road,

Landform Type	Habitat Type
Lateritic Hills	Open Forest
	Woodland
	Open Heath
	Pastoral
Creek Bed	Creek Bed
Alluvial plains	Pastoral
	Woodland

Of the above habitat types, the Open Forest and Creek Line are considered to be of the highest value as fauna habitat. Woodland and Open Heath are considered of medium value, while the Pastoral habitat is considered to be of the lowest value.

The Open Forest habitat type is considered to be high-value fauna habitat because of the microhabitats it provides and the possible fauna of conservation significance it supports. Fauna of conservation significance such as Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*), the Chuditch (*Dasyurus geoffroii*), the Greater Long-eared Bat (*Nyctophilus timoriensis timoriensis*) and the Southern Brown Bandicoot (*Isoodon*

macrourus) are associated with this habitat type. Additionally, the *Gaius* sp., of trapdoor spider is likely to inhabit areas of the Open Forest habitat, particularly where vegetation with linear leaves, such as *Allocasuarina sp*, occur. This habitat type has reasonable representation in the project area, but is well represented in areas adjacent to Horton Road.

The Creek Line habitat is of high value as fauna habitat because it has low representation in the project area and it provides possible habitat for fauna of conservation significance, such as the Water Rat (*Hydromys chrysogaster).* The Creek Line also provides potential breeding habitat for frogs, none of which are formally protected. Outside the project area, the Creek Line habitat is moderately well represented on the Darling Plateau. The Creek Line is characterised by running water and eucalypts along the banks. It is possible that during the drier months, sections of the Creek Line dry up. This habitat type is unlikely to be affected by the development, as it is the Client's intention to avoid this section of the project area.

Woodland habitat is considered to be of medium value as fauna habitat, providing microhabitats like fallen logs, leaf litter, soft soils for burrowing, and trees for arboreal fauna, such as Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and Baudin's Cockatoo (*Calyptorhynchus baudinii*). The Woodland habitat type is reasonably represented within the project area and well represented in areas outside of the project area.

The Open Heath habitat type is of medium value as fauna habitat, providing fewer microhabitats that include leaf litter and small logs. Fauna likely to inhabit this area are ground-dwelling animals such as the Shingleback Skink (*Tiliqua rugosa*), the Snake-eyed Skink (*Cryptoblepharus buchananii*), the Dugite (*Pseudonaja affinis*) and Gilbert's Dunnart (*Sminthopsis gilberti*). This habitat type is restricted within the projected area and is moderately represented in surrounding areas.

The Pastoral habitat type is of low value in terms of both its habitat rank and conservation significance. These areas have been cleared and converted to farmland. As a fauna habitat, it is degraded and provides very few microhabitats, with soils suitable only for burrowing animals. The only fauna, other than livestock, that appears to be supported by the Pastoral habitat is the European Rabbit (**Oryctolagus cuniculus*). This habitat type is well represented in the project area and in the surrounding areas.

3.3 RECORDED FAUNA

3.3.1 Mammals

Thirty species of mammal potentially occur in the project area, eight of which were recorded during the survey (Appendix E).

Of these eight species, two are introduced: the Dog (**Canis lupus*) and the European Rabbit (**Oryctolagus cuniculus*).

Conservation Significance

Six native mammal species were recorded during the survey. Of these six species, one - the Quenda (*Isoodon obesulus fusciventer*) - is classified as being of conservation significance. Secondary evidence of the Quenda, in the form of these diggings, was recorded in the project area.

The Quenda is listed as Priority 5 (taxa in need of monitoring) by the DEC. It typically seeks daytime refuge from predators in very thick ground-storey vegetation usually associated with woodlands, swamps or damplands. This habitat is not well represented in the project area, but is well represented outside it. The Quenda forages broadly in a range of habitats at night, and it is possible Quenda utilises the Woodland and Open Forest habitat types for foraging. In the process of foraging, the Quenda leaves small funnel-shaped diggings.

3.3.2 Reptiles

Forty-nine species of reptile potentially occur in the project area, five of which were recorded in the project area during the survey (Appendix F).

Conservation Significance

Of the five species of reptiles recorded in the project area, none are of conservation significance.

3.3.3 Amphibians

Thirteen species of amphibians potentially occur in the region of the project area, three of which were recorded in the project area during the survey (Appendix G). The Creek Line habitat is a fast-flowing freshwater winter stream, which provides habitat for these species.

Conservation Significance

No species of amphibians in the project area are of conservation significance.

3.3.4 Birds

One-hundred and two species of bird potentially occur in the project area, 21 of which were recorded during the survey (Appendix J).

Conservation Significance

Of the 21 bird species recorded, two, Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) and the Emu (*Dromaius novaehoolandiae*) are of conservation significance. Baudin's Black Cockatoo is listed as Vulnerable by the EPBC Act and as Schedule 1 (i.e. rare or likely to become extinct) by the WC Act. This species uses woodland and forest habitat for foraging and breeding. The Emu is considered to be of local significance, this species tends to avoid built up areas, dense bushland, and arid areas.

3.4 POTENTIALLY OCCURRING FAUNA

Fauna species of conservation importance that potentially occur within the site are discussed in the following sections. These species were not recorded during the survey, but have been assessed as potentially occurring after consideration of the habitat in the project area.

3.4.1 Mammals

Several mammal species that potentially occur in the project area (additional to those recorded) are of conservation significance (Appendix E).

EPBC Act

The Chuditch (*Dasyurus geoffroii*) is listed as Schedule 1 under the WC Act and as Vulnerable under the EPBC Act. It has been noted as highly likely to occur within the region (URS Australia 2003), but was not recorded in the current survey. However, individuals of this species are wide-ranging and occur in low densities, and therefore may occur in the project area, utilising it as part of a home range.

The Quokka (*Setonix brachyurus*) is listed as Schedule 1 under the WC Act and as Vulnerable under the EPBC Act. It is found on Rottnest Island and the south-west regions of the State, mostly in densely-vegetated swamps, in tea-tree thickets on sandy soils along creek lines and in dense heath on slopes.

WC Act

The Southern Brush-tailed Phascogale, *Phascogale tapoatafa* ssp. (WAM M434), was not recorded in the current survey, but has been recorded in mining areas of Jarrah forest on the Darling Plateau (URS Australia 2003). The distribution of this species is believed to have been reduced to approximately 50% of its former range. This subspecies has been observed in dry sclerophyll forests and open woodlands containing hollow-bearing trees, with a sparse ground cover. Habitat destruction, in particular loss of hollow-bearing trees and predation by feral animals, is thought to be the major threat to surviving populations. Suitable

habitat is present in the project area, but is likely to only be used as part of a larger home range.

Priority Species

Three mammal species – the Quenda (*Isoodon obesulus fusciventer*), the Water Rat (*Hydromys chrysogaster)* and the Western Brush Wallaby (*Macropus irma)* - are listed as Priority fauna by the DEC. The Quenda (discussed above) is listed as Priority 5. The Water Rat and the Western Brush Wallaby are both listed as Priority 4 by the DEC.

The Western Brush Wallaby is known to occur along the Darling Scarp and east onto the Darling Plateau (Van Dyck and Strahan 2008). It is not specifically dependent on a particular habitat in the project area. It is wide-ranging, and requires large tracts of bushland with relatively little disturbance in order to persist.

The Water Rat favours areas close to fresh, brackish or saltwater water bodies with thick vegetation cover. This species is widespread, and therefore it is possible it could be found in areas of the Creek Line, where suitable habitat is present.

Locally Significant

The Yellow-footed Antechinus or Mardo (*Antechinus flavipes* subsp. *leucogaster)* is considered of local importance. This species is likely to occupy only the Open Forest and Woodland habitats. It is considered of local importance because it is a species highly predated by feral fauna.

3.4.2 Reptiles

Two reptile species of conservation significance potentially occur in the project area (Appendix F).

WC Act

The south-western population of the Carpet Python is classified as Schedule 4 by the WC Act, and is also listed as Priority 4 by the DEC. This subspecies has a wide distribution in the south-west, but is generally uncommon, having been recorded from semi-arid coastal and inland habitats, Banksia woodland, Eucalypt woodlands, and grasslands. It commonly utilises hollow logs for shelter (Wilson & Swan 2003). Local populations in the south-west have suffered because of extensive clearing and removal of habitat. Lack of habitat makes the species vulnerable to predation and severely limits the potential for dispersal.

Locally Significant

The Bardick (*Echiopsis curta*) is widely distributed from the coast to the interior of south-western Western Australia (Cogger 2000). It is listed on the IUCN list as Vulnerable and is known to inhabit heaths, sheltering among leaf litter and vegetation (Wilson & Swan 2003).

3.4.3 Amphibians

Locally Significant

Two amphibian species considered of local importance, the Western Marsh Frog (*Heleioporus barycragus*) and the Sand Frog (*Heleioporus psammophilus*), occur in the project area (Appendix G). These species of frogs are associated with ephemeral watercourses that flow in winter or spring and are restricted to the Perth region of Western Australia.

3.4.4 Birds

Of the 102 bird species that potentially occur in the project area, five are protected by the EPBC Act, four are listed as Scheduled by the WC Act, three are listed as Priority by the DEC, and three are of local significance (Appendix G).

EPBC Act

Four species of bird listed by the EPBC Act potentially occur in the project area: Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Muir's Corella (*Cacatua pastinator pastinator*), the Forked-tailed Swift (*Apus pacificus*) and the Rainbow Bee-eater (*Merops ornatus*).

Muir's Corella is listed as Schedule 1 by the WC Act and as Vulnerable by the EPBC Act. Muir's Corella occurs only in the south-west region of Western Australia, and depends on mature eucalypts with hollows for nesting. Suitable trees occur in the project area in sections of the Open Woodland habitat, but now Muir's Corellas were recorded.

Carnaby's Black-cockatoo is listed as Endangered by the EPBC Act and as Schedule 1 by the WC Act. Roosting and foraging amongst tall Marris and eucalypts, Carnaby's Black-cockatoo will potentially find the Woodland and Open Forest habitat types suitable.

The Forked-tailed Swift is listed as Migratory by the EPBC Act. It is almost totally an aerial species of bird that can be observed flying in large flocks. This bird is a summer migrant and can be found in the south-west between November and

April. It does not breed in Australia and is rarely found roosting (Simpson, Day 2004).

The Rainbow Bee-eater is listed as Migratory by the EPBC Act. It nests by digging tunnels in river banks and drainage lines. Although there is suitable habitat present within the project area it will not be developed by the client.

WC Act

Four birds are Scheduled by the WC Act: the Peregrine Falcon (*Falco peregrinus*), Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*), and Muir's Corella (*Cacatua pastinator pastinator)*. Carnaby's Black Cockatoo, Baudin's Cockatoo and Muir's Corella are discussed previously.

The Peregrine Falcon (*Falco peregrinus*) is listed as Schedule 4 by the DEC. This species is considered widespread throughout Australia, but uncommon. The Peregrine Falcon utilises the ledges, cliff faces and large hollows/broken spouts of trees for nesting. It also occasionally uses the abandoned nests of other birds of prey (Johnstone & Storr 1998). Potential nesting sites may be present in the project area, but no evidence of Peregrine Falcon nests was observed.

Priority Species

Three birds that potentially occur in the project area are listed as Priority species by the DEC: the Barking Owl (*Ninox connivens connivens*), the Masked Owl (*Tyto novaehollandiae novaehollandiae*) and the south-western subspecies of the Crested Shrike-tit (*Falcunculus frontatus leucogaster*).

The Barking Owl (DEC Priority 2 species) is said to have a large range, and is found in a variety of habitats (Simpson & Day 2004). The Masked Owl is listed as Priority 3 by DEC, and is found in areas having tall trees with suitable hollows for roosting and nesting. The Open Forest and Woodland habitat provides suitable habitat for this species of bird.

The south-western subspecies of the Crested Shrike-tit (DEC Priority 4) is found in the south west of Western Australia, but is absent from the Swan Coastal Plain. It lives in area of eucalypt woodland and forest, and sometimes farms with scattered trees. The Open Forest habitat, the Woodland habitat, and areas near Lot M 1822 Horton Road provide suitable habitat for the Crested Shrike-tit. The subspecies of Crested Shrike-tit that is listed as a priority species that generally occurs further south of the project area; however, it has previously been recorded as far north as Perth (Simpson, Day 2003).

Local

There are three species potentially present that are of local conservation importance, one of which was recorded in the current survey. These species are not protected by legislation, but are known to have a declining distribution or population. The Emu (*Dromaius novaehoolandiae*), has been discussed previously. The Scarlet Robin has a tendency to disappear from fragmented habitats. The Regent Parrot populations have been in decline over recent years as a result of habitat destruction (Bamford Consulting Ecologists 2006).

3.4.5 Invertebrates

Two species of locally significant invertebrates occur within the project area, the *Gauis sp*. of trapdoor spider and an undescribed species of land snail *Bothriembryon* sp.

Due to the known recordings in the region, the *Gauis sp*. of trapdoor spider (URS Australia 2003) was targeted during the survey. This species of spider has not been formally defined and is considered to be of local significance due to few known recordings, restricted distribution and lack of knowledge regarding this species. The *Gaius sp.* of spider lives in areas with loamy soils, shade, water retention and linear leaf litter like that of *Allocasuarina sp*. (Main 2002). Known populations exist on the BGC Voyager Quarry site, and the Brookton Highway. During the survey two possible trapdoor burrows were found. The first of which appeared to have been old and disused, the second burrow had the trapdoor open and was uninhabited. It is possible that the latter belonged to a male of the species which is known to leave their burrow when searching for a mate; whereas the female of the species are sedentary and do not leave the burrow. Conclusive evidence of the presence of the *Gauis sp* of trapdoor spider was not found during the survey, however, with the recent recording of the spider in the area (URS Australia 2003) and the presence of suitable habitat along Horton road, it is possible that the *Gauis* trapdoor spider occurs in the project area.

4 DISCUSSION

Habitats

The proposed development of the western end of Lot M 1822 Horton Road will affect two main areas, one in the property and one along Horton Road. The area within the property will be located in the pastoral land to the west of the creek line that runs north-south through the property. The creek line is to be left untouched by the client. Horton Road will be impacted along its length, including up to five metres on either side, to cater for the proposed expansion of the road.

There are five habitat types in the project area: Open Forest, Creek Line, Woodland, Open Heath, and Pastoral. Of these, the Open Forest and Creek Line are considered to be of the highest value as fauna habitat, as they provide a range of microhabitats and support several species of fauna of conservation significance like the Carnaby's Black-cockatoo (*Calyptorhynchus latirostris*), and Chudich (*Dasyurus geoffroii*). Additionally the Baudin's Black-cockatoo (*Calyptorhynchus baudinii*).was recorded in this habitat type during the survey.

The Woodland and Open Heath habitat types are considered of medium-value fauna habitat. They are poorly represented in the project area, and do not have fauna of conservation importance restricted to them. The Woodland and Open Heath habitats are not likely to be heavily impacted by the proposed development. Fauna, like the Bardick (*Echiopsis curta*), are likely to occur in these habitats.

The Pastoral habitat type is considered to be of low value as fauna habitat. This habitat has been cleared, and has previously been used for agriculture. No animals of conservation significance are supported by this habitat, as it provides no suitable microhabitats or food sources. Of all the habitat types, the Pastoral has the greatest representation in the project area, and will be most affected by the proposed development.

It was determined in the Lot M 1822 Horton Road report that the region was examined during the Regional Forest Agreement process and was mapped as the Cooke, Yalanbee 5 and Pinalup vegetation complexes (Mattiske and Havel, 1998). None of these vegetation complexes were listed in Review of Management Options for Poorly Represented Vegetation Complexes (Havel and Mattiske, 1998) and are therefore not considered to be high priority for conservation.

Likely Impacts on Conservation-Significant Taxa

The proposed development at Lot M 1822 Horton Road and the widening of the road is unlikely to have significant impacts on the majority of the terrestrial fauna. There is an abundance of suitable habitat surrounding the project area,

particularly along Horton Road; and because of their mobile nature, most of the fauna will be able to move into these areas when disturbed. However, there is greater potential for sessile fauna, like the *Gauis sp.* of trapdoor, to be impacted.

Of the recorded fauna, the Baudin's Cockatoo is the only fauna that has the potential to be impacted upon. The Open Forest and Woodland on the site provides potential foraging habitat for Baudin's Cockatoo, which is listed as Vulnerable under the EPBC Act and as Schedule 1 under the WC Act. The species forages in Marri (*Corymbia calophylla*) woodland, which by being present also indicates that the area provides habitat for the Carnaby's Black-cockatoo. Carnaby's Black-cockatoo is listed as Endangered under the EPBC Act and as Schedule 1 under WC Act. Baudin's Cockatoo is considered rare in the Perth metropolitan area. In the Perth region it generally occurs only on the eastern edge of the Swan Coastal Plain and the adjacent Darling Ranges (Johnstone & Kirby 2008). A small number of mature trees suitable for roosting and breeding exist in the project area, most along Horton Road. As a preferred food source for Baudin's Black Cockatoo, the removal of any significant amount of Marri (*Corymbia calophylla*) trees may be deemed a controlled action by DEWHA, which administers the EPBC Act, and therefore may necessitate referral of the proposed development. It has been estimated by ENV Australia that 2.04 hectares of vegetation will be affected by the project, with suitable habitat for Baudin's Black-cockatoo and Carnaby's Black-cockatoo making up the greater part of this.

Concerns have also previously arisen regarding possible impacts on the *Gauis sp*. of trapdoor spider by developments in nearby areas. The *Guais sp* of spider, which is not formally described and may be of conservation significance, has the potential to occur in the project area, with known populations existing on the BGC Voyager Quarry site, and the Brookton Highway. Due to the small area of land to be disturbed, approximately two metres either side of Horton Road with a further three metres surveyed as a buffer; it is the view of ENV that the trapdoor spider will not become extinct or unsustainable within the area. Furthermore, a known population has been relocated and a sanctuary established on Lot 14 as part of the conditions imposed by the EPA for the BGC Voyager Quarry expansion (EPA 2005).

5 CONCLUSION AND RECOMMENDATIONS

Analysis of the results of the fauna survey indicates that the project area has habitat value for a number of conservation-significant species, several of which are protected by State and/or Commonwealth legislation. The presence of these species is likely to constrain, but will not necessarily prohibit, the proposal.

Given the presence of fauna species of State and Federal significance, the proposal may require referrals under State and Federal environmental approvals processes. Referring the project to the process will also assist in avoiding potential hold-ups at a later date. It would be prudent to commence discussions with the relevant agencies as early as possible in relation to the findings of the fauna survey and the likelihood of additional assessment being required.

ENV recommends the following actions to maintain fauna diversity in the project area:

- liaison should take place with DEWHA to determine whether referral of the project under the EPBC Act is likely to be required. The fauna and vegetation assessments already undertaken would provide the basis for the required documentation;
- the construction or impact footprint should be aligned, as far as possible, with previously disturbed or rehabilitated areas rather than undisturbed bushland, and drainage lines should be avoided;
- all large mature potentially hollow-bearing trees should be retained where possible;
- clearing should be minimised to that strictly necessary: for instance clearing outside the construction footprint for service areas, lay-down facilities or access roads/turnaround points should be avoided. Working from within the construction footprint can significantly reduce the total area cleared;
- fencing type and construction needs should be designed in consideration of the fauna that utilise the area: fences that can entangle fauna or limit the mobility of fauna should not be considered; and
- there should be a nutrient and drainage management plan for the project, focussing on maintaining the quality of the waterways.

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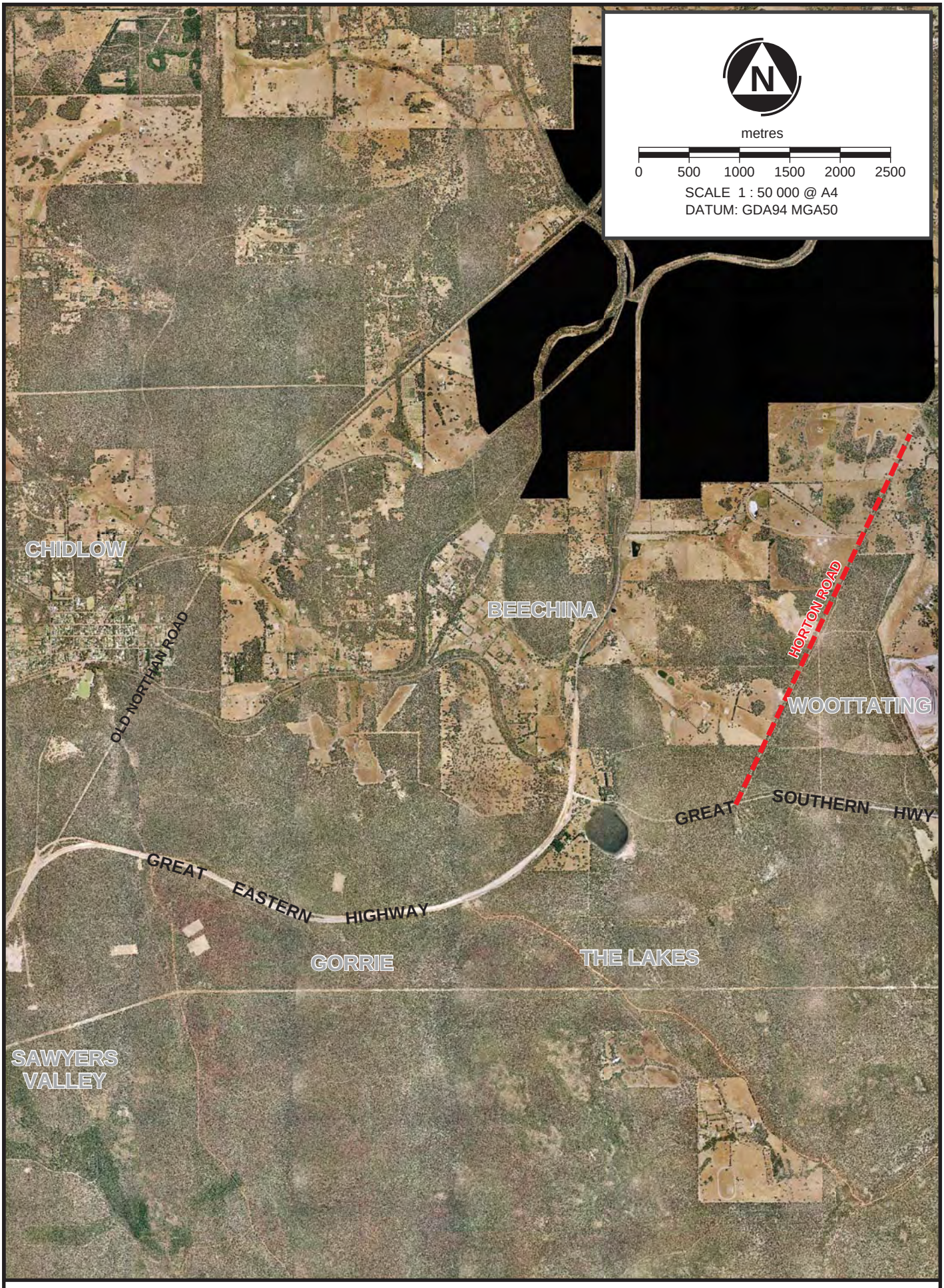
FIGURES



PRINTED: Thu 29 Jan 09

DRAWN: TE 8-01-09 AUTHOR: MB 8-01-09

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Purearth

FAUNA HABITAT ASSESSMENT OF WESTERN SIDE OF LOT M 1822 HORTON ROAD AND HORTON ROAD, WOOTTATING

REGIONAL LOCATION

FIGURE 1

Aerial supplied by Landgate

env Australia

N

metres

0 50 100 150 200 250

SCALE 1 : 5 000 @ A3

DATUM: GDA94 MGA 50

LEGEND

OF	Open Forest
WD	Woodland
OH	Open Heath
CB	Creek Bed
Pas	Pastoral

OF

OF

CB

Pas

OF

OF

OF

OF

OH

OVERLAP TO SHEET 2b

Aerial supplied by Landgate

FIGURE 2a

Purearth

FAUNA AND HABITAT ASESSMENT OF WESTERN SIDE OF LOT M 1822 HORTON ROAD AND HORTON ROAD, WOOTTATING

HABITAT TYPES

FIGURE 3a

env Australia

N

metres

0 50 100 150 200 250

SCALE 1 : 5 000 @ A3

DATUM: GDA94 MGA 50

LEGEND

OF	Open Forest
WD	Woodland
OH	Open Heath
CB	Creek Bed
Pas	Pastoral

OVERLAP TO SHEET 2a

OH

OF

WD

OF

GREAT SOUTHERN HIGHWAY

Aerial supplied by Landgate

FIGURE 2b

Purearth

FAUNA AND HABITAT ASSESSMENT OF WESTERN SIDE OF LOT M 1822 HORTON ROAD AND HORTON ROAD, WOOTTATING

HABITAT TYPES

FIGURE 3b

env Australia

APPENDIX A

DEFINITION OF CONSERVATION CODES FOR FAUNA OF CONSERVATION SIGNIFICANCE

APPENDIX A

Definition of Conservation Codes for Fauna of Conservation Significance

Environment Protection and Biodiversity Conservation Act 1999 (Cth) Threatened Species and Threatened Ecological Communities Codes

The EPBC Act prescribes seven matters of national environmental significance:

- World Heritage properties;
- National Heritage places;
- Wetlands of international importance;
- Threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas; and
- Nuclear actions (including uranium mining).

Environmental Protection and Biodiversity Conservation Act Category Codes

Category Code	Category
Ex	**Extinct** Taxa for which there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa known to survive only in cultivation, in captivity or as a naturalised population well outside its past range; or not recorded in its known and/or expected habitat at appropriate seasons anywhere in its past range despite exhaustive surveys over a timeframe appropriate to its life cycle and form.
CE	**Critically Endangered** Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** Taxa not critically endangered and facing a very high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa not critically endangered or endangered and facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria**.**
CD	**Conservation Dependent** Taxa which are the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within five years.

Wildlife Conservation Act 1950 Schedule Species Codes

Category	Code	Description
Schedule 1	S1	Rare or likely to become extinct.
Schedule 2	S2	Presumed extinct.
Schedule 3	S3	Birds subject to an agreement between the governments of Australia and Japan, the People's Republic of China & the Republic of Korea relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	S4	Other specially protected fauna.

Department of Environment and Conservation Fauna 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: not currently threatened or in need of special protection, but could become so. Usually represented on conservation lands.
Priority 5	P5	Taxa in need of monitoring: not considered threatened, but the subject of a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

International Conventions and Agreements

Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)

This is an intergovernmental treaty under the United Nations Environmental Program which lists migratory species that would significantly benefit from international cooperation on their conservation and management.

Japan-Australia Migratory Bird Agreement (JAMBA)

This is an agreement between the Government of Australia and the Government of Japan for the protection of migratory, threatened and birds in danger of extinction. It requires both parties to conserve and protect the birds and their habitats as well as exchange information and build a cooperative relationship.

China-Australia Migratory Bird Agreement (CAMBA)

This is an agreement between the Government of Australia and the Government of the People's Republic of China for the protection of migratory birds and their environment. It requires both parties to conserve and protect the birds and their habitats as well as exchange information and build a cooperative relationship.

Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)

This is an agreement between the Government of Australia and the Government of the Republic of Korea for the protection of migratory birds and their environment. It requires both parties to conserve and protect the birds and their habitats as well as exchange information and build a cooperative relationship.

APPENDIX B
FAUNA HABITAT PHOTOS

APPENDIX B

SITE PHOTOGRAPHS

Site 1 – Open Forest

Site 2 – Woodland

Site 3 – Open Heath

Site 4 – Pastoral

APPENDIX C
ANABAT RECORDINGS

Specialised Zoological

Bat call identification

from Horton Road, Perth

Type:	Bat Call Analysis
Prepared for:	ENV Australia
Date:	15 November 2008
Job No.:	SZ070
Prepared by:	Specialised Zoological Kyle Armstrong and Yuki Konishi ABN 92 265 437 422 0404 423 264 kyle.armstrong@graduate.uwa.edu.au kyle.n.armstrong@gmail.com

SUMMARY

Bat identifications from Anabat echolocation call recordings are provided from Horton Road, Perth, Western Australia. Five species were identified (Table 1).

Some calls could not be identified reliably to one species. The calls of *Nyctophilus* are typically difficult to identify to species, and those recorded may be attributed to the lesser long-eared bat *Nyctophilus geoffroyi*, Gould's long-eared bat *Nyctophilus gouldi* or the central greater long-eared bat *Nyctophilus timoriensis* (central form), which is listed under Priority 4 of the WA Department of Environment and Conservation's Priority Fauna List. It is still unclear whether this central form represents a subspecies of *Nyctophilus timoriensis* or a distinct species (McKenzie and Parnaby 2008). Likewise, some call types of Gould's wattled bat *Chalinolobus gouldii* and the south-western free-tailed bat *Mormopterus* sp. 4 appear similar, and cannot be separated. The latter species might also have been present but no clear examples were recorded.

Details supporting the identifications are provided, as recommended by the Australasian Bat Society (ABS 2006). A summary of pulse parameters is provided in Table 2, and representative call sequences are illustrated in Figure 1. Further data is available should verification be required.

METHODS

Signals as recorded with an Anabat SD1 unit were supplied as downloaded sequences, which were examined in AnalookW 3.5f software. Three call variables were measured on good quality search phase pulses in representative call sequences: pulse duration (milliseconds), maximum frequency (kHz) and characteristic frequency (equivalent to minimum frequency; kHz). Species were identified based on information in Fullard et al. (1991). Nomenclature follows Armstrong and Reardon (2006).

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TABLE 1. Species identifications, with the degree of confidence indicated by a code. Date correlates with site; see Table 2 for full species names.

Date	*C. gouldii*	*C. morio*	*Nyctophilus* sp.	*T. australis*	*V. regulus*
Serial 3691					
8/10/2008	H	H	M	H	H
9/10/2008	H	—	—	—	H

Definition of confidence level codes:

R Reference. Capture of the species was made at the site, and the identification is supported by measurements, a *Reference* call recording, and/or submission of a specimen/tissue to a museum.

H High. Unambiguous identification of the species at the site based on measured call characteristics and comparison with available reference material.

M Medium. Either call quality was poor, or the species cannot be distinguished reliably from another that makes similar calls. Alternative identifications are indicated in the Summary section of this report. If this is a species of conservation significance, further survey work might be required to confirm the record.

TABLE 2. Summary of variables from representative call sequences.

Species	s,p[1]	Duration (msec)[2]	Max Frequency (kHz)[2]	Char frequency (kHz)[2]
Gould's wattled bat *Chalinolobus gouldii*	2,39	7.6 ± 1.8 4.3 – 10.1	39.2 ± 12.9 28.7 – 70.2	28.0 ± 1.6 26.1 – 31.7
Chocolate wattled bat *Chalinolobus morio*	2,7	1.9 ± 0.5 1.2 – 2.6	54.8 ± 0.6 54.2 – 55.9	51.1 ± 1.1 49.8 – 53.2
Unidentified long-eared bat *Nyctophilus* sp.	1,9	4.2 ± 1.0 2.5 – 5.4	60.8 ± 5.4 49.4 – 66.7	40.5 ± 1.7 39.3 – 44.7
White-striped free-tailed bat *Tadarida australis*	1,12	12.4 ± 2.1 8.1 – 15.8	25.5 ± 5.4 17.9 – 34.2	15.1 ± 2.0 12.7 – 19.8
Southern forest bat *Vespadelus regulus*	1,7	6.0 ± 0.6 5.3 – 6.8	52.3 ± 3.6 48.3 – 59.3	42.1 ± 0.5 41.6 – 42.9

[1] s,p: number of sequences measured, combined total number of pulses measured;

[2] Mean ± SD; range.

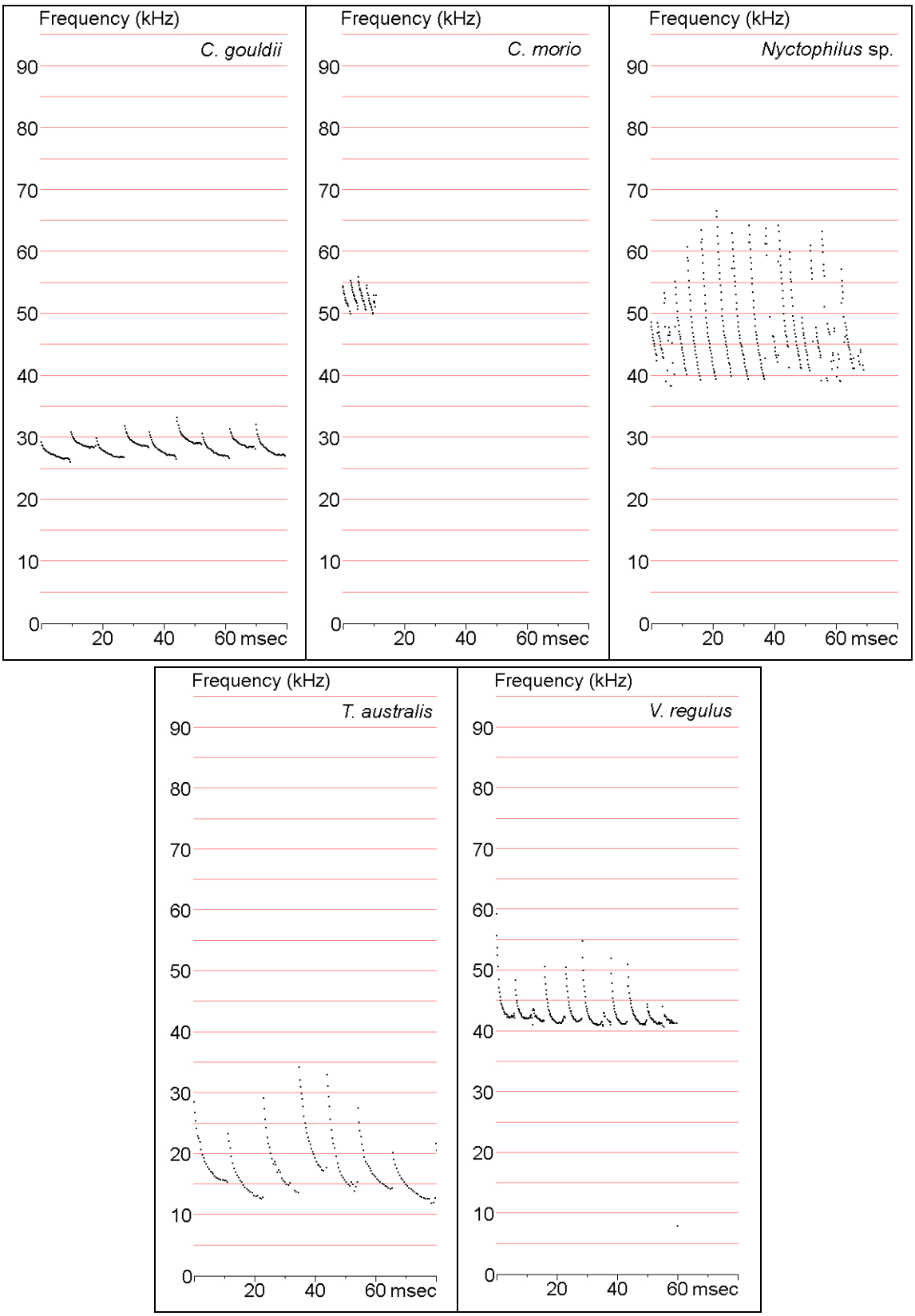


FIGURE 1. Representative call sequences of the five species identified (time is compressed between pulses).

APPENDIX D
HABITAT ASSESSMENT

FAUNA AND HABITAT ASSESSMENT OF WESTERN SIDE OF LOT M 1822 HORTON ROAD, WOOTTATING, AND 5 M EACH SIDE OF HORTON ROAD

Site-Specific Captures

APPENDIX D

M1822 Horton Road **Site** 1

Described by MB **Date** 9/10/2008
Season: Spring **Uniformity:**

MGA Zone 50J 438317**mE** 6475234**mN**
Habitat Open Forest

Soil Sandy top layer with a lateritic base.
Vegetation *Eucalyptus* forest over *Banksia* and *Alucasurina sp*, over grasses and herbs.
Veg Condition VG
Fire Age
Notes
Habitat type: **Logs:** 10% **Leaves:**750% **Twigs:** 5% **Rocks:** 0% **Litter:** 80% **Bare:** 20%

Potential Species of Conservation Significance

Quenda	*Isooden obesulus*
Chuditch	Dasyurus geoffroii
Southern Brush-tailed Phascogale	Phascogale tapoatafa ssp. (WAM M434)
Westernb Brush Wallaby	Macropus irma
Yellow-footed Antechinus	Antechinus flavipes
Carnaby's Black Cockatoo	Calyptorhynchus latirostris
Baudin's Black Cockatoo	Calyptorhynchus baudinii
Muir's Corella	*Cacatua pastinator pastinator*
Peregrine Falcon	*Falco peregrinus*
Barking Owl	*Ninox connivens connivens*
Crested Shrike-tit	*Falcunculus frontatus leucogaster*
Rainbow Bee-eater	*Merops ornatus*
Fork-tailed Swift	*Apus pacificus*
Undescribed Trapdoor Spider	*Gauis sp.*

M1822 Horton Road **Site** 2

Described by MB **Date** 9/10/2008
Season: Spring **Uniformity:**

MGA Zone 50J 437443 **mE** 6473438 **mN**
Habitat Woodland

Soil Sandy top layer with a lateritic base.
Vegetation *Eucalyptus* woodland made up of Jarrah, Marri and scattered Wandoo over *Banksia* shrubs, over grasses and herbs.
Veg Condition VG

Habitat type: **Logs:** <5% **Leaves:**90% **Twigs:** 5% **Rocks:** 0% **Litter:** 100% **Bare:**

Potential Species of Conservation Significance

Quenda	*Isooden obesulus*
Chuditch	Dasyurus geoffroii
Southern Brush-tailed Phascogale	Phascogale tapoatafa ssp. (WAM M434)
Westernb Brush Wallaby	Macropus irma
Yellow-footed Antechinus	Antechinus flavipes
Carnaby's Black Cockatoo	Calyptorhynchus latirostris
Baudin's Black Cockatoo	Calyptorhynchus baudinii
Muir's Corella	*Cacatua pastinator pastinator*
Peregrine Falcon	*Falco peregrinus*
Barking Owl	*Ninox connivens connivens*
Crested Shrike-tit	*Falcunculus frontatus leucogaster*
Rainbow Bee-eater	*Merops ornatus*
Fork-tailed Swift	*Apus pacificus*

M1822 Horton Road **Site** 3

Described by MB **Date** 9/10/2008
Season: Spring **Uniformity:**

MGA Zone 50J 438116**mE** 6474820**mN**
Habitat Open Heath

Soil Latteritic
Vegetation *Banksia* and *Grevillia* mid-storey, over grasses and herbs
Veg Condition VG

Habitat type: **Logs:** 5% **Leaves:**50% **Twigs:** 5% **Rocks:** 0% **Litter:** 50% **Bare:** 50%

Potential Species of Conservation Significance

M1822 Horton Road **Site** 4

Described by MB **Date** 9/10/2008
Season: Spring **Uniformity:**

MGA Zone 50J 439100**mE** 6476628**mN**
Habitat Pastoral

Soil Sandy top layer with a lateritic base.
Vegetation Pastoral grasses with very little native vegetation
Veg Condition VG
Fire Age
Notes
Habitat type: **Logs:** 0% **Leaves:**0% **Twigs:** 0% **Rocks:** 0% **Litter:** **Bare:** 40%

Potential Species of Conservation Significance

M1822 Horton Road **Site** 5

Described by MB **Date** 9/10/2008
Season: Spring **Uniformity:**

MGA Zone 50J 439290 **mE** 6476654 **mN**
Habitat Creek Bed

Soil Sandy top layer with a lateritic base.
Vegetation *Eucalyptus* trees along running waterway. Pastoral grasses also established in this area.
Veg Condition VG

Habitat type: **Logs:** <5% **Leaves:**10% **Twigs:** 10% **Rocks:** 0% **Litter:** 20% **Bare:** 80%

Potential Species of Conservation Significance

Water Rat	*Hydromys chrysogaster*

APPENDIX E

MAMMALS RECORDED AND EXPECTED

APPENDIX E

Potential and Recorded Mammal Species in the Project Area

Species Name	Common Name	EPBC	WC Act	DEC	IUCN	Local	Previously Recorded	Recorded
Dasyuridae								
Western Quoll / Chuditch	*Dasyurus geoffroii*	VU	S1		VU			
Southern Brush-tailed Phascogale	*Phascogale tapoatafa* ssp (WAM M434)		S1		NT			
Gilbert's Dunnart	*Sminthopsis gilberti*				LC			
Grey-bellied Dunnart	*Sminthopsis griseoventer griseoventer*				LC			
Mardo	*Antechinus flavipes leucogaster*				LC	✓	x	
Peramelidae								
Quenda (Southern Brown Bandicoot)	*Isoodon obesulus fusciventer*			P5	LC		x	s
Macropodidae								
Western Brush Wallaby	*Macropus irma*			P4	LC		x	
Quokka	*Setonix brachyurus*	VU	S1		VU		x	
Western Grey Kangaroo	*Macropus fuliginosus*				LC		x	
Phalangeridae								
Common Brushtail Possum	*Trichosurus vulpecula vulpecula*				LC		x	
Burramyidae								
Western Pygmy-possum, Mundarda	*Cercartetus concinnus*				LC			
Tarsipedidae								
Honey Possum, Noolbenger	*Tarsipes rostratus*				LC			
Vespertilionidae								
Gould's Wattled Bat	*Chalinolobus gouldii*				LC		x	x
Chocolate Wattled Bat	*Chalinolobus morio*				LC			x
Lesser Long-eared Bat	*Nyctophilus geoffroyi*				LC		x	M
Greater Long-eared Bat	*Nyctophilus timoriensis timoriensis*				DD			M
Southern Forest Bat	*Vespadelus regulus*				LC		x	x

Species Name	Common Name	EPBC	WC Act	DEC	IUCN	Local	Previously Recorded	Recorded
Molossidae								
White-striped Free-tailed Bat	*Tadarida australis*				LC			x
Muridae								
Water Rat	*Hydromys chrysogaster*			P4	LC			
House Mouse	*Mus Musculus*				LC			
Bush Rat	*Rattus fuscipes*				LC			
Black Rat	*Rattus rattus*				LC		x	
Ash-grey Mouse	*Pseudomys albocinereus*				LC		x	
Leporidae								
European Rabbit	*Oryctolagus cuniculus*				NT		x	x
Canidae								
Dog	*Canis lupus*				LC			s
Red Fox	*Vulpes vulpes*				LC			
Felidae								
Feral/House Cat	*Felis catus*							
Mustelidae								
European Polecat, Ferret	*Mustela putorius*				LC			
Suidae								
Feral Pig	*Sus scrofa*				LC		x	
Bovidae								
Goat	*Capra hircus*							

[X] indicates that the fauna was recorded during the site visit.
[S] indicates when secondary evidence is used (e.g. Track).
[M] indicates when a positive identification could not be made between two species. See Appendix C.
* When species fall under more than one 'conservation importance' category, the highest status is noted.

APPENDIX F

REPTILES RECORDED AND EXPECTED

APPENDIX F

Potential and Recorded Reptile Species in the Project Area

Common Name	Scientific Name	EPBC	WC Act	DEC	IUCN	Local	Previously Recorded	Recorded
Agamidae (dragons)								
Western Bearded Dragon	*Pogona minor minor*						x	
Sandhill or Heath Dragon	*Ctenophorus adelaidensis*							
Ornate Rock Dragon	*Ctenophorus ornatus*						x	
Gekkonidae (geckoes)								
Marbled Gecko	*Christinus marmoratus*							x
Diplodactylidae								
Speckled Stone Gecko	*Diplodactylus polyophthalmus*						x	
Carphodactylidae								
Barking Gecko	*Nephrurus milii*						x	
Pygopodidae (legless lizards)								
Granite Worm-lizard	*Aprasia pulchella*							
Fraser's Legless Lizard	*Delma fraseri*							
Side-barred Delma	*Delma grayii*							
Keeled Legless Lizard	*Pletholax gracilis*							
Common Scalyfoot	*Pygopus lepidopodus*							
Hooded Scaly-foot	*Pygopus nigriceps*						x	
Burton's Legless Lizard	*Lialis burtonis*						x	
Scincidae (skinks)								
South-West Cool Skink	*Acritoscincus trilineatum*						x	
Snake-eyed Skink	*Cryptoblepharus buchanoni*							x
Western Limestone Ctenotus	*Ctenotus australis*							
	Ctenotus delli			P4			x	
West Coast Ctenotus	*Ctenotus fallens*							
Jewelled Ctenotus	*Ctenotus gemmula*			P3				
Odd-striped Ctenotus	*Ctenotus impar*							
	Ctenotus labillardieri						x	
Coastal Slender Bluetongue	*Cyclodomorphus celatus*							
King's Skink	*Egernia kingii*							

Common Name	Scientific Name	EPBC	WC Act	DEC	IUCN	Local	Previously Recorded	Recorded
Salmon-bellied Skink	*Egernia napoleonis*						x	
	Hemiergis initialis						x	x
Two-toed Earless Skink	*Hemiergis quadrilineata*							
Five-toed Earless Skink	*Lerista distinguenda*						x	
West Coast Four-toed Lerista	*Lerista elegans*						x	
	Lerista microtis							
Dwarf Skink	*Menetia greyii*						x	
Southern Pale-flecked Morethia	*Morethia obscura*						x	x
West Coast Morethia	*Morethia lineoocellata*							
Bobtail	*Tiliqua rugosa*						x	x
Varanidae								
Gould's Goanna	*Varanus gouldii*							
Southern Heath Monitor	*Varanus rosenbergi*							
Typhlopidae								
Southern Blind Snake	*Ramphotyphlops australis*						x	
Fat Blind Snake	*Ramphotyphlops pinguis*						x	
Boidae								
Southern Carpet Python	*Morelia spilota imbricata*		S4	P4	LR/NT			
Elapidae (front fanged snakes)								
Narrow-banded Snake	*Brachyurophis fasciolata fasciolata*							
Southern Shovel-nosed Snake	*Brachyurophis semifasciata*							
Yellow-faced Whip Snake	*Demansia psammophis reticulate*							
Bardick	*Echiopsis curta*				VU	✓		
Black-naped Snake	*Neelaps bimaculatus*							
Tiger Snake	*Notechis scutatus*						x	
Gould's Hooded Snake	*Parasuta gouldii*							
Black-backed Snake	*Parasuta nigriceps*						x	
Dugite	*Pseudonaja affinis affinis*							
Jan's Banded Snake	*Simoselaps bertholdi*							
Southern Half-girdled Snake	*Simoselaps semifasciatus*							

An [X] indicates that the fauna was recorded during the site visit.
* When species falls under more than one 'conservation importance' category, the highest status is noted.

APPENDIX G

AMPHIBIANS RECORDED AND EXPECTED

APPENDIX G

Potential and Recorded Amphibian Species in the Project Area

Species Name	Common Name	EPBC	WC Act	DEC	IUCN	Local	Previously Recorded	Recorded
Hylidae								
Slender Tree Frog	*Litoria adelaidensis*				LC		x	x
Motorbike Frog or Bell Frog	*Litoria moorei*				LC			
Myobatrachidae								
Quacking Frog	*Crinia georgiana*				LC		x	x
Glauert's Froglet	*Crinia glauerti*				LC		x	
Squelching Froglet	*Crinia insignifera*				LC			
Bleating Froglet	*Crinia pseudinsignifera*				LC			
Lea's Frog	*Geocrinia leai*				LC		x	
Western Marsh Frog	*Heleioporus barycragus*				LC	✓		
Moaning Frog	*Heleioporus eyrei*				LC			
Whooping Frog	*Heleioporus inornatus*				LC			
Sand Frog	*Heleioporus psammophilus*				LC	✓	x	
Bullfrog or Banjo Frog	*Limnodynastes dorsalis*				LC			x
Humming Frog	*Neobatrachus pelobatoides*				LC			

[X] indicates that the fauna was recorded during the site visit.
* When species falls under more than one 'conservation importance' category, the highest status is noted.

APPENDIX H

BIRDS RECORDED AND EXPECTED

APPENDIX H

Potential and Recorded Bird Species in the Project Area

Species Name	Common Name	EPBC	WC Act	DEC	IUCN	Local	Previously Recorded	Recorded
Casuariidae								
Emu	*Dromaius novaehollandiae*				LC	✓	x	S
Phasianidae								
Stubble Quail	*Coturnix pectoralis*				LC			
Anatidae								
Grey Teal	*Anas gracilis*				LC			
Pacific Black Duck	*Anas superciliosa*				LC			
Australian Wood Duck	*Chenonetta jubata*				LC			
Australian Shelduck (Mountain Duck)	*Tadorna tadornoides*				LC			
Ardeidae								
Nankeen, Rufous Night Heron	*Nycticorax caledonicus hilli*				LC			
Accipitridae								
Collared Sparrowhawk	*Accipiter cirrocephalus cirrocephalus*				LC			
Brown Goshawk	*Accipiter fasciatus fasciatus*				LC			
Wedge-tailed Eagle	*Aquila audax audax*				LC		x	
Swamp Harrier	*Circus approximans*				LC			
Spotted Harrier	*Circus assimilis*				LC			
Black-shouldered Kite	*Elanus axillaris*				LC			
Whistling Kite	*Haliastur sphenurus*				LC			
Square-tailed Kite	*Hamirostra isura*				LC			
Little Eagle	*Hieraaetus morphnoides morphnoides*				LC			

Species Name	Common Name	EPBC	WC Act	DEC	IUCN	Local	Previously Recorded	Recorded
Falconidae								
Brown Falcon	*Falco berigora berigora*				LC			
Nankeen Kestrel	*Falco cenchroides*				LC			
Australian Hobby	*Falco longipennis*				LC			
Peregrine Falcon	*Falco peregrinus*		S4		LC			
Turnicidae								
Painted Button-Quail	*Turnix varia varia*				LC			
Columbidae								
Common Bronzewing	*Phaps chalcoptera*				LC		x	x
Brush Bronzewing	*Phaps elegans*				LC			
Psittacidae								
Muir's Corella	*Cacatua pastinator pastinator*	VU/Mi	S1		LC			
Galah	*Cacatua roseicapilla*				LC			x
Little Corella	*Cacatua sanguinea*				LC			
Long Billed Corella	*Cacatua tenuirostris*				LC			
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*				LC		x	x
Baudin`s Cockatoo, Long-billed Black Cockatoo	*Calyptorhynchus baudinii*	VU	S1		EN			x
Carnaby`s Black Cockatoo, Short-billed Black Cockatoo	*Calyptorhynchus latirostris*	EN	S1		EN		x	
Australian Ringneck	*Barnardius zonarius*				LC		x	x
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*				LC			
Elegant Parrot	*Neophema elegans*				LC			
Western Rosella	*Platycercus icterotis icterotis*				LC		x	
Red-capped Parrot	*Platycercus spurius*				LC		x	x
Regent Parrot	*Polytelis anthopeplus anthopeplus*				LC	✓		

Species Name	Common Name	EPBC	WC Act	DEC	IUCN	Local	Previously Recorded	Recorded
Cuculidae								
Fan-tailed Cuckoo	*Cacomantis flabelliformis*				LC		x	
Horsfield's Bronze-cuckoo	*Chrysococcyx basalis*				LC		x	
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*				LC			
Pallid Cuckoo	*Cuculus pallidus*				LC			
Strigidae								
Barking Owl (SW population)	*Ninox connivens connivens*			P2	LC			
Southern Boobook	*Ninox novaeseelandiae*				LC			
Tytonidae								
Barn Owl	*Tyto alba*				LC			
Masked Owl (Southern ssp)	*Tyto novaehollandiae novaehollandiae*			P3	LC			
Podargidae								
Tawny Frogmouth	*Podargus strigoides*				LC		x	
Caprimulgidae								
Spotted Nightjar	*Eurostopodus argus*				LC			
Aegothelidae								
Australian Owlet Nightjar	*Aegotheles cristatus cristatus*				LC			
Apodidae								
Fork-tailed Swift	*Apus pacificus*	MI			LC			
Halcyonidae								
Laughing Kookaburra	*Dacelo novaeguineae*				LC		x	x
Sacred Kingfisher	*Todiramphus sanctus sanctus*				LC			
Meropidae								
Rainbow Bee-eater	*Merops ornatus*	MI			LC			
Climacteridae								
Rufous Treecreeper	*Climacteris rufa*				LC		x	

Species Name	Common Name	EPBC	WC Act	DEC	IUCN	Local	Previously Recorded	Recorded
Maluridae								
Red-winged Fairy-wren	*Malurus elegans*				LC		x	
Splendid Fairywren	*Malurus splendens*				LC		x	
Pardalotidae								
Spotted Pardalote	*Pardalotus punctatus*				LC		x	
Striated Pardalote	*Pardalotus striatus*				LC		x	x
Acanthizidae								
Broad-tailed Thornbill (Inland Thornbill)	*Acanthiza apicalis*				LC		x	
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*				LC			
Western Thornbill	*Acanthiza inornata*				LC		x	
Western Gerygone	*Gerygone fusca fusca*				LC		x	x
White-browed Scrubwren	*Sericornis frontalis*				LC		x	
Weebill	*Smicrornis brevirostris*				LC		x	x
Meliphagidae								
Western Spinebill	*Acanthorhynchus superciliosus*				LC		x	
Red Wattlebird	*Anthochaera carunculata*				LC		x	x
Western Little Wattlebird	*Anthochaera lunulata*							x
Yellow-plumed Honeyeater	*Lichenostomus ornatus*				LC			
Singing Honeyeater	*Lichenostomus virescens*				LC			
Brown Honeyeater	*Lichmera indistincta indistincta*				LC		x	x
Yellow-throated Miner	*Manorina flavigula*				LC			
Brown-headed Honeyeater	*Melithreptus brevirostris*				LC			
Western White-naped Honeyeater	*Melithreptus chloropsis*				LC		x	
Tawny-crowned Honeyeater	*Phylidonyris melanops*				LC		x	
White-cheeked Honeyeater	*Phylidonyris nigra*				LC			

Species Name	Common Name	EPBC	WC Act	DEC	IUCN	Local	Previously Recorded	Recorded
New Holland Honeyeater	*Phylidonyris novaehollandiae*				LC		x	
Petroicidae								
Western Yellow Robin	*Eopsaltria australis griseogularis*				LC		x	
White-breasted Robin	*Eopsaltria georgiana*				LC		x	
Jacky Winter	*Microeca fascinans*				LC			
Hooded Robin	*Petroica cucullata*				LC			
Red-capped Robin	*Petroica goodenovii*				LC			
Scarlet Robin (SW Population)	*Petroica multicolor campbelli*				LC	✓	x	
Neosittidae								
Varied Sittella	*Daphoenositta chrysoptera*				LC		x	
Pachycephalidae								
Grey Shrike-Thrush	*Colluricincla harmonica harmonica*				LC		x	x
Crested Shrike-tit (SW ssp)	*Falcunculus frontatus leucogaster*			P4	LC			
Golden Whistler	*Pachycephala pectoralis*				LC		x	
Rufous Whistler	*Pachycephala rufiventris rufiventris*				LC		x	x
Dicruridae								
Magpie-lark	*Grallina cyanoleuca*				LC			
Restless Flycatcher	*Myiagra inquieta*				LC			
Grey Fantail	*Rhipidura fuliginosa*				LC		x	
Willie Wagtail	*Rhipidura leucophrys*				LC			x
Campephagidae								
Black-faced Cuckoo-Shrike	*Coracina novaehollandiae*				LC		x	x
White-winged Triller	*Lalage tricolor*				LC			
Artamidae								

Species Name	Common Name	EPBC	WC Act	DEC	IUCN	Local	Previously Recorded	Recorded
Black-faced Woodswallow	*Artamus cinereus*				LC			
Dusky Woodswallow	*Artamus cyanopterus*				LC		x	
Grey Butcherbird	*Cracticus torquatus*				LC			
Australian Magpie	*Gymnorhina tibicen*				LC			x
Grey Currawong	*Strepera versicolor*				LC		x	
Corvidae								
Australian Raven	*Corvus coronoides*				LC		x	x
Hirundinidae								
Welcome Swallow	*Hirundo neoxena*				LC			
Tree Martin	*Hirundo nigricans nigricans*				LC		x	
Zosteropidae								
Silvereye	*Zosterops lateralis*				LC		x	x
Dicaeidae								
Mistletoebird	*Dicaeum hirundinaceum*				LC			
Passeridae								
Red-eared Firetail	*Stagonopleura oculata*				LC			

An [X] indicates that the fauna was recorded during the site visit.
* When species falls under more than one 'conservation importance' category, the highest status is noted.

Proposed Organic waste recycling facility, Woottating, Shire of Northam: Groundwater and Surface water resources assessment.

October 2008

Table of Contents

1. Background

There is little direct information available to define the local geological, hydrogeological and hydrological conditions at the site at 10 Horton Road, Woottating. Hence a programme of drilling and investigation of groundwater and surface waters at the site was carried out to provide sufficient data to evaluate impacts of the proposed organic waste recycling facility on water resources local to the site, and to define ways in which impacts would be minimised.

2. Site investigation:

The following investigations were carried out:

- Review of a geological map of the region, and of the area specific to the site
- Drilling of 6 bores around the site and installation of 50mm diameter casing and 3m long slotted PVC screens to provide groundwater monitoring points at locations around the site. The installation of the bores was in accordance with Department of Water Guidelines (Water Quality Protection Note: Groundwater Monitoring Bores, June 2005), and the Land and Water Biodiversity Committee's Minimum Construction Requirements for Water Bores in Australia, Edition 2, September 2003. These broadly require use of pea-gravel grout in the annulus around bore screens, backfill above the screens with low permeability 9clay) material and cementing of casing within 150mm diameter PVC outer casing to a depth of 20-30cms below surface;
- Evaluation of soil lithology to the drilled depth from drill cuttings and establishment of bore lithological logs (Table 1);
- Initial monitoring of groundwater levels (rest water levels) in all bores and determination of reduced levels relative to a common site datum to evaluate water table distribution across the site and to determine the local hydraulic gradient;
- Carrying out of slug tests on each bore (Freeze and Cherry, 1979) to determine local saturated hydraulic conductivity of soils at the site, and to assess likely groundwater flow rates;
- Determine relative water levels in the creek running across the site, and with water table evaluations, assess possible groundwater-surface water interaction;
- Collect samples of groundwater from bores, and samples of surface water from the creek to determine background water quality, variability in water quality across the site and to provide further evidence of surface water – groundwater interaction. Standard low-flow sampling techniques (Puls and Barcelona, 1996) were used for this to avoid disturbance of sediments which had separated out from initially turbid groundwater in the bores. Following Groundwater Quality guidelines, TDS, pH and ORP were determined on site during sampling. Following stabilisation of these, samples were taken in plastic bottles supplied by SGS analysts through an in-line 0.45micron filter for determination of dissolved nitrogen and phosphorus compounds.

This information collected in the above investigations has been used to assess impacts of the development, and to recommend actions which can be taken to reduce impacts on water resources.

3. Assessment of Groundwater Resources.

3.1 Geology

The site at Lot 13 Horton Road, Woottating is underlain by soils which are essentially weathered granitic basement rocks and reworked sediments of the Yilgarn Craton. Geological maps of the region and specific to the site indicate significant areas of gravel soils, with alluvium along the course of the Creek which runs across the property.

Lithological logs for each of the drilled bores are shown in Table 1. These largely confirm the presence of lateritic gravel soils immediately beneath the site and some distance from the creek. Much finer, silty and dark brown alluvial soils are found on flatter ground within 20-30m of the creek, confirming information on the geological map.

The generally dark brown coloured lateritic gravels on higher ground beneath the site vary in thickness, and in places (bore BH1, bore BH4) are underlain by light grey sandy clay material, taken to be weathered granitic rock. The latter bores are all on higher ground above the local height datum of 9-10m.

Bore	Depth	Lithological description
BH1	0-1m	Deep brown lateritic gravel with subrounded fragment to 8mm, in dominant coarse, dark brown sandy matrix
	1-2m	Fine to coarse brown sand with some lateritic fragments
	2-3m	Light grey clumps of clay with coarse lateritic and weathered granite sandy material.
	3-4m	Light grey and brownish grey clay particles, with coarse quartz and weathered granite sandy particles.
BH3	0-1m	Brown coloured lateritic gravel with subrounded particles to 10mm, in fine-coarse sand matrix.
	1-2m	Brown lateritic gravel, subrounded fragments to 16mm, in finer gravel matrix of sandy particles 1-2mm dia.
BH4	0-1m	Brown lateritic gravel, 50% subrounded fragments to 16mm in coarse brown sandy matrix
	1-2m	Dark brown fine-coarse sand, minor lateritic gravel fragments to 5mm dia
	2-3m	Brown lateritic gravel, subrounded fragments, 30% to 10mm dia, in coarse brown sand with some fine particles.
	3-4m	Coarse light brown sand particles with <10% gravel and minor soft clay particles
	4-5m	Coarse light grey crystalline sands (quartz) and red-brown particles with <20% finer sand
	5-6m	Light grey coarse sand and coarse brown laterite in clayey light grey matrix, with some larger soft clay fragments.

BH5	0-1m	Deep brown lateritic soil with 50% lateritic gravel, subrounded fragments to 6mm, in dark brown coarse sand matrix with some dark clay fragments (soft).
	1-2m	Deep brown lateritic soil, 60-70% lateritic gravel, subrounded to 6mm dia, in coarse brown sand matrix.
	2-3m	Deep brown laterite, 30% gravel fragments to 8mm dia, in fine-coarse brown sand matrix
BH6	0-1m	Deep brown fine-coarse alluvial sand, 10% lateritic gravel to 8mm dia
	1-2m	Deep brown fine-coarse sand with some clay, 10% lateritic gravel
	2-3m	Deep brown fine-coarse alluvial sand with soft clay fragments, 5% lateritic gravel to 5mm dia.
BH7	0-1m	Brown lateritic gravel ~20% in fine to coarse brown sand matrix.
	1-2m	Light brown, fine to coarse sand, some soft clay fragments
	2-3m	Grey brown fine to coarse sand with some soft clay fragments

Table 1. Lithological description of drill cuttings sampled from air-rotary drill rig, Woottating site, August 2008.

3.2 Groundwater levels and groundwater flow

Unconfined groundwater was found in all bores within 1-2m of the surface on lower-lying ground around the creek as anticipated, and 3-5m below surface on higher ground (Figure 1, Table 2). Contours on reduced groundwater levels (to local height datum) define the water table distribution and hydraulic gradient across the site.

Borehole	**Rest water level m. below top of casing**	**Rest Water level m. local datum**	**Bottom of hole m. below top of casing**
BH1	2.06	8.00	5.43
BH3	1.88	3.63	3.72
BH4	3.35	5.51	4.80
BH5	1.44	3.79	3.83
BH6	1.78	3.74	3.83
BH7	2.99	12.87	4.23

Table 2a. Bore level details September 2008.

Borehole	Rest water level m. below top of casing	Rest Water level m. local datum	Bottom of hole m. below top of casing
BH1	2.13	7.93	5.43
BH3	1.73	3.78	3.72
BH4	3.93	5.33	4.80
BH5	1.62	3.61	3.83
BH6	1.93	3.59	3.83
BH7	Dry, base of hole wet	~11.7	4.23

Table 2b. Bore level details for 8 October 2008.

Contoured groundwater levels to the local datum based on data in Table 2b are shown in Figure 1. These indicate the distribution of the water table across the site within the lateritic gravel and weathered basement and in the alluvial sediments near the creek. Groundwater flow directions (perpendicular to the groundwater contours) are broadly easterly across the site. On higher ground towards the western boundary of the site, hydraulic gradients are steeper (contours more closely spaced), with an estimated hydraulic gradient (i) of 0.09. On lower ground closer to the creek, hydraulic gradients are lower, assessed to be on average 0.01, and groundwater flow is somewhat north of east, moving broadly towards an area of groundwater discharge where the land is waterlogged (Figure 1).

This suggests that at the end of the winter period, groundwater largely discharges into the creek, contributing to baseflow particularly around the broad area of groundwater discharge in the northeast region of the site within a broad meander of the creek (Figure 1). There are also some minor spring discharges on the south eastern corner of the site very close to the creek.

3.3 Shallow Aquifer properties

Slug tests were carried out on all bores, to define particularly the saturated hydraulic conductivity of aquifer sediments. Results are shown in Table 3, and data interpretation graphs using the Hvorslev method (Freeze and Cherry, 1979) are given in Attachment 1.

Borehole	Hydraulic Conductivity (K)	Comment on slug test analysis
BH1	0.5m/d	Poor dataset
BH3	3.7m/d	Good
BH4	0.3m/d	Poor dataset
BH5	2.7m/d	Very good data
BH6	30m/d	Satisfactory to poor dataset
BH7	0.85m/d	Moderate - poor data

Table 3. Results of slug tests carried out on completed bores 4 September 2008. Full analysis using the Hvorslev method is given in Attachment 1.

The resulting hydraulic conductivities (K values) show a wide range of values. Generally, bores on the higher ground (BH1. BH4, BH7) where the proposed facility will be situated show lower K values, these being bores with shallow depths of lateritic soils, and indications of clay materials and weathered granitic rock in the bore logs. These K values are taken to represent typical values for groundwater in weathered granitic basement, and groundwater flows from these areas should be typical of flows directly beneath the proposed facility. Typically these regions of low hydraulic conductivity show the highest hydraulic gradients, discussed above.

Those bores on lower ground adjacent to the creek (BH3, BH5, BH6) show the highest K values and lowest hydraulic gradients, with that for BH6 being very high. These bore locations showed significant depths of lateritic gravels and alluvium with little or no observable clays. Groundwater flow rates in these areas of the site would be expected to be higher than those on higher ground beneath the proposed facility. However, it is possible that flows around the creek are complex, and at times creek water may recharge groundwater (eg when creek levels are high after heavy rain) whilst at other times groundwater slowly discharges to the creek.

Rates of groundwater flow can be estimated for the two regions of the site using Darcys Law. This states that the groundwater flux (volume passing through unit area of aquifer) is proportional to the product of the hydraulic gradient and the hydraulic conductivity. The groundwater velocity can be estimated by dividing the Darcy flux by the estimated porosity of the aquifer media (in this case laterite or alluvial sediment). This has been estimated to be 0.3 from examination of sediment samples.

Average groundwater velocities estimated using Darcy's law, using determined K and i values discussed above are approximately 50- 82m/year.

4. Groundwater quality

4.1 Sampling and Analysis

Samples of groundwater were taken from all bores after considerable baling of water from these in September 2008. Concentrations of Total Dissolved Salts (TDS), pH and Oxidation Reduction Potential (ORP) were determined on site (Table 4a).

All samples had high turbidity in September as a result of recent drilling, although attempts were made to develop (clean out) the turbid water after drilling using compressed air. It was decided to allow the bore water to settle for 2-3 weeks before low-flow sampling (to minimise disturbance of sediment in the bore) for determination of dissolved nitrogen species (ammonium-N, organic N, Total Oxidised nitrogen (nitrite and nitrate), Total-N and ortho-phosphate. The latter are considered to be the main constituent of leachate from the proposed facility, and sampling of groundwater and analysis for dissolved nutrient will establish background levels in groundwater.

Groundwater was sampled again on 8 October 2008, using a Wattera peristaltic pump, when groundwater in each bore was found to have greatly reduced turbidity. The pump line was placed mid-screen in each bore, and this was pumped for several

minutes whilst monitoring TDS, pH, ORP and temperature. These were recorded once stabilised and then a 0.45µ in-line filter was inserted in the pump discharge line and filtered samples were collected in plastic bottles provided by SGS analytical laboratories for later nutrient analysis. Samples were delivered to SGS in an Esky with an ice pack within 2 hours of sampling, and chain-of-custody forms provided to the laboratory. A duplicate sample was taken at BH6, to allow quality assurance / quality control (QA/QC) assessment. Results of this later analysis are shown in Table 4b.

In addition, surface water in the creek was sampled in September and October 2008 and TDS, pH and ORP were determined in water taken at the upstream end of the creek at the southeast corner on the property boundary, and at the downstream end at the fence by the northeast boundary. Surface water samples were also taken for nutrient analysis in October 2008, using the same sampling techniques as for groundwater. A duplicate sample was taken from the upstream location for QA/QC assessment. Results of both sets of data are shown in Table 5a (September 2008) and Table 5b (October 2008).

4 September 2008			
Borehole	TDS	pH	ORP
BH1	1580*	9.2*	43
BH3	102	6.47	155
BH4	174	6.3	43
BH5	451	6.9	126
BH6	1930	5.85	146
BH7	68	6.1	127

Table 4a. Preliminary groundwater quality data for 4 September 2008 a few days after drilling when bore water was mainly turbid,
*****suspected these values are in error due to leakage of water from cement capping around the casing at the surface.

8 October 2008								
Bore	**TDS**	**pH**	**ORP**	**NH4-N**	**Organic-N**	**Total oxidised-N**	**Total-N**	**o-Phosphorus**
BH1	3356	6.53	39	0.6	0.2	0.02	0.85	<0.003
BH3	168	6.73	116	<0.1	0.9	5.7	6.6	<0.003
BH4	174	6.10	163	0.1	0.6	7.1	8.0	<0.003
BH5	545	5.54	193	<0.1	1.0	4.0	5.1	<0.003
BH6a	2280	5.53	290	<0.1	0.2	0.03	0.31	<0.003
BH6b	-	-	-	<0.1	<0.2	<0.02	0.22	<0.003

Table 4b. Results of analyses of samples taken on 8 October when most turbidity had settled out from standing water. Nutrient samples were collected using low-flow techniques and filtered (0.45µ) in-line from the peristaltic sampling pump. BH6a and BH6b are duplicate samples taken for quality assurance /control (QA/QC) purposes.

4 September 2008			
Location	TDS	pH	ORP
Upstream	1960	6.84	80
Downstream	2270	7.05	84

Table 5a. Initial sampling and analysis of stream water, 4 September 2008.

8 October 2008								
Location	**TDS**	**pH**	**ORP**	**NH4-N**	**Organic-N**	**Total oxidised-N**	**Total-N**	**o-Phosphorus**
Upstream a	2280	6.55	90	<0.1	0.4	0.16	0.61	<0.003
Upstream b	-	-	-	<0.1	0.4	0.08	0.47	<0.003
Downstream	2550	6.69	145	<0.1	0.3	0.15	0.44	<0.003

Table 5b. Results of analysis of samples of stream water taken on 8 October 2008.

4.2 Groundwater and surface water quality

The results of initial sampling and analysis of groundwater in September 2008, shown in Table 4a indicate that groundwater is of low salinity on higher ground below where the proposed facility will be sited, with TDS varying from 68mg/L in bore BH7 on the highest level in the catchment, 102mg/L in BH3 and 174mg/L in BH4 closer to the creek, but still on higher ground. In October 2008, bore BH7 was dry but bores BH3 and BH4 still showed the lowest TDS values.

Groundwater in bore BH1 on the eastern site boundary shows anomalously high salinity and pH in September, and high salinity in October. Some contamination of water by cement grouting at the surface is suspected to be the cause of these anomalous results.

Bores BH5 and BH6 are much closer to the creek and on lower ground, and showed higher TDS values (451mg/L and 1930mg/L respectively) in September 2008. These had increased somewhat by October 2008, and pH values were somewhat lower than those in bores BH3 and BH4 higher in the catchment. Both bores BH5 and BH6 are closer to the groundwater discharge zone (particularly bore BH6 some 30m from the creek). The latter bore particularly shows salinities similar to those in the creek at this location, which suggests some recharge of groundwater by the creek, or a possible impact of evaporation of discharged groundwater and a general increased salinity in and around the zone of groundwater discharge and around the creek.

The creek itself shows consistently high TDS (salinity) in September and October 2008, when reasonable stream flows were noted. Where the creek flows onto the southern boundary of the property, TDS concentrations of 1960mg/L were found in

September, rising to 2280mg/L in October. Downstream where the creek leaves the property on the northern boundary, salinities were higher, showing 2250mg/L in September and 2550mg/L in October. The increased salinity is considered to arise from accumulated salts in the groundwater discharge zone entering the stream either as direct groundwater discharge (baseflow) , or as spring flows or possibly from flushing of accumulated salts in the soils by streamflow around the main discharge area.

It is concluded that the stream has degraded water quality from secondary salinisation consistently throughout the winter period, as this was sampled at the end of the winter period in September and October. The property itself would seem to contribute additional salts to the stream as it flows from east to west across the property.

4.3 Nutrients in groundwater and surface water

Dissolved nitrogen and phosphorus species concentrations were determined in both surface waters and groundwater at the site in October 2008 (Tables 4b and 5b). The QA/QC duplicate samples show reasonable correspondence for bore BH6 (Table 4b) and the upstream creek sample (S1 in Table 5b).

Of the groundwater samples, bores BH3, BH4 and BH5 showed somewhat elevated concentrations of oxidised nitrogen (nitrite plus nitrate) and lesser concentrations of organic nitrogen (Table 4b), whilst bores BH1 and BH6 to the south contain much lower oxidised and organic nitrogen. There are low concentrations of ammonium-N in all groundwater samples except BH1, where 0.8mg/L was detected. No dissolved phosphorus was detected in any of the groundwater samples.

The data in Table 4b indicate that groundwater downgradient of the proposed leachate ponds and retention pond (Figure 1) shows elevated concentrations of oxidised nitrogen and organic nitrogen, presumable from past application of fertilisers and manures on the property or on adjoining property to the west.

Water in the creek shows no evidence of elevated concentration of nitrogen or phosphorus either upstream or downstream of the property (total nitrogen 0.4-0.6mg/L and <0.003mgP/L), despite receiving groundwater discharge from the site. This suggests that baseflow and spring discharge to the creek is a relatively small proportion of total streamflow, or possibly oxidised nitrogen in groundwater is removed by bacterial denitrification within the areas of groundwater discharge (Figure 1) where the soils are waterlogged and groundwater is possibly anoxic.

5. Assessment of Impacts of the proposed facility on groundwater and surface water

5.1 Infiltration through soils

Most liquids arising on site within the site boundaries are collected in leachate or stormwater drains and stored in HDPE lined ponds, or during storm events in an additional retention pond if volumes of collected water are sufficient to warrant this. Thus most if not all of the fluids arising on site would be collected from hardstanding

or compacted clay areas and export off-site onto more permeable soils would be expected be negligible.

The permeable nature of undisturbed lateritic and alluvial soils on the site outside of the main proposed site boundaries would clearly allow infiltration of rainfall and other liquids discharged from the site, such as from the retention pond and the proposed swale area intended for management of overflow from the retention pond during 1 in 10year storm events. The latter overflow water is considered likely to have low salinity and low concentrations of nutrients during the high flow events. Any impacts on the groundwater system from dissolved salts and nitrogen contaminants would be expected to be within current background concentrations in groundwater (eg see Table 4b).

Despite this, it is recommended that two shallow interception bores are emplaced downgradient of the leachate ponds close to and to the north of the current location of monitoring bore BH3 (shown in Figure 1), where alluvial soils are relatively permeable and where groundwater salinities are low and unaffected by high salinities in the creek and groundwater discharge areas. Groundwater pumped from these bores would be stored in either leachate or retention ponds and re-used in the composting process as make-up water.

5.2 Leachate management

The most contaminating fluids on site, leachate draining from the primary (covered) composting areas on hardstanding and from the secondary composting areas, are intended to be stored in the HDPE lined leachate ponds 1 and 2, with most contaminating leachates also being stored in tanks near the food waste storage and mixing area. Leachates would be recycled on site as make-up water for the composting process.

Possible leakage through the pond liner would impact on groundwater quality, most likely from nitrogenous compounds (ammonium-N and organic-N). Potential leakage rates of 100L/ha/d through such liners (eg Class III landfill liners) could be anticipated, based on DEC Guidelines.

The two ponds have a combined area of ~3500m2 (Figure 1); thus potential leachate discharge through the liner is estimated to be ~ 35L/d. If this discharge contained 1g/L total nitrogen (considered to be a worst case scenario) then the groundwater potentially could receive 35g/d of nitrogen in the 35L/d of discharge.

The total volume of groundwater flowing beneath the leachate ponds can be determined from Darcy's law and the flownet downgradient of the leachate ponds shown in Figure 1. The total flow of groundwater (Q m3/y) flowing beneath the ponds is given by Darcy's Law as follows

$$Q = K\ i\ A \qquad \text{(Eq 1)}$$

Where K is the hydraulic conductivity of the alluvial materials (4m/d as for BH3, Table 3)

i is the hydraulic gradient (0.01 from Figure 1)

and A is the cross-sectional area of aquifer within the flownet downgradient of the ponds (determined as 40m length by an estimated 3m depth of aquifer, total 120m^2).

The total flowrate of groundwater beneath the ponds is thus estimated to be 4.8m^3 /d.

The potential increase in concentration of total nitrogen immediately downgradient of the ponds as a result of this rate of leakage is thus 7.3mg/L, assuming mixing of leachate and groundwater within the shallow aquifer. This compares with the current background concentrations within this part of the aquifer of ~5 to 8mg/L as N (Table 4b).

Given that this is a worst-case scenario of nitrogen concentration in leachate, then impacts of leakage of leachate through the HDPE liners would give a negligible increase in concentration immediately downgradient of the ponds. However, installation of the shallow interception bores and pumping of groundwater immediately downgradient of the ponds from these would provide an additional barrier reducing contaminant movement in groundwater towards the creek. As indicated above, this would also provide additional make-up water for the composting process over the drier summer months.

5.3 Creek water quality

As indicated above, the surface water quality in the creek is currently poor, with higher salinities in this than in groundwater higher in the catchment. There were also low concentrations of nutrients in the stream in October 2008, when sampled, despite elevated concentrations of oxidised nitrogen and organic nitrogen in groundwater. It is concluded above that either baseflow of groundwater to the stream is a small proportion of the total stream flow in October 2008, and/or nitrogen is being attenuated within the groundwater system, for example by denitrification near the waterlogged groundwater discharge area.

6. Summary, Conclusions and Recommendations

The proposed composting facility at Woottating aims to contain as much water and leachate within the facility, and to re-use water within the composting process, so off-site impacts are thereby minimised. Leachate is contained within two leachate ponds which are lined with HDPE, and there is provision in the longer term for capture of stormwater from 10-year storm events in a retention basin. The latter basin is designed to overflow into a swale drain for infiltration of excess water if the retention basin becomes full to capacity. The latter stormwater would be low salinity, low nutrient water collected from the storm event. Hence most fluids are contained within the main site for reuse in the composting process.

Water discharge off-site, such as that in the swale drain, would infiltrate through the permeable lateritic and alluvial soil into the underlying shallow, unconfined aquifer. The latter groundwater flows mostly eastwards towards a small creek running across the property. Groundwater discharges to the creek as baseflow, and in small spring discharges, as well as through a waterlogged groundwater discharge area where vegetation (mostly grasses) have been impacted, presumably by salt accumulation.

Shallow groundwater is mostly of good quality, with TDS between 68-451mg/L, but near the creek, TDS increases to over 2000mg/L. The creek itself is of poor quality, with over 2000mg/L TDS. Groundwater contains up to 8mg/L Total nitrogen, mostly oxidised nitrogen (nitrite plus nitrate) and lesser amounts of organic nitrogen in the area immediately downgradient of the proposed leachate ponds and swale drain. Elsewhere groundwater contains low concentrations of nutrients. The surface water in the creek also shows low concentrations of nitrogen, and no detectable phosphate.

Impacts of the facility on shallow groundwater and the surface water in the creek have been assessed. Given the relatively high background concentration of total nitrogen in the groundwater immediately downgradient of the swale drain, it is considered unlikely that water discharged into the latter would impair groundwater quality with respect to total nitrogen. Additionally, the TDS of groundwater would decrease as stormwater infiltrates through the shallow (1-2m deep) unsaturated zone. Despite this, it is recommended that two shallow interception boreholes be emplaced immediately downgradient of the leachate ponds and swale drain for monitoring of groundwater quality, for removal of any contaminated groundwater and to use pumped water for make-up supplies to the composting plant.

Leachates from the composting process are contained within the leachate ponds by HDPE liners. An assessment of impacts of typical rates of leakage from these (100L/ha/d for a class III HDPE lined landfill) has been carried out using a simple Darcian model, assuming a worse-case scenario of leachate containing 1g/L total nitrogen. This assessment indicates a potential concentration of total nitrogen immediately downgradient of the leachate ponds of ~7mg/L, within the background total nitrogen concentration range in groundwater of 4-8mg/L. This impact is considered to be minimal.

Much larger impacts would occur from a major breach of a pond liner. However, there is sufficient additional storage on site to pump out any remaining leachate from the pond if this occurred. Also the two shallow interception bores downgradient of the ponds would provide an additional barrier to offsite movement of contaminated water within the groundwater system.

Groundwater currently does not have any detrimental effect on nutrient concentrations within the creek, despite elevated concentrations of total nitrogen in groundwater. Hence baseflow to the creek from groundwater is only a small proportion of total flow at present (at the end of the winter period), or oxidised nitrogen is being attenuated in the groundwater system near its point of discharge. The surface water quality is generally poor, with TDS over 2000mg/L. It is considered that the Woottating compost facility would not impair water quality (nitrogen contaminants particularly)

within the creek, given the multiple barriers (liners and interception bores) to minimise movement of these in groundwater at the site.

It is concluded that the current distribution of monitoring bores at the site is adequate for assessing impacts of the proposed development on groundwater, although it is clear there are several additional sources of contaminants (nutrients, salts) within the area. As indicated above, it is recommended that two interception boreholes be emplaced downgradient of the leachate ponds and swale drain to provide additional monitoring points of impacts of the ponds and swale discharges on groundwater, to recover any contamination by intercepting groundwater flow and any contaminated leakage from the ponds, and also to provide additional make-up water for the composting process. The location and design of the interception bores, and assessment of effects of groundwater interception are outside the scope of this report. This information would likely be required when application is made to the Department of Water for licences to drill these bores and for abstraction of groundwater for the above purposes.

7. References

Freeze RA and Cherry JA, 1979. Groundwater. Prentice Hall.

Puls RW and Barcelona MJ,1996. Low flow (minimal drawdown)groundwater sampling procedures.USEPA ReportEPA/540/S-95/504, Cincinnati, Ohio.

Limitations of this report

This report was prepared at the request of Bowman and Associates Pty Ltd. In evaluating information, reports and comments, Crisalis International Pty Ltd (CIPL) has relied in good faith on the information provided by Bowman and Associates Pty Ltd. We accept no responsibility for any deficiency or inaccuracy contained in this report as a result of our reliance on the aforementioned information.

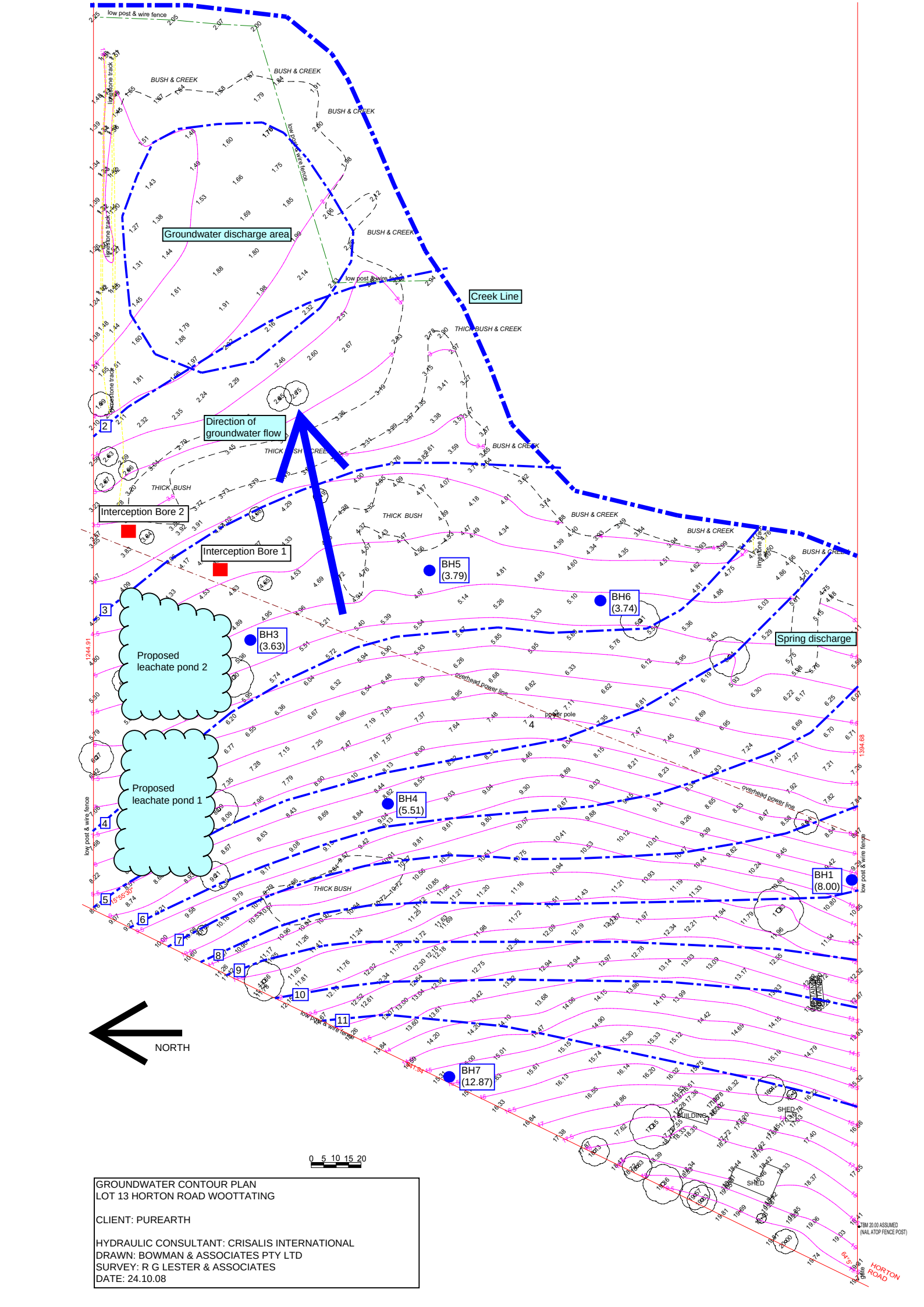
The findings and conclusions documented in this report have been prepared for specific application to this project, and have been developed in a manner consistent with that level of care normally exercised by environmental professionals currently practicing under similar conditions in this jurisdiction. Crisalis International makes no other warranty, expressed or implied.

Dr Chris Barber
Director / Principal, Crisalis International Pty Ltd

Figure 1 (Following)

Map of the Woottating site showing:

- locations of monitoring bores BH1-7,
- rest water levels (m. to local datum) for each bore as measured in October 2008,
- estimated groundwater contours (blue) based on borehole water levels,
- positions of proposed leachate ponds (in aqua), and
- proposed interception bores (in red).



GROUNDWATER CONTOUR PLAN
LOT 13 HORTON ROAD WOOTTATING

CLIENT: PUREARTH

HYDRAULIC CONSULTANT: CRISALIS INTERNATIONAL
DRAWN: BOWMAN & ASSOCIATES PTY LTD
SURVEY: R G LESTER & ASSOCIATES
DATE: 24.10.08

Attachment 1. Slug test analysis.

Freeze and Cherry (1979) provide details of the Hvorslev analysis of slug test data for determination of hydraulic conductivity in piezometer tubes. The piezometers at Woottating were all 50mm diameter tubes with 2n long slotted screens to base of each bore.

The Hvorslev analysis and solution defines a basic time lag (To) which can be related to the relative bore recovery after removing a "slug" of water from the bore as

$$[(h - H) / (Ho - H)] = e^{(-t/To)}$$

Where
H is the bore rest water level
Ho is the initial level after removal oif water from the bore
H is the measured water level at time t
And the term in square brackets is the relative bore recovery (varies between 0 and 1)

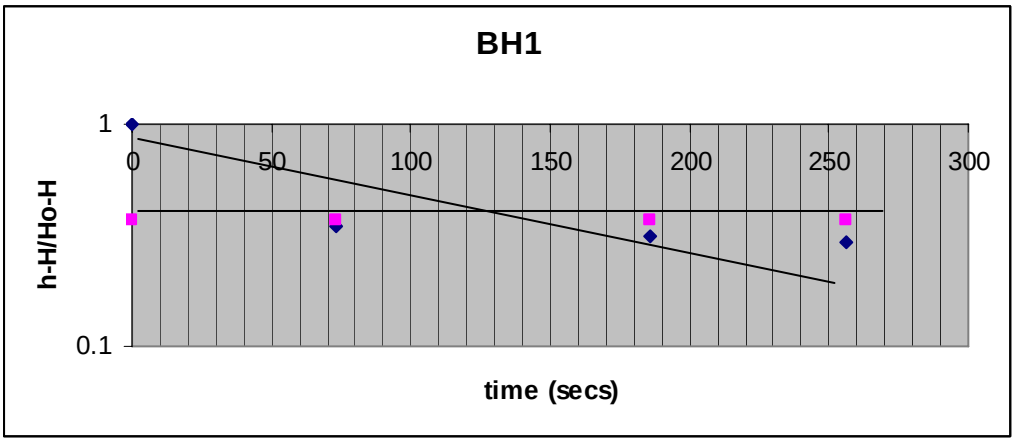
Plotting log [(h - H) / (Ho - H)] against time, where the [ ] = 0.37, t = To.

Hydraulic conductivity is then given by

$$K = r^2 \ln[L/r) / 2.L.To$$

Plots of slug test data for each bore are shown below, with resulting To and K values.

Bore BH1

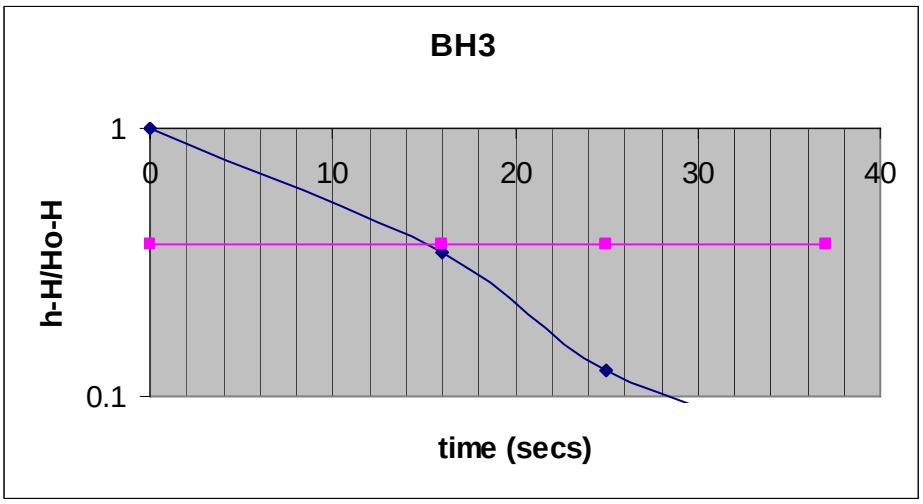


To = 120 secs

K = 0.5 m/d

Dataset is poor, but the estimate of K is considered reasonable.

Bore BH3

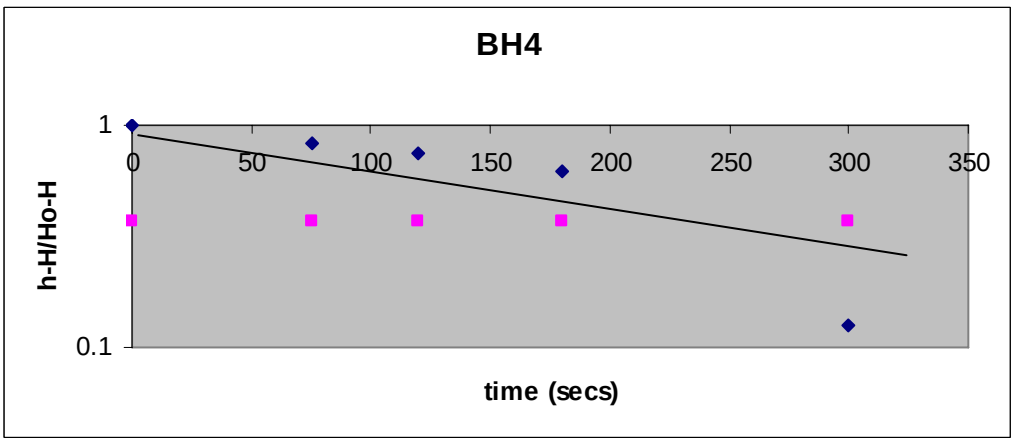


To = 16 secs

K = 3.7m/d

The value of K is considered reasonably accurate.

Bore BH4

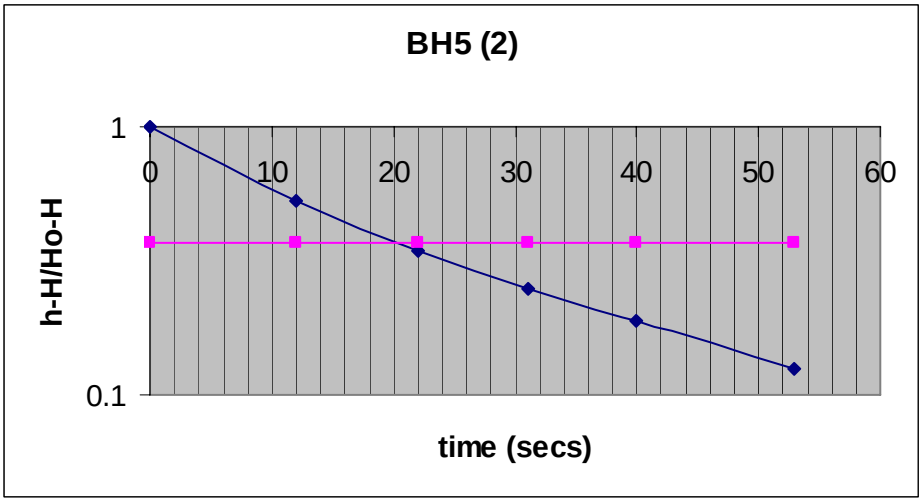


To = 200 secs

K = 0.3 m/d

The estimated K is possibly order-of-magnitude indication, given the poor dataset.

Bore BH5

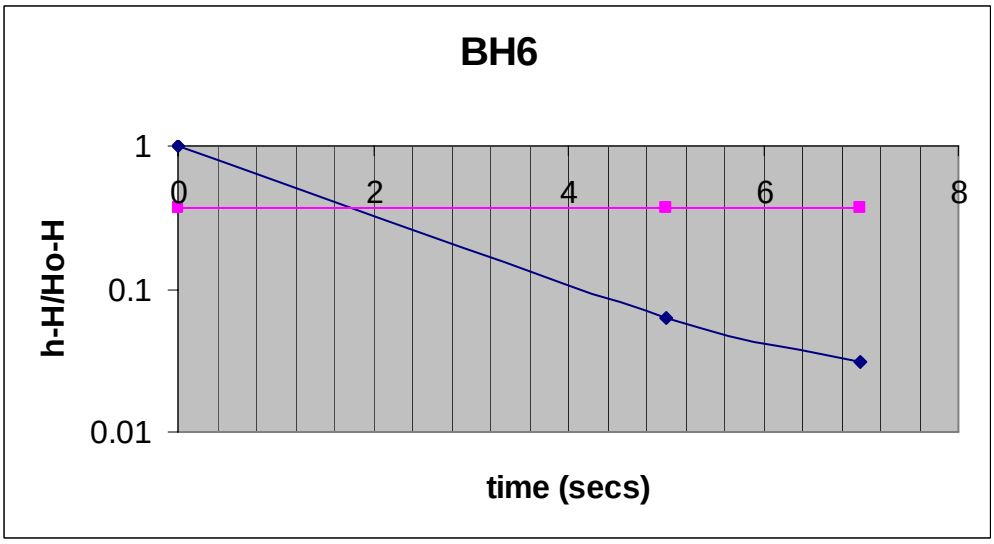


To = 22 secs

K = 2.7 m/d

The estimated K is considered accurate.

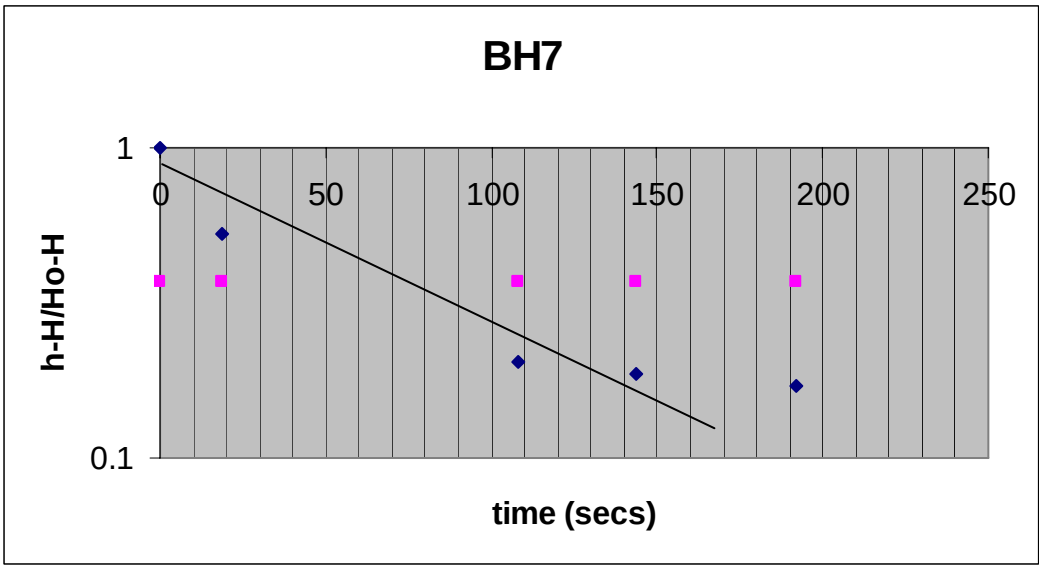
Bore BH 6



To = 2 secs

K = 30 m/d

The estimated K is considered reasonably accurate from the results above.



To = 70 secs

K = 0.85 m/d

The estimated K is approximate, given the dataset above.

Attachment 2. Analytical results from SGS.

crisalis international pty ltd

SGS

CLIENT: Crisalis International Pty Ltd **OUR REFERENCE:** PE018920
PROJECT: Water Analysis

LABORATORY REPORT

Your Reference Our Reference Date Sampled Type of Sample	Units	BH1 PE018920-1 8/10/2008 Water	BH2 PE018920-2 8/10/2008 Water	BH3 PE018920-3 8/10/2008 Water	BH4 PE018920-4 8/10/2008 Water	BH5 PE018920-5 8/10/2008 Water
Ammonia Nitrogen NH_3-N	mg/L	0.6	<0.1	<0.1	0.1	<0.1
Organic Nitrogen as N	mg/L	0.2	<0.2	0.9	0.6	1.0
Kjeldahl Nitrogen (calculated)	mg/L	0.83	0.20	0.94	0.82	1.1
Total Persulphate Nitrogen, N	mg/L	0.85	0.22	6.6	8.0	5.1
NOx-N	mg/L	0.020	0.022	5.7	7.1	4.0
Ortho Phosphorus, PO_4-P	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003

Your Reference Our Reference Date Sampled Type of Sample	Units	BH6 PE018920-6 8/10/2008 Water	S1 PE018920-7 8/10/2008 Water	S2 PE018920-8 8/10/2008 Water	S3 PE018920-9 8/10/2008 Water
Ammonia Nitrogen NH_3-N	mg/L	<0.1	<0.1	<0.1	<0.1
Organic Nitrogen as N	mg/L	0.2	0.4	0.4	0.3
Kjeldahl Nitrogen (calculated)	mg/L	0.28	0.45	0.40	0.29
Total Persulphate Nitrogen, N	mg/L	0.31	0.61	0.47	0.44
NOx-N	mg/L	0.028	0.16	0.075	0.15
Ortho Phosphorus, PO_4-P	mg/L	<0.003	<0.003	<0.003	<0.003

VIPAC ENGINEERS & SCIENTISTS

Vipac Engineers & Scientists Limited A.C.N. 005 453 627 A.B.N. 33 005 453 627

3/320 Great Eastern Highway, ASCOT WA 6104, Australia
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MEMORANDUM

Attention:	**Paul Curtis**	Date:	**11 Mar 2009**
Company:	**Purearth**	Pages:	**1 of 7**
Email:	**Paul.Curtis@purearth.com.au**	Document No:	**60W-08-0043-TRP-378390-2**
From:	**William Dawson**	Reviewed By:	**Elizabeth Cheng**
Subject:	**Purearth Organics Recycling Facility – Environmental Noise Assessment**		

CC:	Name:	Company:	Email:
	Bruce Bowman	**Bowman & Associates Pty Ltd**	**bruce@bowmanassociates.com.au**

Dear Paul,

Re: Purearth Organics Recycling Facility – Environmental Noise Assessment

VIPAC Engineers & Scientists Ltd. were engaged to conduct an environmental noise assessment of the noise emitted from the proposed Purearth Organics Recycling Facility located at Lot 13 Horton Road, Woottating, Western Australia. This report presents the results of our noise impact assessment on nearby noise sensitive receiver locations based on future operations at the Organics Recycling Facility.

1. REFERENCES

[1] Environment Protection (Noise) Regulations 1997. Department of Environmental Protection, Government of Western Australia.

[2] Noise data sheet for Volvo Model L120E Loader provided by Little Loads on 24th February 2009.

[3] Western Australian Planning Commission, May 2005. Statement of Planning Policy: Road and Rail Transport Noise (Draft).

[4] Site layouts and vehicle access plans provided by Bowman & Associates Pty Ltd on 16th December 2008. Drawings: 081020a Site Layout Stage 1.pdf, 081020a Site Layout Stage 2.pdf, 081211 Wooroloo Buffer Zone.jps, Figure 3 Vehicle Access Plan.pdf.

2. ASSESSMENT CRITERIA

The legislation covering environmental noise in Western Australia is the Environmental Protection (Noise) Policy Regulations 1997 [1], which sets out the maximum allowable noise levels based on the time of day and land use, applicable at noise sensitive premises in the vicinity of the development. The maximum allowable noise levels are determined based on the assigned noise levels (L_{A10}, L_{A1}, and L_{Amax}) adjusted with the influencing factor calculated in accordance with the Regulations which takes into account the land zoning in the vicinity of the receiver location. Table 2-1 shows the maximum assigned noise levels at various premises.

Table 2-1: Assigned noise levels depending on type of premises receiving noise [1].

Type of premises receiving noise	Time of day	Assigned level (dB)		
		L_{A10}	L_{A1}	$L_{A\ max}$
Noise sensitive premises at locations within 15 metres of a building directly associated with a noise sensitive use	0700 to 1900 hours Monday to Saturday	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 22 hours all days	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday, public holidays	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises at locations further than 15 metres from a building directly associated with a noise sensitive use	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises	All hours	65	80	90

The closest noise sensitive receiver is a residence (house) located at 132 Warrin Road, which is approximately 530m south of the proposed development, and is situated in a rural area (no commercial or industrial zones exist within 450m of the property, nor any significant roads). We therefore consider that no influencing factor is required at the nearest receiver, which will have the scheduled limits as per Table 2-2.

Table 2-2: Assessment criteria at the nearest noise sensitive premises.

Time of day	Noise criteria (dB)		
	L_{A10}	L_{A1}	$L_{A\ max}$
0700 to 1900 hours Monday to Saturday	45	55	65
0900 to 1900 hours Sunday and public holidays	40	50	65
1900 to 22 hours all days	40	50	55
2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35	45	55

We note that in addition to the criteria outlined above, if the far field sound pressure level produced by the source exhibits tones, modulation, or contains an impulse component, the measured noise level would incur a 5dB(A) penalty for tones and modulation and a 10dB(A) penalty for impulsiveness [1], to a maximum cumulative penalty of 15dB(A).

Noise emissions from vehicles and trucks travelling to / from the facility are not covered by the Environmental Protection (Noise) Regulations 1997 [1], and we therefore note that the design criteria outlined above do not apply for traffic noise. We propose the application of the WA Planning Commission's Statement of Planning Policy: Road and Rail Transport Noise (Draft), May 2005 [3]. The draft policy provides the following target continuous equivalent noise exposure levels (L_{Aeq}) depending on the time of day:

- Day-time (6:00 a.m. – 10:00 p.m.) – L_{Aeq} 55dB(A).
- Night-time (10:00 p.m. – 6:00 a.m.) – L_{Aeq} 50dB(A).

We note that the draft policy [3] stipulates that where the above noise levels are achieved no action is required under the policy in relation to the management or amelioration of transport noise.

3. SITE DESCRIPTION AND UNDERSTANDING

We have conducted our assessment of noise due to the Purearth Organics Recycling Facility based on the following understanding:

- The hours of operation of the facility will be from 7:00 am to 5:00 p.m. Monday to Saturday inclusive, excluding Christmas Day and Good Friday. We have therefore conducted assessment of noise from the site against the day-time noise criterion between 0700 and 1900 hours as per the Regulations [1].
- We understand that the following equipment / machinery will operate within the facility during standard operation:
  - A mulcher used to shred organic waste material. We understand that this will be located outside the mixing shed.
  - A single Volvo Loader (Model: L120E Loader) used to move compost material around the site. We have based our noise assessment on the provided noise data for the Volvo Model L120E Loader which stipulates a radiated sound pressure level of 76 to 82dB(A) at 7m from the unit [2].
  - An excavator used to move compost / recycled material.
  - Truck loading / unloading within the site. We understand that the truck would generally be left idling while being loaded with the Volvo loader.
  - Screening plant used to sort the organic waste.
- In addition to the equipment operated within the site, we understand that heavy trucks will be used to move compost and recycled material to / from the facility. We understand that the proposed transport route is for trucks to exit the site and drive down the northern end of Horton Road. The trucks will then turn right into a private road, approximately 700m long, to be constructed along the southern boundary of Lot 9249 Carter Road. The private road would lead directly into the eastern end of Carter Road. Trucks will drive towards the west along Carter Road and, in most instances, turn left onto Great Eastern Highway. Figure 3-1 shows the proposed vehicle access plan provided by Bowman & Associates Pty Ltd [4]. We understand that there will be a maximum of up to 14 heavy vehicle movements per day from Stage 2 of the development (Year 5).

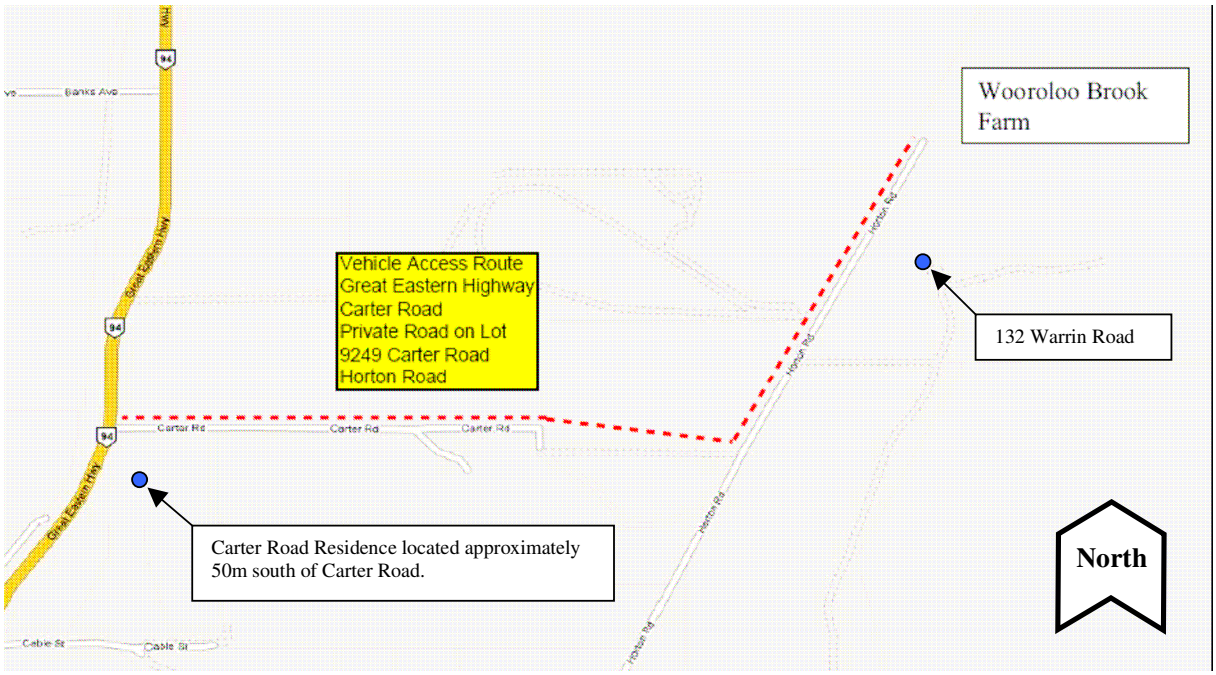


Figure 3-1: Proposed vehicle access route for trucks entering / exiting the recycling facility [4].

- We understand the development site has the following boundaries:
  - North – 284 Warrin Road, a 284Ha grazing property.
  - East – 598 Warrin Road, a 225Ha grazing property.
  - South – 132 Warrin Road, a 132 Ha property.
  - West – 3 Great Eastern Highway. Owned by Quintal, used for grazing.

4. NOISE SURVEY

Manual (attended) noise measurements were conducted at an existing Purearth recycling facility in order to measure noise levels of equipment and machinery expected to operate at the new facility. Measurements were conducted 9th December 2008 during operation of recycling equipment (mulcher, loading of a truck, and excavators) using a Bruel and Kjaer Class 1 Hand-held Analyser Type 2250 (Serial Number 2630389) with an approved windshield fitted at all times. The sound level was spot calibrated using a Larson Davis precision acoustic calibrator before and after the measurements. The calibrations were found to be consistent before and after the measurements, with no drift in measured sound pressure levels.

5. RESULTS AND ASSESSMENT

Assessment of noise levels due to operations within the proposed Organics Recycling Facility and truck movement along the proposed route from Great Eastern Highway to the facility was conducted based on the proposed site layouts provided [4], and the following conditions:

- Excess attenuation calculated using the CONCAWE prediction method, and Category 6 weather condition (worst-case conditions).
- Atmospheric absorption based on 50% humidity, 25°C.

Table 5-1 presents a summary of the predicted noise levels at the nearest noise sensitive receivers and assessment against the relevant criteria (i.e. for operations conducted Monday to Saturday inclusive, from 7:00 a.m. to 5:00 p.m.). Note that in each case we have considered the worst-case conditions (i.e. the Volvo loader operating at the southern side of the site, closest to the receiver location), and that for continuous operation of each of the noise sources during the operation hours between 7:00 a.m. to 5:00 p.m., the calculated equivalent continuous noise levels L_{Aeq} would be similar to the L_{A10} levels.

Table 5-1: Predicted noise levels at the nearest noise sensitive boundary (132 Warrin Road, located approximately 500m south of the proposed facility) rounded to the nearest whole dB, and assessment against night-time environmental noise criterion.

Activity / Site operation	Predicted noise level, dB(A)	Day-time Noise Criterion, dB(A)	Assessment
Volvo loader operating at the southern end of the site	44	45	Criterion achieved.
Truck loading at the southern end of the facility	24		Criterion achieved.
Mulcher located next to the mixing shed	36		Criterion achieved.
A digger / excavator operating at the southern end of the site	33		Criterion achieved.
Screening plant at the southern end of the site	44		Criterion achieved.
Total	48	45	Criterion *exceeded*.

In addition to noise sources within the recycling facility, we have assessed noise due to heavy truck movement along the proposed travel route outlined in Section 3. Note that we have considered noise impact at the nearest affected premises as follows:

- Carter Road residence – located approximately 50m south of Carter Road, and
- 132 Warrin Road – located approximately 200m east of Horton Road.

For each receiver, we have conducted assessment based on a maximum of 2 heavy truck pass-bys within a 15-minute period (i.e. one truck leaving the facility as another is entering). Table 5-2 displays assessment of heavy truck noise on the receivers outlined above.

Table 5-2: Predicted continuous equivalent A-weighted noise level (L_{Aeq}) due to truck movements along the proposed transport route on the nearest affected receivers.

Noise sensitive receiver	Predicted noise level, dB(A)	Day-time Vehicle Noise Criterion, dB(A)	Assessment
Carter Road residence	29	55	Criterion achieved
132 Warrin Road	16		Criterion achieved

Based on the predicted noise levels, we comment as follows:

- We note that overall noise levels due to operations within the Purearth Organics Recycling Facility will be dominated by operation of the screening plant and the Volvo loader within the site. Simultaneous operation of the screening plant and the loader within the facility will exceed the environmental noise design criterion by up to 3dB under worst-case conditions (i.e. worst-case meteorological conditions with the Volvo loader located at the southern side of the facility).

- Noise due to other operations within the facility (truck idling during loading, operation of the mulcher and excavator) will achieve the day-time noise criterion and is not expected to impact upon the amenity of the nearest noise sensitive receivers.

- Noise due to heavy vehicle movement along the proposed transport route will readily achieve the traffic noise criterion. We therefore consider that no treatment / amelioration measures are required to treat vehicle noise outside the facility and along the proposed road.

6. RECOMMENDATIONS

We note that under worst-case meteorological conditions, noise due to operation of the screening plant and a Volvo loader within the facility will result in an exceedance of the environmental noise design criterion. In order to achieve the noise limits stipulated by the Environment Protection (Noise) Regulations 1997 [1], we make the following acoustic recommendations:

- We note that an acoustic barrier installed between the operating Volvo loader and the nearest noise sensitive premises with an effective height of no less than 5m will achieve the environmental noise design criterion. We note that the barrier should be 5m high extending from the facility hardstand level (the level that the Volvo loader will be operating at) and may be constructed as a combination of an earth mound and a fence (constructed from either 9mm fibre cement sheeting or colorbond steel sheeting). Where the hardstand is to be sunk below the existing ground level, we note that the required height of the barrier would be reduced, i.e. where the hardstand is 2m below ground level, a barrier of only 3m height installed to ground level would provide an effective barrier height of 5m, and would therefore provide sufficient attenuation. Note that the barrier should be continuous (i.e. extend to be flush with ground level), as any gaps or discontinuities will significantly reduce the acoustic performance.

- We note that installing the acoustic barrier away from the hardstand perimeter, along the southern site boundary (refer Figure 6-1) would achieve the environmental noise design criterion.

- We understand that the entrance road into the facility (leading from Horton Road) is required to enter from the southern side of the site, and would make construction of a barrier directly to the perimeter of the hardstand area difficult (noise flanking through the vehicle entrance would reduce the acoustic performance of the barrier).

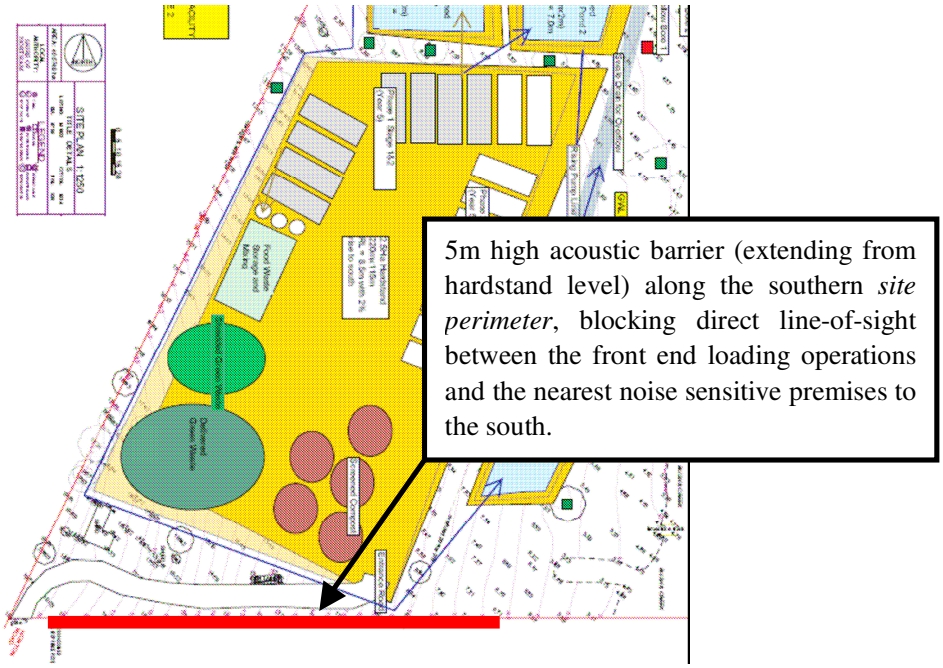


Figure 6-1: Acoustic barrier installed to southern site perimeter.

We trust that the information provided is satisfactory. However, if you have any queries or require further information, please do not hesitate to contact us.

Yours sincerely,

VIPAC ENGINEERS & SCIENTISTS LTD –

William Dawson
Project Engineer

11.2 DRAWINGS

DRAWING 1: LOCATION SKETCH

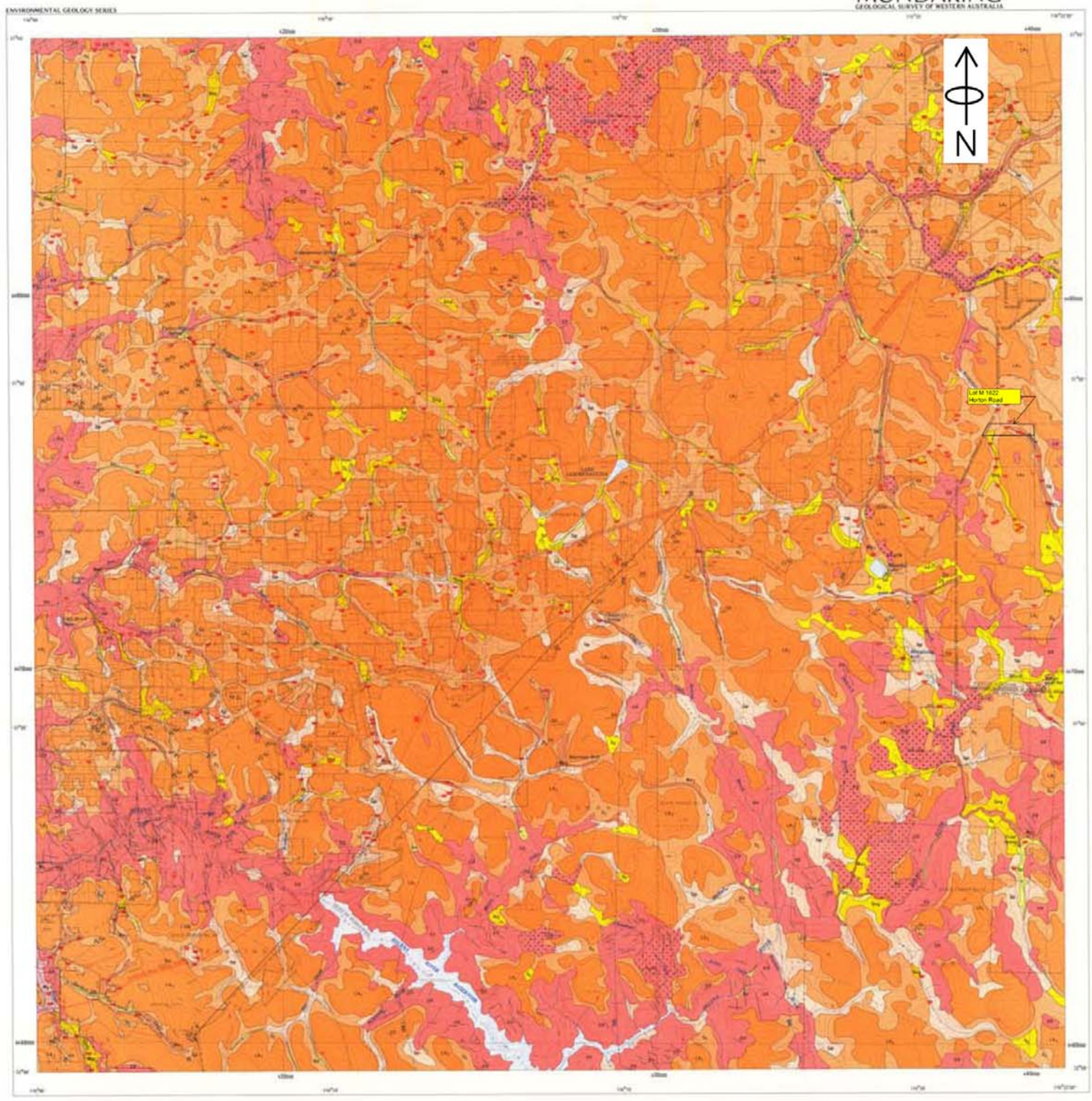
Bowman and Associates Pty Ltd	
ABN 22 112 399 514	
PO Box 2059	Phone: 0402 373 582
Rossmoyne WA 6148	Fax: 9457 6277

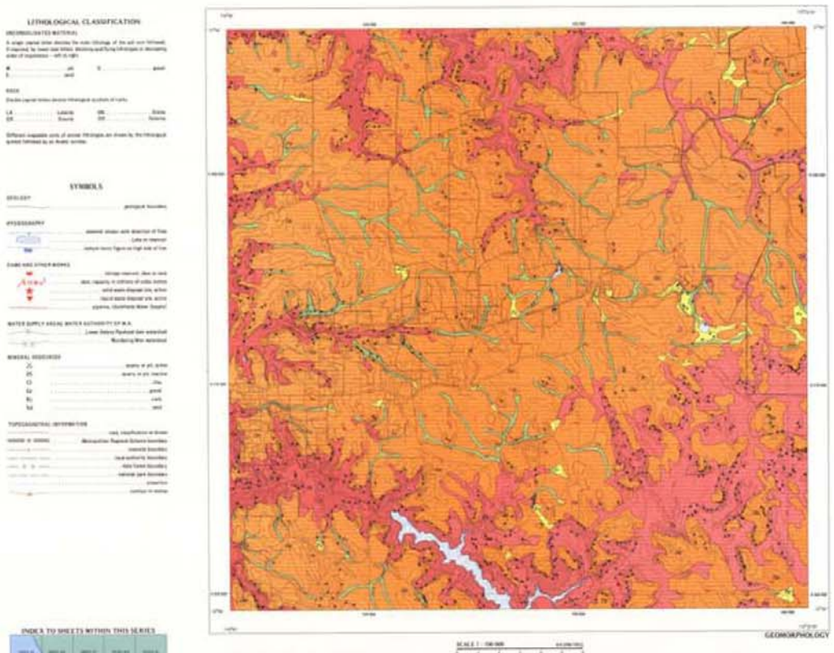
Project	Location	Drawing Title
Gravel Extraction & Rehabilitation	Woottating, WA	Location Sketch

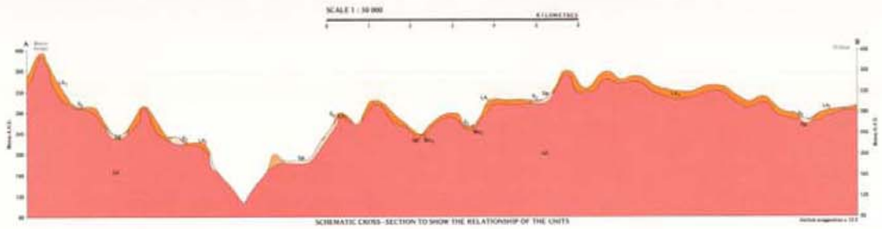
Date	Design	Drawing	Approved	Client
24 August 2012	PA	PA	BB	Capital Recycling

Drawing	Revision	Size
CR-01	1	A3

DRAWING 2: MUNDARING ENVIRONMENTALGEOLOGY MAP







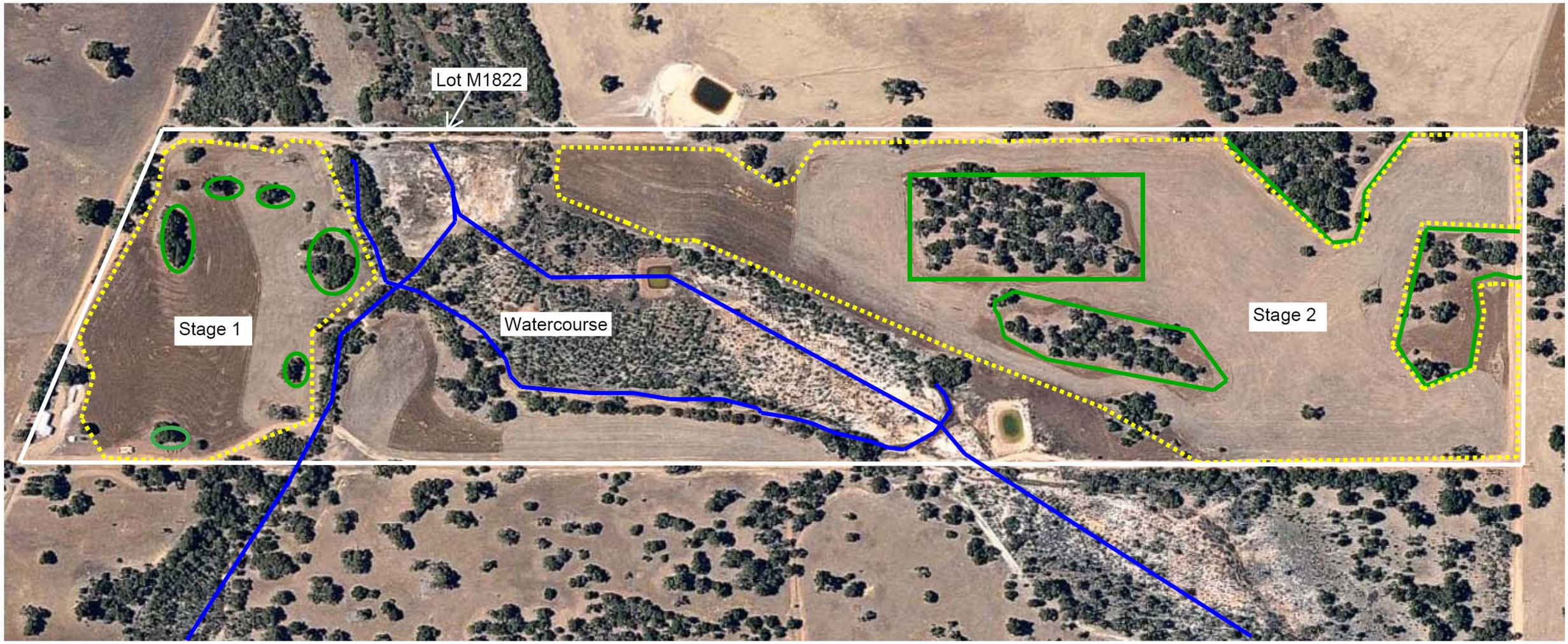
Bowman and Associates Pty Ltd	
ABN 22 112 399 514	
PO Box 2059 Rossmoyne WA 6148	Phone: 0402 373 582 Fax: 9457 6277

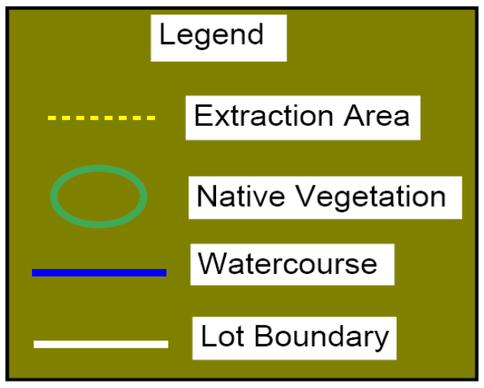
Project	Location	Drawing Title
Gravel Extraction & Rehabilitation	Woottating, WA	Mundaring Environmental Geology Map

Date	Design	Drawing	Approved	Client
24 August 2012	PA	PA	BB	Capital Recycling

Drawing	Revision	Size
CR-02	1	A3

DRAWING 3: PROPOSED AREA FOR GRAVEL EXTRACTION



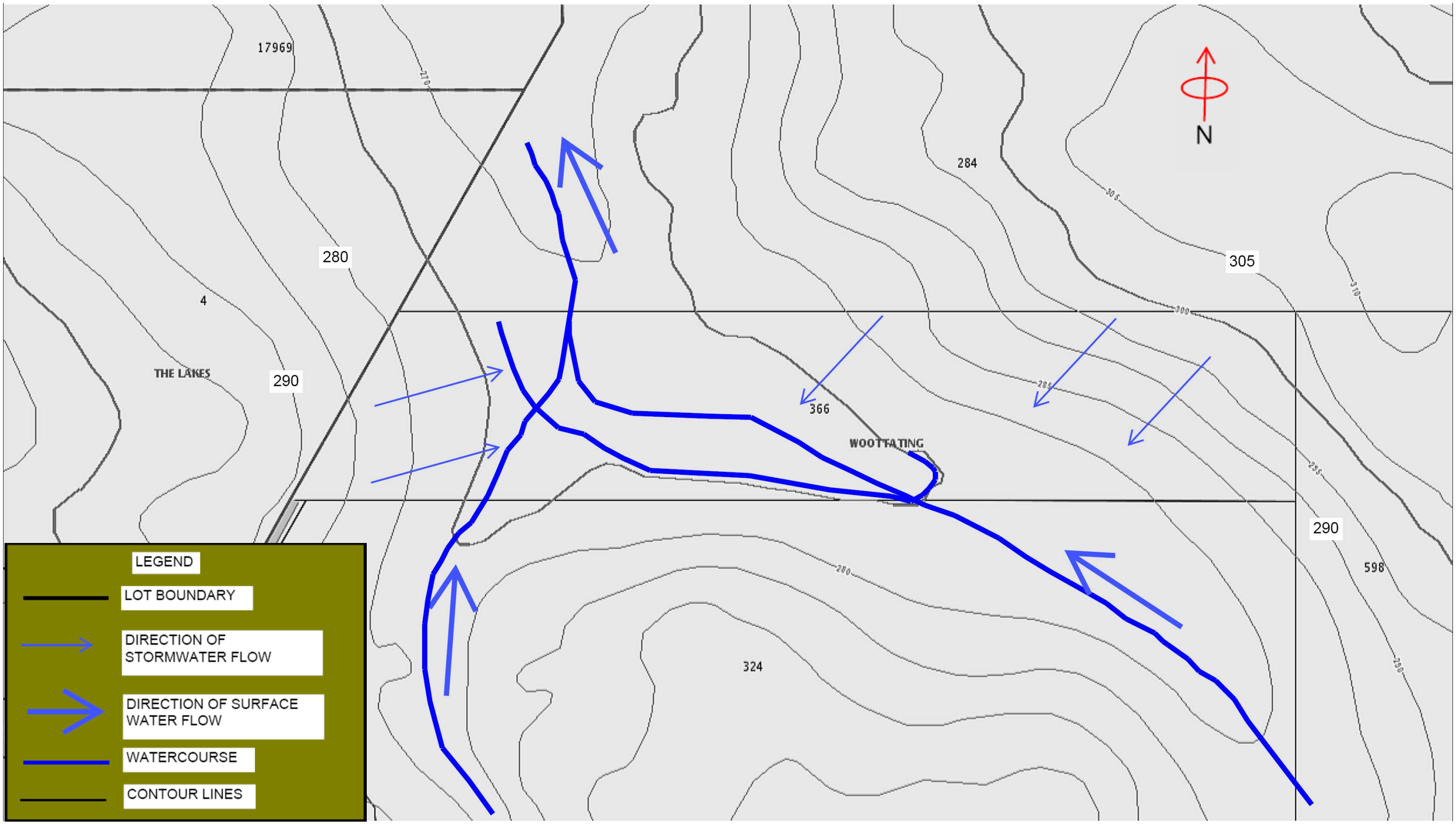


Bowman and Associates Pty Ltd
ABN 22 112 399 514
PO Box 2059
Rossmoyne WA 6148
Phone: 0402 373 582

Project	Location	Drawing Title
Gravel Extraction & Rehabilitation	Woottating, WA	Proposed Area for Gravel Extraction

Date	Design	Drawing	Approved	Client	Drawing	Revision	Size
31 October 2012	PA	PA	BB	Capital Recycling	CR-03	1	A3

DRAWING 4: TOPOGRAPHY AND WATERCOURSES ON THE LOT

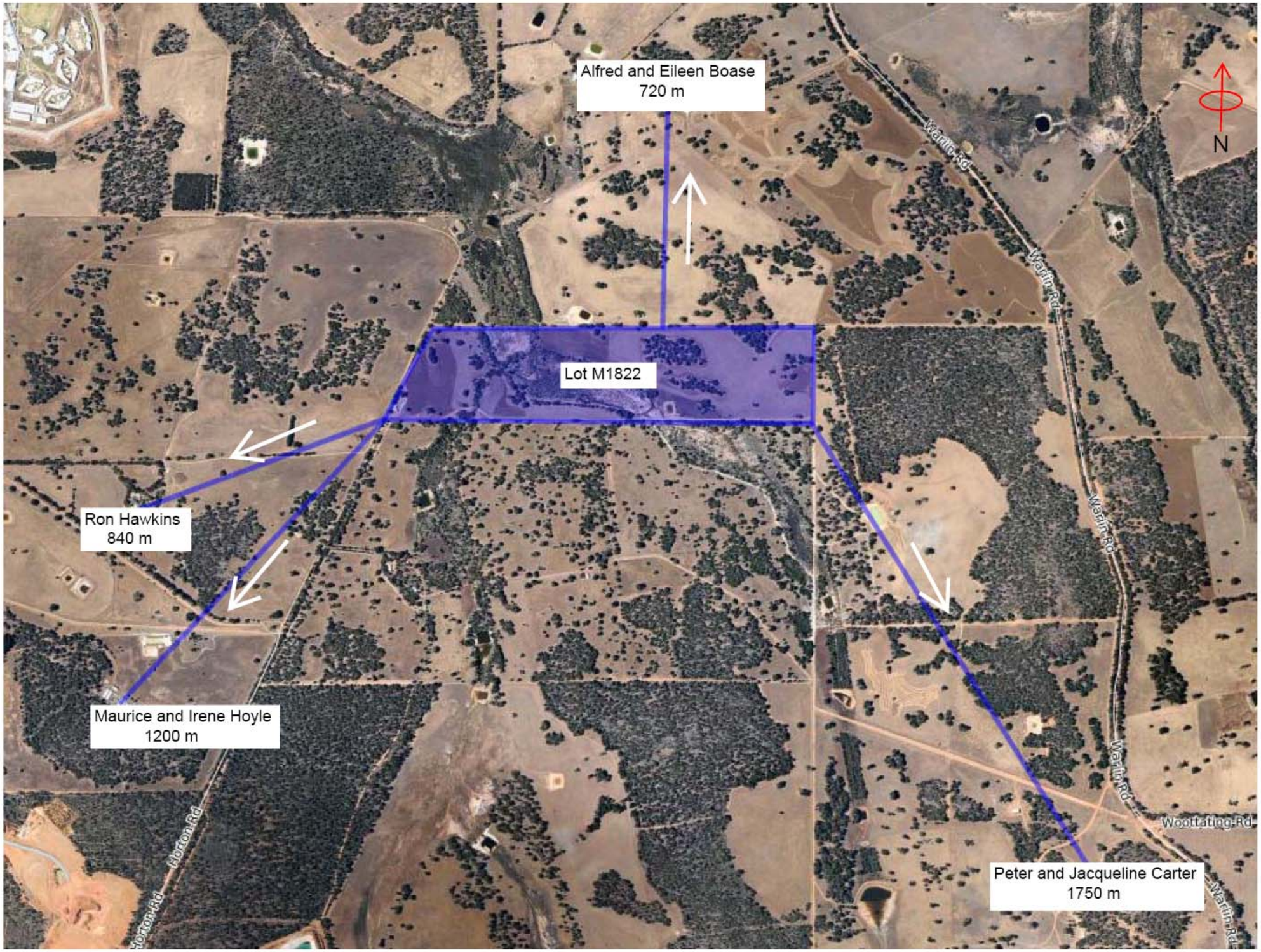


Bowman and Associates Pty Ltd
ABN 22 112 399 514
PO Box 2059
Rossmoyne WA 6148
Phone: 0402 373 582
Fax: 9457 6277

Project	Location	Drawing Title
Gravel Extraction & Rehabilitation	Woottating, WA	Topography and Watercourses on the Lot

Date	Design	Drawing	Approved	Client	Drawing	Revision	Size
31 October 2012	PA	PA	BB	Capital Recycling	CR-04	1	A3

DRAWING 5: SENSITIVE RECEPTORS NEAR THE LOT



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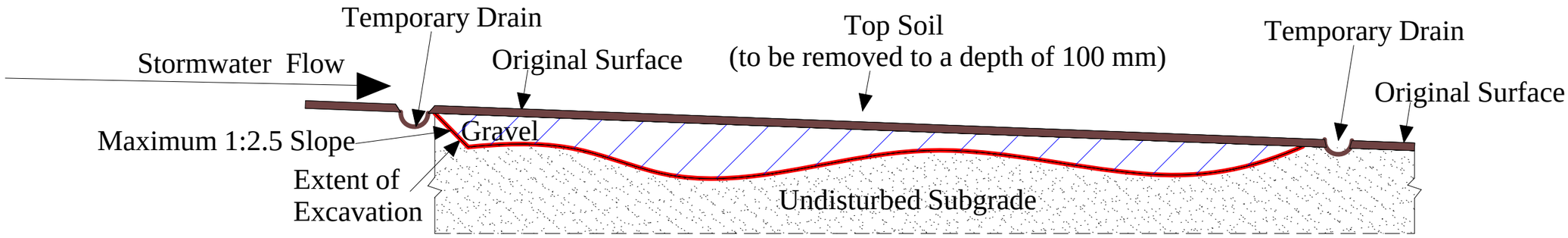
Project	Location	Drawing Title
Gravel Extraction & Rehabilitation	Woottating, WA	Sensitive Receptors Near the Lot

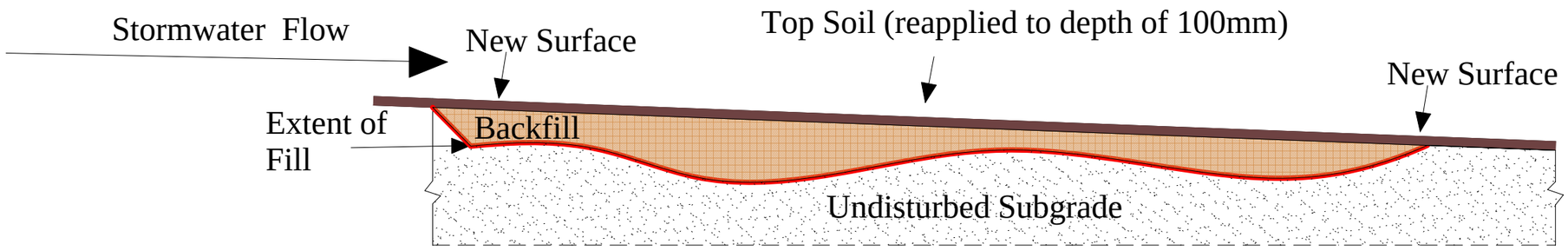
Date	Design	Drawing	Approved	Client
28 August 2012	PA	PA	BB	Capital Recycling

Drawing	Revision	Size
CR-05	1	A3

DRAWING 6: PROPOSED EXCAVATION AND REHABILITATION SECTIION



Typical Section - Excavation



Typical Section - Rehabilitation

Bowman & Associates Pty Ltd

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PO Box 2059 ROSSMOYNE WA 6148

Tel:(08) 9457 5899 Mob: 0402 373 582

Project			
Gravel Extraction			
Date	Design	Drawing	Approved
22 Oct 2012	BB	PA	BB

Location
Lot M1822 Horton Road Woottating
Client
Shire of Northam

Title			
Proposed Excavation and Rehabilitation Section			
Scale	Drawing	Revision	Size
Not to Scale	CR-BA-06	1	A3

DRAWING 07: STAGE 1 EXISTING AND PROPOSED CONTOURS

N
W E
S

SCALE 10 0 20 50 (metres)

1 : 1,000 (A1), 1 : 2,000 (A3)

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Project			
Gravel Extraction			
Date	Design	Drawing	Approved
17 Oct 2012	BB	PA	BB

Location
Lot M1822 Horton Road Woottating
Client
Shire of Northam

Title			
Stage 1 Existing and Proposed Landfrom Contours			
Scale	Drawing	Revision	Size
1:2,000	CR-BA-07	1	A3

DRAWING 08: STAGE 1 EXCAVATION AREA

STAGE 1	
Excavation Face	**Length (m)**
A	115
B	85
C	43
D	23
E	17
F	18
G	65
H	65
I	18
J	60
K	66
L	85
M	57
N	30
O	52
Total Area (sqm)	29,100
Depth (m)	2 to 4
Expected Volume (cu.m)	60,000

Excavation Limit

SCALE 10 0 20 50 (metres)

1 : 1,000 (A1), 1 : 2,000 (A3)

Bowman & Associates Pty Ltd

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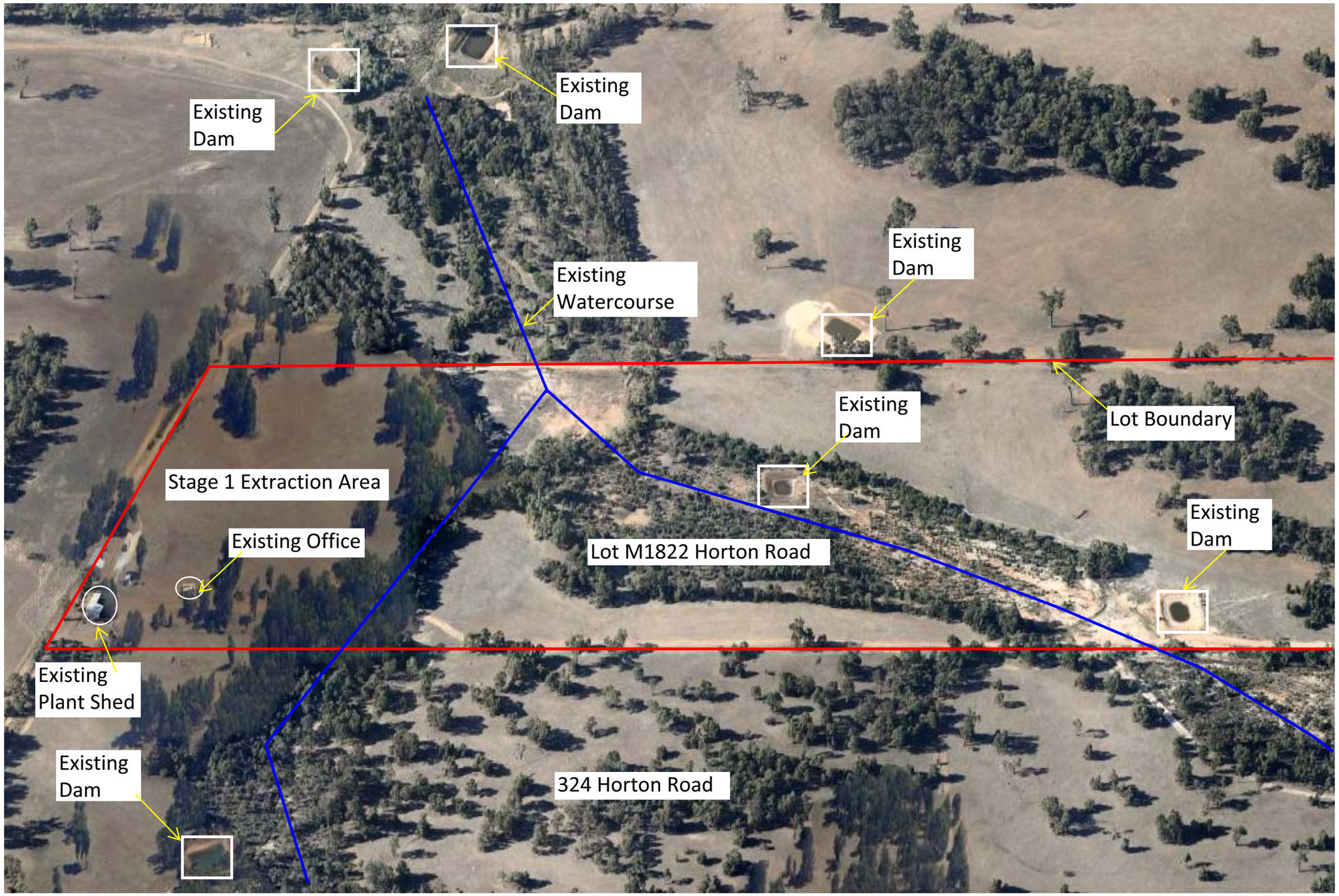
Project			
Gravel Extraction			
Date	**Design**	**Drawing**	**Approved**
17 Oct 2012	BB	PA	BB

Location
Lot M1822 Horton Road Woottating
Client
Shire of Northam

Title			
Stage 1 Excavation Area			
Scale	**Drawing**	**Revision**	**Size**
1:2,000	CR-BA-08	1	A3



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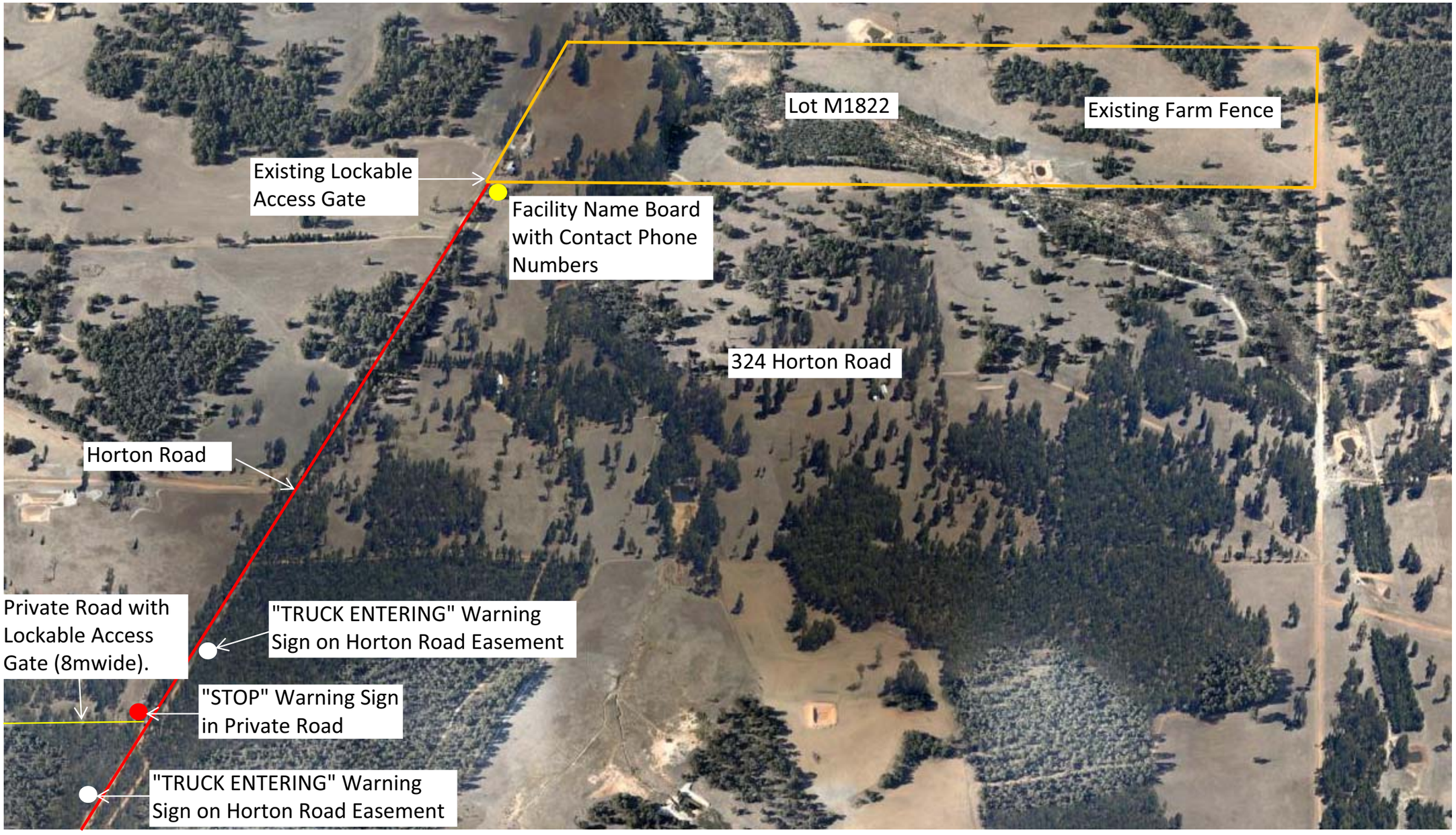
Project			
Gravel Extraction			
Date	**Design**	**Drawing**	**Approved**
17 Oct 2012	BB	PA	BB

Location
Lot M1822 Horton Road Woottating
Client
Shire of Northam

Title			
Location of Infrastructure			
Scale	**Drawing**	**Revision**	**Size**
Not to Scale	CR-BA-09	1	A3



Bowman & Associates Pty Ltd

ABN 22 112 399 514

PO Box 2059 ROSSMOYNE WA 6148

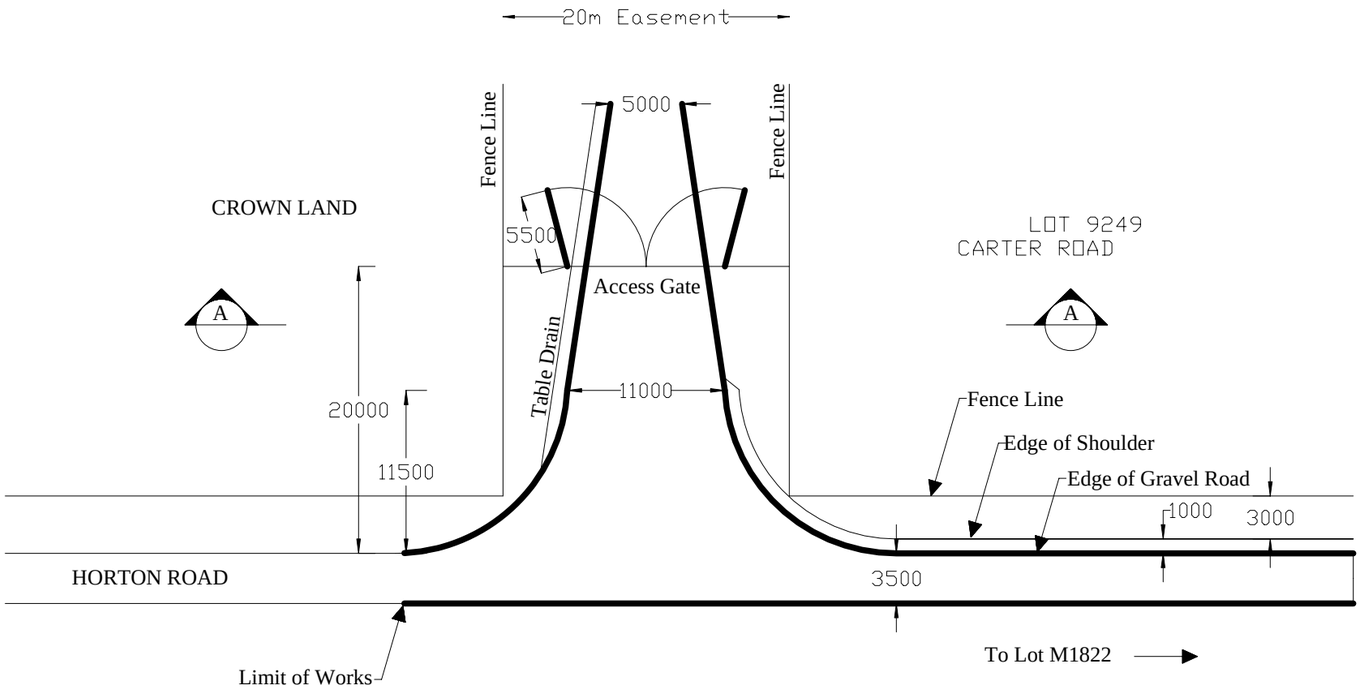
Tel:(08) 9457 5899 Mob: 0402 373 582

Project			
Gravel Extraction			
Date	**Design**	**Drawing**	**Approved**
17 Oct 2012	BB	PA	BB

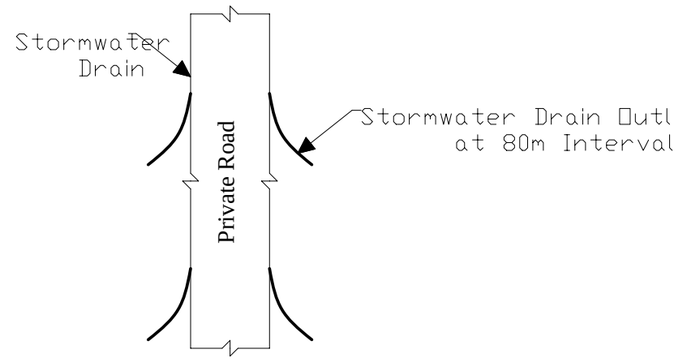
Location
Lot M1822 Horton Road Woottating
Client
Shire of Northam

Title			
Location of Fences, Gates and Signs			
Scale	**Drawing**	**Revision**	**Size**
Not to Scale	CR-BA-10	1	A3

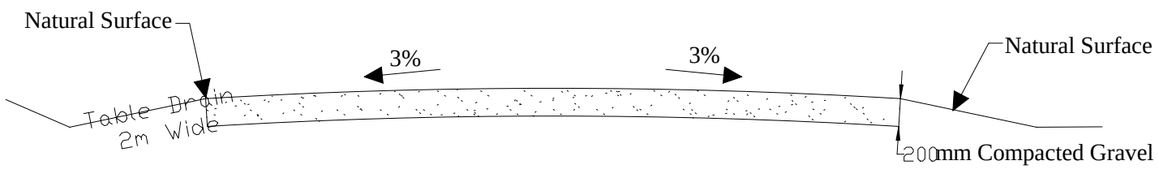
DRAWING 11: PRIVATE ENTRY ROAD DESIGN- LOT 9249



PLAN VIEW



DETAIL - STORMWATER DIVERSION



SECTION A-A

SECTION - TABLE DRAIN

Bowman & Associates Pty Ltd

ABN 22 112 399 514

PO Box 2059
ROSSMOYNE
WA 6148

Tel:(08) 9457 5899
Mob: 0402 373 582

Project			
Gravel Extraction			
Date	**Design**	**Drawing**	**Approved**
18 Oct 2012	BB	PA	BB

Location	
Lot M1822 Horton Road Woottating	
Client	
Shire of Northam	

Title			
Private Entry Road Design - Lot 9249			
Scale	**Drawing**	**Revision**	**Size**
Not to Scale	CR-BA-11	1	A3

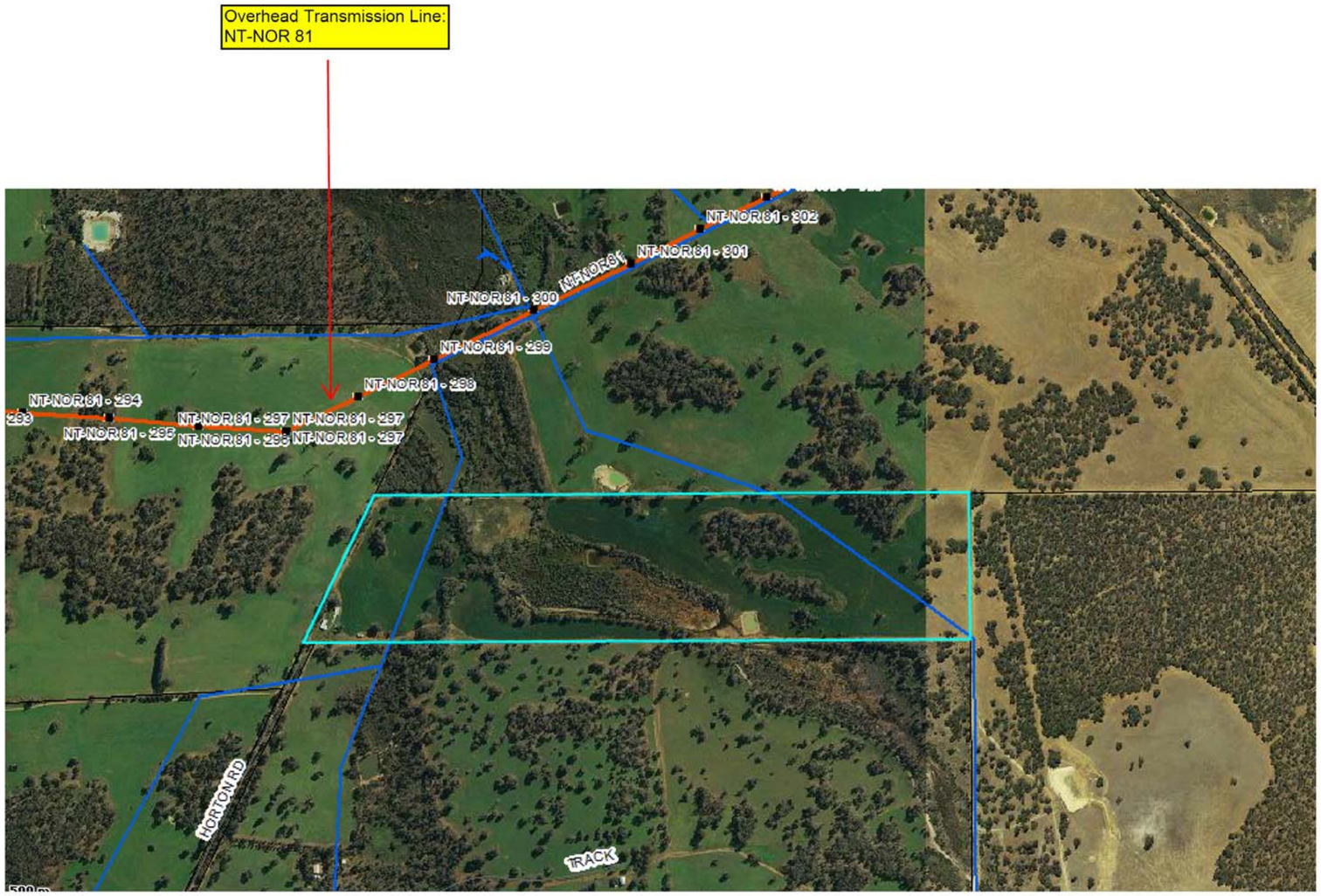
DRAWING 12: OVERHEAD POWER LINE LOCATION

N
W E
S

Bowman & Associates
Gravel extraction Lot 1822, Horton Rd, Woottating
Overhead Transmission Line: Northern Terminal-Northam 81 132kV (NT-NOR 81 132kV)

westernpower

Cable positions shown are indicative.
Services are to be individually located on site.



Legend

Transmission
- 330kV overhead line
- 132kV underground cables
- Other underground cables
- 132kV overhead line
- 66kV overhead line
- Communications cables

Distribution
- 22kV overhead line
- 22kV underground cable
- 415V overhead line
- 415V underground cable

Transmission contact -
Name Rachel Clough
Ph 9326 5180

Source: Western Power

Bowman & Associates Pty Ltd
ABN 22 112 399 514
PO Box 2059 ROSSMOYNE WA 6148
Tel:(08) 9457 5899
Mob: 0402 373 582

Project	Location	Title
Gravel Extraction	Lot M1822 Horton Road Woottating	Overhead Power Line Location

Date	Design	Drawing	Approved	Client
26 Oct 2012	PA	PA	PA	Shire of Northam

Scale	Drawing	Revision	Size
Not to Scale	CR-BA-12	2	A3

DRAWING 13: CONCEPT STOCKPILE LOCATION

Bowman & Associates Pty Ltd

ABN 22 112 399 514

PO Box 2059
ROSSMOYNE
WA 6148

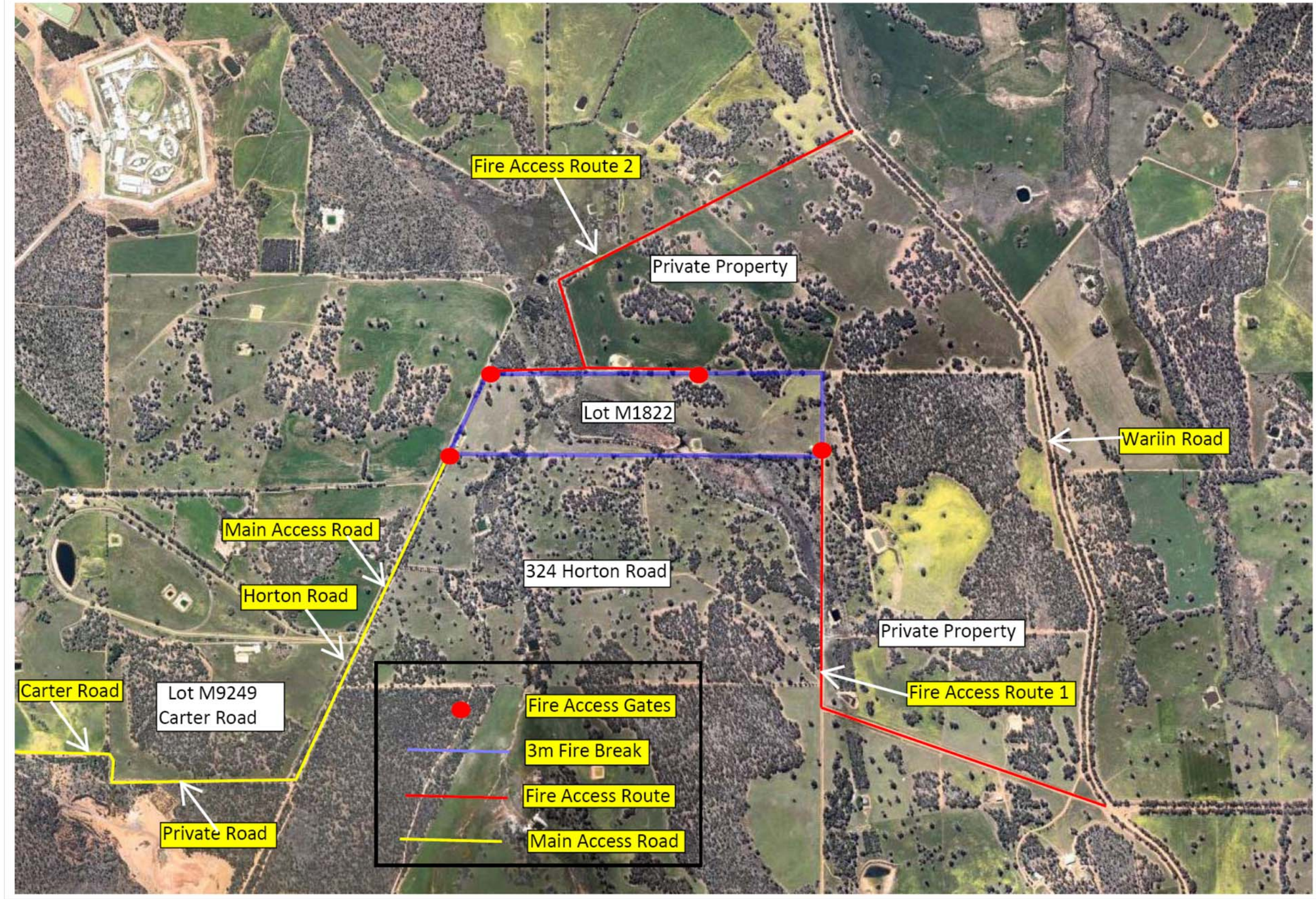
Tel:(08) 9457 5899
Mob: 0402 373 582

Project			
Gravel Extraction			
Date	Design	Drawing	Approved
22 Oct 2012	BB	PA	BB

Location
Lot M1822 Horton Road Woottating
Client
Shire of Northam

Title			
Concept Stockpile Locations			
Scale	Drawing	Revision	Size
Not to Scale	CR-BA-13	1	A3

DRAWING 14: FIRE ACCESS ROUTES, GATES AND FIRE BREAK



Bowman & Associates Pty Ltd

ABN 22 112 399 514

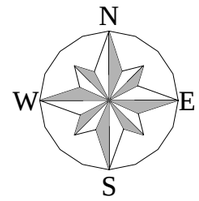
PO Box 2059
ROSSMOYNE
WA 6148

Tel:(08) 9457 5899
Mob: 0402 373 582

Project			
Gravel Extraction			
Date	Design	Drawing	Approved
19 Oct 2012	BB	PA	BB

Location
Lot M1822 Horton Road Woottating
Client
Shire of Northam

Title			
Fire Access Routes, Access Gates, and Fire Break			
Scale	Drawing	Revision	Size
Not to Scale	CR-BA-14	1	A3



Zone 1: Excavation Footprint

Zone 2: Stockpile Area

Zone 3: Office Area

Bowman & Associates Pty Ltd

ABN 22 112 399 514

PO Box 2059 ROSSMOYNE WA 6148

Tel:(08) 9457 5899 Mob: 0402 373 582

Project			
Gravel Extraction			
Date	Design	Drawing	Approved
19 Oct 2012	BB	PA	BB

Location
Lot M1822 Horton Road Woottating
Client
Shire of Northam

Title			
Fire Risk Zones			
Scale	Drawing	Revision	Size
Not to Scale	CR-BA-15	1	A3