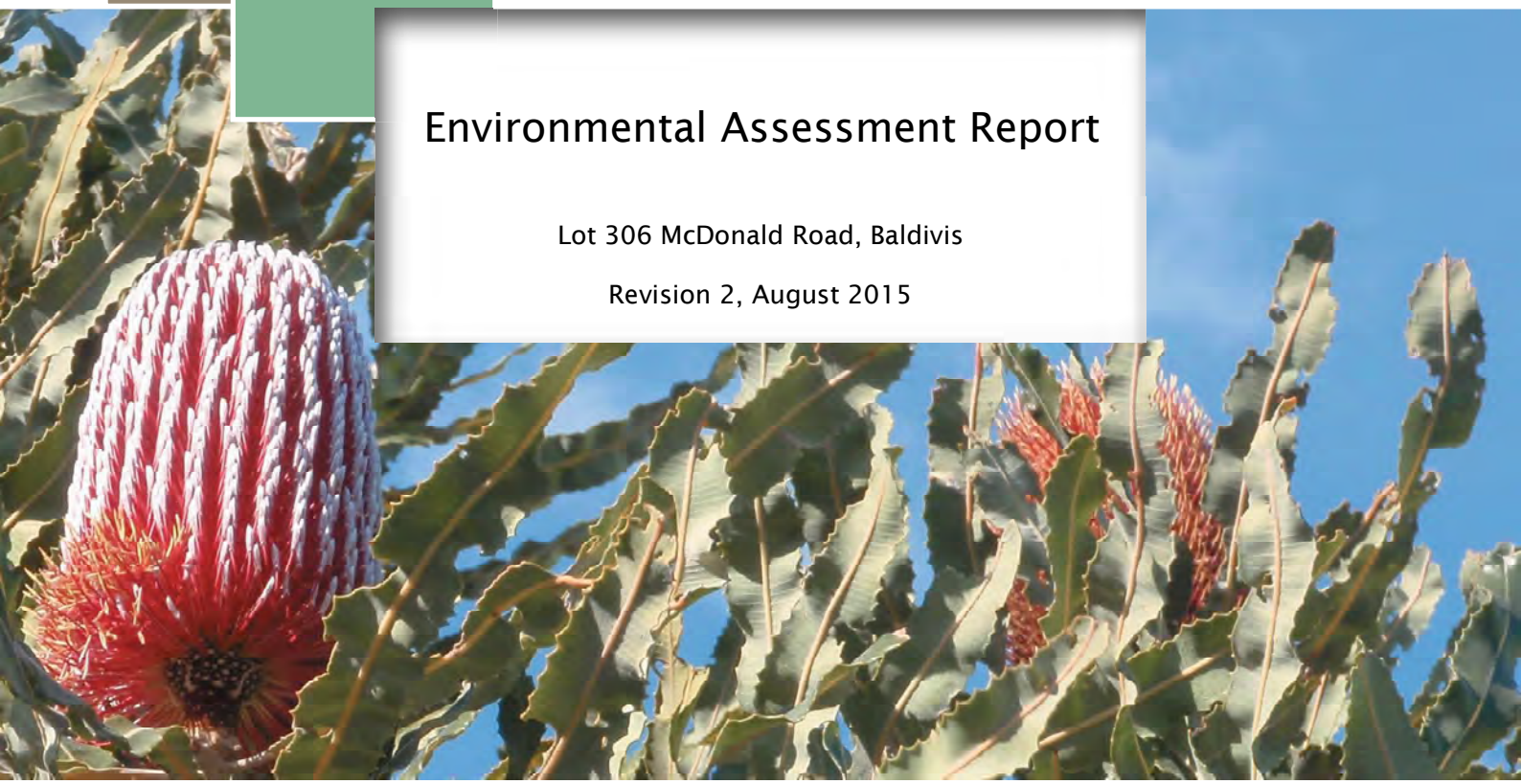
COTERRA ENVIRONMENT

Environmental Assessment Report

Lot 306 McDonald Road, Baldivis

Revision 2, August 2015



CALIBRE | COMMITMENT | COLLABORATION

Environmental Assessment Report

Lot 306 McDonald Road, Baldivis

Revision 2, August 2015

This report was prepared by:

Coterra Pty Ltd trading as COTERRA ENVIRONMENT
ABN: 92 143 411 456

Our Ref: SPAMAC03
Author(s): E Bryce & S. Harley
Reviewer: K. Bennetts
Report Version: Revision 2
Date: August, 2015

This report was prepared for:

Spatial Property Group
Unit 1, 896 Canning Highway
APPLECROSS WA 6153

EXECUTIVE SUMMARY

Spatial Property Group, on behalf of the landowners (Carcione Group of Companies) are proposing to develop part of Lot 306 McDonald Road, Baldivis for urban development.

The area currently proposed for urban development is approximately 13.6 ha and is zoned 'Urban' under the Metropolitan Region Scheme (MRS) and 'Development' under the City of Rockingham Town Planning Scheme No. 2 (TPS).

The subject area has been identified in the North Baldivis District Structure Plan (DSP) as part of the future urban growth of the North Baldivis precinct. A Local Structure Plan has been developed by Creative Design and Planning to guide the subdivision and development of the subject area within the North Baldivis DSP precinct, and is supported by this Environmental Assessment Report.

This report provides a detailed description of the existing environment, and outlines proposed management measures to effectively mitigate any potential environmental impacts resulting from the implementation of the development. It is considered that urban development of the subject area is an appropriate land use, given the current environmental condition of the area, and in consideration of the proposed management strategies outlined in this report. The key environmental aspects of the site and proposed development are summarised below.

The majority of the site has historically been used as a market garden including associated buildings and infrastructure. This has been the predominant land use of the subject area for at least 40 years, with these operations ceasing in 2014.

Given this previous land use, a Preliminary Site Investigation for potential contamination and a Sampling and Analysis Quality Plan for a Detailed Site Investigation have been completed. A Detailed Site Investigation is currently being undertaken (early 2015).

The historical land use has resulted in the majority of the site being cleared. There is a small portion of vegetation in the central-west portion. The vegetation within the subject area largely consists of tuart and marri trees over sheoak, banksia and jarrah woodland. The condition of the vegetation is considered to be significantly to severely altered by multiple disturbances, including prior clearing of the entire vegetation structure and understorey in areas and edge effects from development of market gardens adjacent to the vegetation. As the majority of the subject area was previously cleared, only the central-west Public Open Space area (POS B) in the LSP is proposed to retain some trees where the engineering design will allow. Understorey is not proposed for retention to address bushfire management requirements.

Soils at the site are predominantly identified as having a 'Low to Nil risk' of ASS occurring within 3 m of the soils surface, while the south-western corner of the Rural area has a 'High to Medium risk' of ASS occurring.

A range of management strategies have been proposed to effectively manage any potential environmental impacts caused as a result of the development. Proposed management actions are summarised in the table below.

Table A Proposed Management Actions

Item	Action	Frequency	Responsibility
Pre-construction Phase			
Vegetation protection	Delineate POS areas containing retained trees with a road separation in subdivision plans.	Once	Planner (Developer)
	Clearly demarcate any individual trees proposed for retention prior to works commencing onsite to ensure they are not accidentally impacted.	Once	Licensed Surveyor (Developer)
Acid Sulfate Soils (ASS)	Undertake an ASS Investigation to assess the likely risk of encountering ASS and any proposed management measures.	Once	Developer
Potential Contamination	Undertake a Detailed Site Investigation (DSI) for DER approval, in accordance with the Sampling and Analysis Quality Plan (SAQP).	Once	Developer
	Contaminated Sites (CS) Auditor to prepare a Mandatory Auditors Report (MAR) after DSI is completed and remediation undertaken (if required). (Dependent on receipt of relevant subdivision condition).	Once	CS Auditor (Developer)
Urban Water Management Plan (UWMP)	Following approval of the LWMS, prepare a UWMP prior to subdivision for approval by DoW.	Once	Developer
Construction Phase			
Fauna protection	Undertake clearing in the direction of existing bushland (west) to allow fauna to disperse.	Ongoing during construction phase.	Construction Contractor (Developer)
	Employ air horns or other loud alerts prior to clearing commencement.	Ongoing during construction phase.	Construction Contractor (Developer)
	All contractors to be advised of their responsibilities with regard to injured wildlife.	Ongoing during construction phase.	Developer
Aboriginal Heritage	All contractors to be advised of their responsibilities with regard to discovery of potential Aboriginal artefacts.	Ongoing during construction phase.	Developer
Post-construction Phase			
POS Management	Ensure ongoing maintenance of vegetation retained and fuel load management prior to handover.	Ongoing until handover.	Developer until hand over to the City of Rockingham.

TABLE OF CONTENTS Page

1.0 INTRODUCTION 1

1.1 Project Description 1

1.2 Planning Context 1

1.3 Scope of Report 2

1.4 Previous Environmental Assessments 2

2.0 KEY ENVIRONMENTAL POLICIES 3

2.1 Environmental Protection Act 1986 3

2.1.1 Environmental Protection (Peel Inlet – Harvey Estuary) Policy 1992 3

2.2 Water Quality Improvement Plan for the Rivers and Estuary of the Peel - Harvey System – Phosphorus Management 3

2.3 State Planning Policy 2.1: Peel – Harvey Coastal Plain Catchment 3

2.4 City of Rockingham – Local Bushland Strategy 4

2.5 EPA Guidance Statement No. 33 – Environmental Guidance for Land Development 5

3.0 LOCAL STRUCTURE PLAN 6

3.1 Description 6

3.2 Environmental Aspects of LSP Design 6

3.2.1 Public Open Space 6

3.3 Areas of Retained Vegetation 7

4.0 EXISTING ENVIRONMENT 8

4.1 Context and Setting 8

4.1.1 Historical Land Use 8

4.1.2 Surrounding Land Use 8

4.2 Topography, Landforms and Soils 8

4.2.1 Topography 8

4.2.2 Landforms and Soils 8

4.2.3 Acid Sulfate Soils 9

4.3 Contamination 9

4.4 Hydrology 11
4.4.1 Groundwater 11
4.4.2 Surface Water and Wetlands 11
4.4.3 Peel-Harvey Estuary Catchment 12
4.5 Vegetation and Flora 12
4.5.1 Level 2 Flora and Vegetation Survey 13
4.5.2 Significant Flora and Vegetation Communities 16
4.5.3 Weeds 17
4.5.4 Bush Forever and Ecological Linkages 17
4.5.5 Phytophthora Dieback 17
4.6 Fauna and Habitat 18
4.7 Fire 19
4.8 Cultural Heritage 19
5.0 IMPACTS AND MANAGEMENT 20
5.1 Vegetation and Flora 20
5.2 Fauna and Habitat 21
5.3 Drainage and Nutrient Retention 22
5.4 Acid Sulfate Soils 22
5.5 Contamination 23
5.6 Fire 23
5.7 Surrounding Land Use and Buffer Requirements 23
5.7.1 Horticultural Activities 23
5.7.2 High Pressure Gas Pipeline 24
6.0 IMPLEMENTATION STRATEGY 25
7.0 CONCLUSION 27
8.0 REFERENCES 28

TABLES (Compiled within the report)

Page

Table 1: Regional and Local Conservation Status of Cottesloe Complex – Central and South. 13

Table 2: Keighery Scale of Vegetation Condition Ratings 14

Table 3: Weed Species Recorded in Subject Area 17

Table 4: Conservation Significant Fauna Desktop Search Results 18

Table 5: Implementation Plan 25

PLATES (Compiled within the report)

Plate 1: Vegetation unit Cc at eastern edge of vegetated area (Photo: Kristen Bennetts, March 2015) 15

Plate 2: Vegetation unit Cc (Photo: Kristen Bennetts, March 2015) 15

Plate 3: Vegetation unit Eg (Photo: Kristen Bennetts, March 2015) 16

Plate 4: Cleared area at western edge of vegetated area, transitioning into vegetation unit Eg (Photo: Emma Bryce, May 2014) 16

FIGURES (Compiled at the end of the report)

Figure 1: Site Location

Figure 2: Subject Area and Metropolitan Region Scheme Zoning

Figure 3: Local Structure Plan

Figure 4: Topography and Geology Mapping

Figure 5: Acid Sulfate Soils Risk Mapping

Figure 6: Groundwater Contours

Figure 7: Geomorphic Wetlands and Buffers

Figure 8: Vegetation Units

Figure 9: Vegetation Condition

Figure 10: Bush Forever and Ecological Linkages

Figure 11: Potential Cockatoo Habitat Tree Mapping

APPENDICES

Appendix A: Ministerial Statement No. 580

Appendix B: Level 2 Vegetation and Flora Survey (BEC, 2015)

1.0 INTRODUCTION

1.1 Project Description

Spatial Property Group, on behalf of the landowners (Carcione Group of Companies) are proposing to develop part of Lot 306 McDonald Road, Baldivis (Figure 1) for urban development. The landholding is located north of the location at which McDonald Rd currently terminates, and is bounded by lots on Mandurah Road to the west, 'Paradiso Estate' to the north, 'The Chimes Estate' to the east, and rural land and 'Spires Estate' to the south. It is located in the City of Rockingham (CoR), approximately 43 kilometres (km) south of Perth (Figure 1).

The area currently proposed for urban development is approximately 13.6 ha ("the subject area") (Figure 2). The subject area is zoned 'Urban' under the Metropolitan Region Scheme (MRS) (Figure 2) and 'Development' under the CoR Town Planning Scheme No. 2 (TPS). It has been identified in the North Baldivis District Structure Plan (DSP) as part of the future urban growth of the North Baldivis precinct.

A large portion of the subject area was historically cleared and developed as a market garden and associated buildings and infrastructure. This was the predominant land use of the subject area for at least 40 years, with operations ceasing in 2014. The central-west portion of the subject area contains a small area of vegetation which is impacted by weeds and disturbance.

It is considered that urban development of the subject area is an appropriate land use, given the current environmental condition of the area, and in consideration of the proposed management strategies outlined in this report.

1.2 Planning Context

The North Baldivis DSP was formulated by the CoR in recognition of the general designation of the North Baldivis locality as suitable to accommodate future residential development. As such, the City embarked on a comprehensive 'district level' structure planning exercise in the late 1990s over the potential urban cell east of Baldivis Road and spanning from Kerosene Lane in the north to the future Baldivis Town Centre to the south. This exercise culminated in the release of the Baldivis (North) DSP as formally adopted by the CoR Council in July 2000.

The DSP outlined the preferred broad land use and district road framework for the study area.

In accordance with the objectives of the DSP, the proponent has commissioned the formation of a Local Structure Plan (LSP) over the subject area, providing a greater level of detail in respect to the structure plan design for the landholdings.

The LSP design was completed by Creative Design and Planning, and is presented in Figure 3.

1.3 Scope of Report

The CoR TPS No.2 requires an LSP to be prepared and submitted for 'Residential Development Zones' prior to granting and/or recommending approval of any development within this zone.

This Environmental Assessment Report (EAR) has been prepared to address the following:

- Facilitate the assessment and approval of the LSP with the CoR.
- Provide a detailed description of the existing environment.
- Outline proposed management measures to effectively manage any potential environmental impacts resulting from the implementation of the development.

1.4 Previous Environmental Assessments

The subject area (Figure 2) was part of Amendment No. 300 of the CoR's Town Planning Scheme No. 1, which was initiated to rezone the associated landholdings from 'Rural' to 'Development'. The rezoning application was formally assessed by the EPA in 2001 and it was determined that the proposal could be implemented subject to conditions. The approval and associated conditions are outlined in Ministerial Statement No. 580 (dated 19th December 2001) (Appendix A).

Conditions included the development of the following management plans, although not all of these conditions are specifically relevant to the subject area:

- Condition 1: Drainage and Nutrient Management Plan (addressed as a Local Water Management Strategy (LWMS) in accordance with the Department of Water's (DoW) Better Urban Water Management Guidelines (DoW, 2008));
- Condition 2: Soil and Groundwater Investigation and Remediation Plan (addressed as a Preliminary Site Investigation – detailed in Section 4.3 of this report);
- Condition 3: Pipeline Protection Plan (this will be prepared as a separate document to this report at subdivision stage);
- Condition 4: Spray Drift Investigation and Management Plan (not relevant for this site; see Section 5.7.1); and
- Condition 5: Vegetation Management Plan (not relevant for this site; see Section 5.1.

2.0 KEY ENVIRONMENTAL POLICIES

2.1 Environmental Protection Act 1986

The *Environmental Protection Act 1986* ('the Act') is the pre-eminent environmental legislation in Western Australia. Development projects are regulated under Part IV of the Act.

Assessment opportunities under the Act occur at the rezoning stage (region scheme and/or town planning scheme) under Section 48A of the Act and the subdivision/ development stage under Section 38 of the Act.

The Act also has a number of Environmental Protection Policies and regulations which provide guidance on environmental management. Relevant documents are discussed below.

2.1.1 Environmental Protection (Peel Inlet – Harvey Estuary) Policy 1992

The subject area is located within the Swan Coastal Plain Catchment of the Peel Inlet - Harvey Estuary, which has a history of poor water quality. The objective of the *Environmental Protection (Peel Inlet – Harvey Estuary) Policy 1992* (Peel–Harvey EPP) is to reduce the input of nutrients, particularly phosphorus, into the Peel Inlet – Harvey Estuary through a number of means, which include appropriate land management by landowners in the policy area (EPA, 1992).

The Peel–Harvey EPP requires any future development within the policy area be designed to meet the water quality objectives. This may require the preparation of a nutrient budget or appropriate management plans for proposed land uses.

2.2 Water Quality Improvement Plan for the Rivers and Estuary of the Peel - Harvey System – Phosphorus Management

The *Water Quality Improvement Plan for the Rivers and Estuary of the Peel – Harvey System – Phosphorus Management* (WQIP) was released by the EPA in November 2008 (EPA, 2008a). The objective of the WQIP is to limit the level of phosphorus reaching the Peel - Harvey waterways to 75 tonnes per year (currently 145 t/a). There are thirteen actions stated in the WQIP. Actions 1, 2, 5, 6 and 7 relate to agricultural land and hence are not relevant to this development, as the current agricultural land use will have ceased. All requirements, and mechanisms by which this proposal can and will address the objectives of the WQIP are discussed in the LWMS (Coterra Environment, 2015), prepared separately to this report.

2.3 State Planning Policy 2.1: Peel – Harvey Coastal Plain Catchment

State Planning Policy (SPP) 2.1 was prepared to ensure that land use changes within the Peel-Harvey Estuarine System likely to cause environmental damage are brought under planning control and prevented. The objectives of this policy are to:

- Improve the social, economic, ecological, aesthetic, and recreational potential of the Peel - Harvey coastal plain catchment.

- Ensure that changes to land use within the catchment to the Peel - Harvey estuarine system are controlled so as to avoid and minimise environmental damage.
- Balance environmental protection with the economic viability of the primary sector.
- Increase high water using vegetation cover within the Peel - Harvey coastal plain catchment.
- Reflect the environmental objectives in the *Environmental Protection (Peel Inlet -Harvey Estuary) Policy 1992*.
- Prevent land uses likely to result in excessive nutrient export into the drainage system.

The policy highlights that proposed changes to land zonings should take into account land capability and suitability with regards to the net effect that such changes are likely to have on the nutrient load discharging from that catchment into the Peel-Harvey system. Subdivision proposals should also make provision for a drainage system which maximises the consumption and retention of drainage on site. Industrial development where processes would create liquid effluent must include provision for connection to a reticulated sewerage system (WAPC, 2003a).

2.4 City of Rockingham – Local Bushland Strategy

The *CoR Planning Policy 7.2 – Local Bushland Strategy* (CoR, undated) aims to:

"provide Council with guidance in the assessment of proposals to rezone, subdivide and develop land in the City where remnant bushland is present".

The policy guides the assessment of the ecological value of remnant bushland to assist in determining the suitability of development over the land proposing to be developed. As such, in line with the policy directives, the bushland on site is assessed against the following factors:

- Presence of Rare species or threatened ecological communities
- Rarity of the vegetation complex present - (ie. is the present complex an example of which less than 10% remains in secure conservation reserves, either in a regional or locally representative context)
- Vegetation diversity
- Naturalness i.e. vegetation condition (level of degradation, structure retained)
- Connectivity as a wildlife corridor
- Significance as an isolated pocket and is the only remaining bushland in that area (particularly important in developed areas)
- Social value (e.g. educational resource, recreational area, locally admired for rural or visual amenity)
- Acts as a buffer between potentially conflicting land uses

- Impact from removal or modification on other parts of the environment
- Other significant attributes

2.5 EPA Guidance Statement No. 33 – Environmental Guidance for Land Development

Environmental Protection Authority (EPA) Guidance Statement No. 33 (EPA, 2008b) outlines the environmental protection process and provides the EPA's advice on a range of environmental factors in order to assist in the protection, conservation and enhancement of the environment during the land planning and development process.

3.0 LOCAL STRUCTURE PLAN

3.1 Description

The LSP proposes predominantly residential development in accordance with the 'Urban' zoning in the MRS. The LSP design is shown in Figure 3 and is shown to represent the following land uses:

- Residential
- Movement network
- Gas pipeline easement
- Public Open Space (POS)

3.2 Environmental Aspects of LSP Design

This EAR is primarily concerned with management and maintenance of the natural areas to be retained within the subject area, and the minimisation of potential environmental impacts. The process for the preparation of this report involved the input into design of the LSP to designate natural areas across the subject area suitable for retention based on their environmental value and as a mechanism to mitigate any potential environmental impacts resulting from the implementation of the development.

The LSP design has responded to as many of the environmental opportunities presented as practicable in a residential area. These are discussed in detail below.

3.2.1 Public Open Space

There are a number of environmental objectives which underpin the LSP design. These are to:

- Preserve areas of higher conservation value.
- Create sustainable conservation areas.
- Incorporate natural areas into new urban fabric.
- Interpret existing landscape and site memory in development areas.
- Develop community awareness and involvement.

Areas of POS in the LSP have been developed to provide the necessary active recreation opportunities for the future residents of the area whilst also preserving remaining ecological values, where possible. The area allocated to POS in the LSP is 1.74 ha of 13.58 ha total LSP area (or 12.8% of net subdivisible area).

3.3 Areas of Retained Vegetation

As the majority of the subject area was previously cleared for horticultural use, only POS B may be able to retain mature trees. Tree retention is constrained by the need to stabilise the slope in this location. As such engineering constraints will dictate what trees can be retained. This level of details will be available at subdivision stage.

Detailed landscape design plans will be submitted to the CoR for approval prior to implementation. These plans will provide details of any specific trees being retained.

4.0 EXISTING ENVIRONMENT

4.1 Context and Setting

4.1.1 Historical Land Use

Since approximately 1974 the majority of the subject area has historically been developed for market gardening, with the practice ceasing in early 2014. The remainder of the subject area includes a pocket of bushland which has been impacted by weeds and disturbance.

4.1.2 Surrounding Land Use

The property is approximately 750 m east of Cooloongup Lake and approximately 2 km from the Perth to Bunbury Highway. Rockingham Railway Station, serviced by the Perth to Mandurah Railway, is approximately 4.5 km from the subject area.

Market gardens were histroically located immediately north of the subject area, at Lot 299 Kerosene Lane, Baldivis, however this land use activity has ceased operation.

The Parmelia high pressure natural gas pipeline easement occurs parallel to the western boundary of the subject area in a general north-south direction (Figure 2).

Three current and proposed residential estates ('Paradiso Estate', 'The Chimes Estate' and 'Spires Estate') surround the subject area to the north, east and south respectively.

4.2 Topography, Landforms and Soils

4.2.1 Topography

The subject area has a significant rise to the central west boundary, with the remainder of the area being relatively flat (Figure 4). The land height is roughly 5 metres (m) Australian Height Datum (AHD) at the eastern and southern boundaries, and approximately 15 m AHD at the northern boundary. The elevation of the subject area rises steeply to 40 m AHD in the western portion.

4.2.2 Landforms and Soils

The Department of Minerals and Energy (2000) mapping provided in Figure 4 indicates that the subject area contains two natural soil types of the Spearwood and Tamala soil systems consisting of:

- Sand (S7): pale yellowish brown, medium to coarse-grained, sub-angular to well-rounded quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin; and,
- Limestone (LS1): pale yellowish brown, fine to coarse-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin.

4.2.3 Acid Sulfate Soils

According to Acid Sulfate Soil (ASS) risk mapping sourced from the CSIRO *Australian Soil Resource Information System* (ASRIS) database, the subject area is identified as having 'no known occurrence of AASS and PASS occurring', whilst a small portion of the south-western corner of the Rural area to the south of the subject area may be within an area where there is a 'high probability of AASS and PASS occurring'.

The Department of Environment Regulation (DER) ASS Risk Mapping confirms these results, indicating that the subject area generally has a 'Low to Nil risk' of ASS occurring within 3 m of the soils surface, while the south-western corner of the Rural area has a 'High to Medium risk' of ASS occurring (Figure 5) (DEC, 2010). This high risk area is associated with Opwin Swamp, the boundary of which intersects the Rural area boundary. Another area of high risk associated with Cooloongup Lake occurs approximately 800 m to the west of the subject area. A high ASS risk area associated with Kerosene Lane Swamp occurs approximately 700 m to the north of the subject area.

DER guidance advises that consideration of ASS issues should be undertaken within a 500 m radius of all high risk ASS mapped features, wetlands and/or surface water bodies (DEC, 2008 - 2009).

4.3 Contamination

The DER's online Contaminated Sites Database was searched for known or suspected contaminated sites in November 2014. No known or suspected contaminated sites were identified within the subject area, however the search did identify that 'Chimes Estate' to the east of McDonald Road has been classified as 'Remediated for restricted use' (DER, 2014). The classification states that groundwater has heavy metal and nutrient contamination under the southern half of the site.

Given the previous land uses of the subject area (horticulture), Spatial Property Group have commissioned Emission Assessments Pty Ltd (EAPL) to undertaken a Preliminary Site Investigation (PSI) for contamination and prepare a Sampling and Analysis Quality Plan (SAQP) for a Detailed Site Investigation (DSI), consistent with the DER Contaminated Sites Management Series (DER, 2001-2011) and National Environment Protection Council (NEPC) National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 2013.

The PSI for contamination identifies parts of the site which have been adversely impacted from past contaminating activities or land uses, and other environmental issues or hazardous materials which could pose a constraint to development. The SAQP has been prepared to outline the investigative works required to assess the presence, nature, extent and magnitude of any potential areas of contamination identified in the PSI (EAPL, 2014a).

The key findings of the PSI and SAQP are summarised below (EAPL, 2014a):

- The local geology at the subject area comprises the Spearwood Dune System (medium to coarse grained Aeolian calcarenite).
- The local lithology consists largely of yellow brown sands or pale sands with yellow-brown subsoil.

- Groundwater is expected to be from 1 metre below ground level (mbgl) to 32 mbgl, within an unconfined superficial aquifer and is interpreted to flow in a westerly direction towards Lake Cooloongup.
- Part of the subject area was previously used as a market garden operated by Trodan Produce (WA) Pty Ltd. Trodan Produce records are included in Appendix A of the PSI and indicate that all application of fertilisers, pesticides and herbicides are applied in accordance with industry standard.
- The historical review and site inspection identified the following potential sources of contamination:
  - Current and historical market gardening, both on- and off-site
  - Rural/grazing activities (off-site in Rural area)
  - Storage of fuels and chemicals within sheds and pump houses
  - Abandoned above ground storage tank and old vehicles
  - Termiticide applications beneath residential dwelling
  - Rubbish Piles
  - Potential asbestos containing materials in fencing and house
- Recommendations made by EAPL (2014a) include the following:
  - The PSI / SAQP should be issued to an accredited CS auditor, to assess if the report has been prepared in accordance with DER and NEPC requirements.
  - Based on the findings of the PSI, intrusive investigations comprising a DSI are required to assess the nature, extent and magnitude of contamination (if present) within the subject area. The need for remedial works, if required, will be identified following these site-specific investigations.

In accordance with the requirements of the *Contaminated Sites Act* 2003, an accredited contaminated sites (CS) auditor, Ms Vanessa Bryant of Environ Australia Pty Ltd, has been appointed to ascertain if the works undertaken are consistent with applicable DER and NEPC guidelines (EAPL, 2014a). The SAQP has been approved by the CS auditor, and a DSI of the subject area has been commenced. This will be followed by any associated remedial works (if required). On completion of the DSI and remedial works, when a site classification is possible, the CS auditor will prepare a Mandatory Auditors Report (MAR) for submission to the DER for clearance of the WAPC condition.

4.4 Hydrology

4.4.1 Groundwater

4.4.1.1 Levels

The Perth Groundwater Atlas (DoW, 2014) indicates that the subject area is underlain by three primary aquifers – Perth Superficial Swan Aquifer, Perth Confined Leederville Aquifer and Perth Confined Yarragadee Aquifer. The minimum groundwater level contours are at approximately 1.5 to 1.75 m AHD across the subject area (DoW, 2014) (Figure 6).

The DoW recently undertook groundwater modelling for the Lower Serpentine area to determine the maximum groundwater contours (DoW, 2012). This investigation suggests that the maximum groundwater level is likely to vary between approximately 3.0 to 3.5 m AHD across the subject area.

Groundwater monitoring undertaken at Spires Estate (site immediately south of Lot 306), between August 2012 and November 2013, has generated data to indicate that groundwater levels are in the order of 1.64 to 1.82 m AHD over the peak period (Coterra Environment, 2015). The site specific levels witnessed at both this site and the adjacent Spires Estate indicate that the groundwater levels are 1.68 to 1.86 m lower than the levels indicated by the DoW Serpentine groundwater modelling (Coterra Environment, 2015).

Regional groundwater information indicates that groundwater flow is generally in a westerly direction (DoW, 2014).

4.4.1.2 Quality

Site specific groundwater quality monitoring was undertaken as part of the Detailed Site Investigation (DSI) for Spires Estate (EAPL, 2014b).

Samples were analysed for a wide range of parameters including nutrients (Total Nitrogen (TN), Total Phosphorus (TP), Nitrates / Nitrites (NOx), Total Kjeldahl Nitrogen (TKN), Filterable Reactive Phosphorus (FRP), Ammoniacal Nitrogen), physiochemical parameters, metals, pesticides, hydrocarbons, speciated phenols, and volatile organic compounds. The results of the monitoring indicated that TN levels were in the order of 2.3 - 31 mg/L, exceeding ANZECC (2000) water quality guidelines for long term irrigation (5 mg/L) while TP levels ranged from 0.07 – 0.59 mg/L, also exceeding ANZECC (2000) water quality guidelines for long term irrigation (0.05 mg/L) (EAPL, 2014b). These elevated levels are considered to be the result of historical market gardening at the site.

4.4.2 Surface Water and Wetlands

A search of the Department of Parks and Wildlife (DPaW) geomorphic wetlands database indicated that while no wetlands occur within the subject area, a Conservation Category (CCW) dampland is located in the south-western corner of Lot 306 (outside of the LSP subject area) (Figure 7). The wetland is Opwin Swamp (Unique Feature Identifier (UFI): 6400), and like the other wetlands in this area, is a

surface expression of the unconfined aquifer. CCWs are described as "wetlands [that] support a high level of ecological attributes and functions" (WRC, 2001). As a CCW, this wetland requires a minimum 50 m buffer to development (Figure 7) which does not impact the LSP area.

Lake Cooloongup is located approximately 800 m west of the subject area, and the Peel Main Drain is located approximately 1.5 km east of the subject area. Given the significant distance of these waterbodies from the subject area, it is not considered to be at risk of flooding from either waterbody.

There are no wetlands within the subject area listed under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*.

There are no natural watercourses or waterbodies within or near the subject area.

4.4.3 Peel-Harvey Estuary Catchment

The subject area is located within the Swan Coastal Plain Catchment of the Peel-Harvey Estuary, which has a history of poor water quality. The objective of the *Environmental Protection (Peel Inlet – Harvey Estuary) Policy 1992* is to reduce the input of phosphorous into the Peel-Harvey Estuary through a number of means, which includes appropriate land management by landowners in the policy area. A change in land use from predominantly agricultural to urban development, with a reticulated sewer system, will reduce the potential for nutrient export to the receiving environment, which is in accordance with the general objectives of the policy.

4.5 Vegetation and Flora

The subject area contains an area (approximately 2.5 to 3 ha) of vegetation in the central-west portion of the subject area. The balance of the subject area has previously been cleared to accommodate market gardens and contains no native vegetation at all. The eastern portion of the vegetated area was previously cleared in the early 1980's and has regrown since this time.

Historically (prior to European settlement and associated degradation), vegetation within this area is mapped as a Medium Woodland of *Eucalyptus gomphocephala* and *Eucalyptus marginata* (abbreviated e2,4Mi) (Beard, 1981; Shepherd et al., 2002). The pre-European area of e2,4Mi is estimated to be 79,001 ha, and the current extent 18,398 ha, which represents 23.2% remaining (38% of which is currently in conservation reserve) (Shepherd et al., 2002).

The vegetation within the subject area also belongs to the following regional complex (Heddle et al., 1980):

- Cottesloe Complex (Central and South), described as a mosaic of woodland of *Eucalyptus gomphocephala* and open forest of *Eucalyptus gomphocephala – Eucalyptus marginata – Coryumbia calophylla*: closed heath on the limestone outcrops

The reservation status of this vegetation type within the Swan Coastal Plain (SCP) at both a regional and local level is presented below. As can be seen from Table 1, the Cottesloe Complex meets the State government target of at least 10% of the original

extent proposed for protection (Bush Forever protection area of the Perth metropolitan region). It is also well represented at a local level with a high percentage of the original extent remaining within the CoR.

Table 1: Regional and Local Conservation Status of Cottesloe Complex – Central and South.

	Description	*Cottesloe Complex*	
		Area	**Percentage of Original Area**
Local Representation (CoR)	Original extent	2,017 ha	-
	Remaining area	1,011 ha	50 %
Regional Representation (Perth Metro Area of Swan Coastal Plain)	Original extent	34,439 ha	-
	Remaining area	12,362 ha	36%
	Area proposed for protection (Bush Forever)	6,085 ha	18%

Source: Del Marco et al. (2004).

4.5.1 Level 2 Flora and Vegetation Survey

A Level 2 flora and vegetation survey was undertaken by Bennett Environmental Consulting Pty Ltd (BEC), with the field component of the works carried out on 2 April 2014 and 6 November 2014 (spring survey) (BEC, 2014). Temporary quadrats were recorded and flagged during the first field survey in order to conduct the comparative survey in spring.

Two vegetation units were described as occurring within the subject area (Figure 8). These were:

- Eg - Tall Forest of *Eucalyptus gomphocephala* over Low Woodland A of *Allocasuarina fraseriana*, *Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Scrub of *Jacksonia furcellata* over Open Low Scrub B of *Acacia pulchella* var. *pulchella* and *Macrozamia riedlei* over Dense Tall Grass dominated by **Ehrharta calycina* and **Briza maxima* in grey sand. This vegetation unit was represented by quadrat BD1 and occurred on middle to upper slopes at the north and west of the property.

- Cc - Forest to Dense Forest of *Corymbia calophylla* over Low Woodland A of *Allocasuarina fraseriana*, *Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Low Scrub B dominated by *Hakea lissocarpha*, *Xanthorrhoea preissii* and *Gompholobium tomentosum* over Open Dwarf Scrub D dominated by *Hibbertia hypericoides* and *Acacia pulchella* var. *pulchella* in grey yellowy brown sand. This vegetation unit was represented by quadrat BD2 and occurred on the lower slopes.

Vegetation condition was rated according to the Keighery (1994) vegetation condition scale. The condition of the vegetation in the subject area ranges from Good to Degraded, with completely cleared areas such as access tracks rated Completely Degraded.

Table 2 provides a description of the Keighery vegetation condition rating scale. As can be seen from the explanation of the vegetation condition categories, the vegetation within the subject area (i.e. Good, Degraded and Completely Degraded) is considered to be significantly to severely altered by multiple disturbances, including prior clearing of the entire vegetation structure and understorey in areas and edge effects from development of market gardens adjacent to the vegetation.

Table 2: Keighery Scale of Vegetation Condition Ratings

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

Source: Keighery (1994).

Vegetation condition is mapped in Figure 9.

Plates 1 to 4 provide an indication of the nature of the vegetation within the subject area. For comparative photos from the two quadrats monitored during the flora and vegetation survey, see Appendix A of the flora and vegetation survey report, which is provided in Appendix B.

Plate 1: Vegetation unit Cc at eastern edge of vegetated area (Photo: Kristen Bennetts, March 2015)

Plate 2: Vegetation unit Cc (Photo: Kristen Bennetts, March 2015)

Plate 3: Vegetation unit Eg (Photo: Kristen Bennetts, March 2015)

Plate 4: Cleared area at western edge of vegetated area, transitioning into vegetation unit Eg (Photo: Emma Bryce, May 2014)

4.5.2 Significant Flora and Vegetation Communities

No threatened or priority flora or threatened or priority ecological communities were identified during the flora and vegetation survey.

4.5.3 Weeds

A total of 17 weeds were recorded from the pocket of vegetation in the central-west portion of the subject area (BEC, 2014) (Table 3). All have been determined as weeds by the Western Australian Herbarium (2014) and Department of Parks and Wildlife (DPaW) (2014). According to BEC (2014), ten of the weeds are determined as having a high ecological impact on the environment and fourteen are known to have a rapid rate of dispersal (Table 3).

Table 3: Weed Species Recorded in Subject Area

Species	Ecological Impacts^	Invasiveness#	Control**
**Briza maxima*	U	R	H
**Briza minor*	U	R	H
**Cenchrus clandestinus*	H	S	M
**Cerastium glomeratum*	U	R	U
**Ehrharta calycina*	H	R	M
**Ehrharta longiflora*	H	R	L
**Euphorbia terracina*	H	R	M
**Freesia alba × leichtlinii*	H	R	M
**Hypochaeris glabra*	H	R	L
**Lolium multiflorum*	H	R	L
**Lupinus cosentinii*	H	M	H
**Olea europaea*	H	R	H
**Pelargonium capitatum*	H	R	M
**Romulea rosea*	U	R	L
**Sonchus oleraceus*	U	R	L
**Trifolium campestre*	U	U	L
**Ursinia anthemoides*	U	R	L

^ = Ecological impact: L - low impact species; M - medium impact species; H - high impact species; U - unknown impact

= Rate of dispersal: R – rapid; M – moderate; S – slow; U - unknown

** = Feasibility of control: L – low; M – moderate; H – high; U - unknown

4.5.4 Bush Forever and Ecological Linkages

There are no Bush Forever Sites located within the subject area, however Bush Forever Site No. 356 (Lake Cooloongup, Lake Walyungup and Adjacent Bushland, Hillman to Port Kennedy) occurs approximately 300 m from the southern boundary (WAPC, 2000). Bush Forever Site No. 356 begins at its most eastern point adjacent to Lots 313 and 312 Fifty Rd, and expands westward to include Lakes Cooloongup and Walyungup, and surrounding bushland. Bush Forever Site No. 349 (Leda and adjacent bushland, Leda) occurs approximately 1.2 km from the northern boundary of the subject area (Figure 10). These Bush Forever sites contribute to the Perth Biodiversity Project regional ecological linkages that occur both east and west of the subject area (Figure 10). No ecological linkages occur within or adjacent to the subject area.

4.5.5 Phytophthora Dieback

No evidence of Phytophthora dieback was noted during the flora and vegetation survey (BEC, 2014).

4.6 Fauna and Habitat

A site visit was undertaken by Coterra Environment on 6th May 2014, which was also used as an opportunity to assess the significance of the subject area with regard to fauna habitat. The majority of the subject area is devoid of vegetation and has no habitat value. There is a small patch of impacted vegetation in the central west portion of the subject area.

A search of the DPaW NatureMap database (DPaW, 2014) for potential significant fauna occurrences within 5 km of the subject area was undertaken to provide an indication of the species which may potentially occur in this general area. A 2 km radius search was also undertaken of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (administered by the federal Department of the Environment (DotE)) (DotE, 2014). Ten fauna species of conservation significance were listed as potentially occurring within this general area, of which nine are listed under the EPBC Act as Matters of National Environmental Significance (NES). The species listed in Table 4 are considered to be the only conservation significant fauna species that may potentially visit the subject area, based on the site features.

Mature tuart and marri trees are known to potentially provide roosting, feeding and/or breeding opportunities of the three black cockatoo species listed in Table 4. The site inspection identified that a few of the larger tuarts containing small hollows, in some cases inhabited by feral bees. Results of this survey are mapped in Figure 11. The nearby conservation areas as described in Section 4.5.4 contain higher quality cockatoo habitat than within the subject area. As such, the clearing of the remaining trees within the subject area is not expected to be detrimental to the local populations of cockatoos, as the protected bushland areas nearby provide habitat of significantly greater ecological value.

While the understorey is mostly degraded and weed-infested, there is potential for the subject area to support species such as the quenda (Table 4), whose range may extend from nearby wetland habitats. However it is unlikely that the quenda would rely on this relatively degraded habitat, with other wetland and protected bushland areas nearby providing habitat of significantly greater ecological value.

Other potential fauna habitats noted within the subject area included many fallen logs and stumps, which can provide valuable shelter for small ground-dwelling mammals and reptiles. However the degraded nature of the understorey is likely to limit the biodiversity of the subject area.

Table 4: Conservation Significant Fauna Desktop Search Results

Species	WA Conservation Status	EPBC Act Conservation Status
Calyptorhynchus baudinii (Baudin's Black Cockatoo)	Threatened	Vulnerable
Calyptorhynchus latirostris (Carnaby's Black Cockatoo)	Threatened	Endangered
Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black-Cockatoo)	Threatened	Vulnerable

Species	WA Conservation Status	EPBC Act Conservation Status
Isoodon obesulus fusciventer (Quenda)	Priority 5	-

4.7 Fire

Following development of the subject area, native vegetation is likely to remain within the POS B, and within a portion of the rural zoned land to the south, as well as adjoining lots to the west. This vegetation could pose a bush fire risk to the proposed development, and as such bush fire planning measures are required to be implemented in order to mitigate this risk. To address this issue, a Fire Management Plan has been prepared for the subject area to support the LSP (Strategen, 2015).

4.8 Cultural Heritage

A search of the Department of Aboriginal Affairs (DAA) Heritage Sites database determined that no sites of Aboriginal significance have been recorded within the subject area, however one site is located approximately 1.2 km south of the subject area near the proposed Nairn Road realignment (Site Reference: 4323; Artefact/Scatter). No other registered sites are located within or nearby the subject area (DAA, 2014).

All contractors working on the development will be made aware of their responsibilities under the *Aboriginal Heritage Act 1972* with regard to finding potential archaeological sites. In the event a site is discovered, all work in the area will cease and the DAA will be contacted.

5.0 IMPACTS AND MANAGEMENT

Taking into consideration the existing environment outlined in Section 4, and the requirements of the approved TPS Amendment for Lot 306 McDonald Road outlined in Section 1.2, the following management measures are proposed. These measures are designed to manage any potential environmental impacts resulting from development of the subject area, in accordance with local, state and federal agency objectives.

5.1 Vegetation and Flora

The vegetation remaining within the subject area is considered to be significantly to severely altered by multiple disturbances, including prior clearing of the entire vegetation structure and understorey in areas and edge effects from development of market gardens adjacent to the vegetation.

The LSP proposes to retain trees from the Eg vegetation unit in POS B, where possible, in line with engineering design constraints. The majority of the remaining area of vegetation to be cleared for development is mapped as Degraded to Completely Degraded, with some areas of Good to Degraded (Figure 9).

The condition of this vegetation and the small size of the fragmented vegetated area affects its viability (as an isolated patch). Further to this, the reservation status of the regional vegetation type (Cottesloe Complex – Central and South) within the Swan Coastal Plain (SCP) (Table 1) meets the State government target of at least 10% of the original extent (indicated as 18% as per Table 1). It is also well represented at a local level with a high percentage of the original extent remaining within the CoR.

Each of the trees identified in the fauna habitat survey have been mapped across the subject area (Figure 11). Selected large tuarts and marris within the bushland area were identified for retention based on their ecological value, suitability for retention in an urban development and fauna habitat potential. Trees will be retained where possible within POS B as outlined in the final LSP design (Figure 11). Full details will be provided in future landscape concept plans.

For fire management purposes, trees will be retained in POS B where possible, however the understorey which is currently degraded is required to be removed or managed to maintain a low fuel tonnage of 2 t/ha.

To ensure the protection of retained trees the following management strategies are proposed:

- Delineation of POS areas containing trees to be retained with a road separation / hard edge.
- Clear demarcation of individual trees proposed for retention within the LSP, prior to site works to ensure that these trees are not accidentally impacted.

A Vegetation Management Plan (VMP) has been identified as a condition under Ministerial Statement No. 580. The specifications for the VMP are given as follows:

Prior to subdivision approval, the subdivider shall prepare a Vegetation Management Plan that protects the regionally significant vegetation abutting the Amendment area, particularly Bush Forever Site No. 356, from direct and indirect impacts associated with the development, through the provision of a hard edge along the amendment boundary and the implementation of appropriate construction and access management measures.

The Vegetation Management Plan shall be prepared to the satisfaction of the local government and on advice of the Department of Conservation and Land Management and the Department of Environmental Protection (both agencies now referred to as the Department of Environment and Conservation).

As this site does not abut Bush Forever Site 356, the VMP condition is not relevant to this lot. It is noted that this management plan has been prepared for Lots 312 and 313 Fifty Road, and Lots 2, 4, 7 and 8 Eighty Road, Baldivis, to which the Ministerial Statement and this condition applies, as it directly abuts Bush Forever Site 356 (Coterra Environment, 2014)

5.2 Fauna and Habitat

The subject area contains limited fauna habitat of varied viability. Mature trees within the subject area potentially offer habitat to bird species, potentially including the black cockatoo species listed in Table 4. It should be noted that it is considered that a detrimental impact to local black cockatoo populations appears unlikely to result from the removal of a portion of the potential black cockatoo habitat trees within the subject area. This is supported by the presence of a number of bushland reserves and ecological linkages in the surrounding area that can provide more suitable habitat of higher ecological value to these species. However, some tuart trees are proposed for possible retention in POS B (Figure 3), largely based on their potential value as habitat for fauna including, but not limited to, protected black cockatoo species. The final POS design and engineering constraints will determine the ability for retention of these trees.

To prevent accidental damage to retained trees and to minimise impacts to fauna resulting from any clearing activities, the following management strategies are proposed:

- During construction, the extent of authorised clearing will be clearly defined and demarcated to avoid accidental clearing.
- Loud noises (e.g. air horns) will be made just prior to commencement of clearing to encourage fauna movement away from this area.
- Clearing works will occur in the direction of adjacent bushland areas (ie. to the west) where possible, to allow fauna to disperse.
- If any injured or distressed fauna are encountered during site works the Site Supervisor will be instructed to immediately call the DPaW Wildcare Hotline (08) 9474 9055, to allow for the closest appropriate DPaW registered wildlife rehabilitator to attend the site.

5.3 Drainage and Nutrient Retention

A LWMS has been prepared by Coterra Environment, separate to this EAR, as a requirement of submission of a LSP (Coterra Environment, 2015). The LWMS was prepared in accordance with the Better Urban Water Management Guidelines (DoW, 2008) and addresses the following:

- Identification of the current hydrological regime and existing environment of the subject area.
- Identification of the proposed water supply (including irrigation requirements) and wastewater disposal.
- Identification of the constraints within the development area which may affect the design of the development with respect to urban stormwater drainage,
- Provide a description of the stormwater management strategy for minor and major events, including details on the proposed water sustainable urban design best management practises to be employed.
- Identification and description of mechanisms to protect the water regime, including water quality and water levels. This will include a discussion of the overarching engineering principles that will be employed to mitigate any impact from run-off and water issues, and ensure that the environment and the development will not be adversely impacted upon.
- Identification of monitoring requirements and derivation of agreed performance targets for the urban stormwater and drainage treatment system.
- Identification of contingency measures to be implemented in the event that pollution and nutrient removal, and stormwater detention are not achieving agreed performance targets.

An Urban Water Management Plan will be required to be prepared and approved as a condition of subdivision in accordance with the *Better Urban Water Management Guidelines* (2008).

5.4 Acid Sulfate Soils

DER mapping indicates the subject area contains only areas mapped as having 'Low to Nil' risk of Acid Sulfate Soils (ASS). However a high risk area is located less than 500 m from the boundary of the subject area (Opwin Swamp to the south), triggering a requirement for a more detailed ASS risk assessment in accordance with the DER's requirements.

An ASS investigation is currently being undertaken for the subject area (early 2015). Depending upon the results of the ASS investigation and proposed earthworks, an Acid Sulfate Soil Assessment and Dewatering Management Plan (ASSDMP) will be prepared, if required. This plan will be approved for implementation by the DER prior to any ground disturbing works being undertaken.

5.5 Contamination

As previously discussed, a PSI and SAQP has been completed and approved by an auditor (EAPL, 2014a).

This investigation determined that a DSI is required to assess the nature, extent and magnitude of contamination (if present) at the locations identified as having potential contamination concerns. The need for remedial works will be identified following these site specific investigations. Remedial works would include the excavation and disposal of impacted soils to an appropriate landfill (if required).

Any further investigations completed within the subject area, including any removal and remediation of contamination identified (if required), will be undertaken in accordance with the DER's requirements and will be subject to review and approval by a CS auditor prior to subdivision approval. The DSI is currently in progress (early 2015).

5.6 Fire

A Fire Management Plan has been prepared by Strategen (2015) for the subject area. The FMP provides the following detail with regard to the retention of vegetation within POS areas:

Three Public Open Space (POS) areas are proposed as part of the development, including POS A, POS B and POS C. POS A and POS B are required to accommodate the natural gas pipeline easement along the western boundary. The POS concept is as follows:

- *retention of individual overstorey trees within POS B (all other POS are currently cleared)*
- *maintain a predominant parkland cleared landscape with annual management of the understory to achieve a low fuel tonnage of 2 t/ha.*

The above areas will not pose a significant bush fire risk to future lots provided they are managed annually. POS A and POS B are strategically placed and will provide a significant low fuel buffer to the adjacent west woodland vegetation.

To conform to the FMP and fire management requirements, POS areas will be subject to annual management to achieve a parkland cleared landscape maintained at less than 2 t/ha, with slashing of the understorey and weed control as required. Tree retention in POS will occur as discussed in Sections 5.1 and 5.2, which will not compromise the low fuel objective of the POS.

The FMP provides further detail regarding the fire management requirements for the proposed development (Strategen, 2015).

5.7 Surrounding Land Use and Buffer Requirements

5.7.1 Horticultural Activities

A condition relating to the preparation of a Spray Drift Investigation and Management Plan is specified in the City of Rockingham's TPS No.2, Schedule 8.

However, market gardening activities on the adjacent Lot 299 Kerosene Lane have recently ceased and as such, this condition no longer applies to the proposed development of the subject area.

5.7.2 High Pressure Gas Pipeline

The Parmelia high pressure natural gas pipeline easement runs immediately adjacent to the western boundary of the proposed development area (Figure 2).

Land uses on the pipeline easement, and within proximity to the easement are guided by both the EPA's Ministerial Statement No. 580 for the subject area under Town Planning Scheme Amendment No. 300, and in the WAPC's Planning Bulletin No. 87 – *High Pressure Gas Transmission Pipelines in the Perth Metropolitan Region*.

The current setback of residential lots to the centre of the pipeline easement conforms to the requirements of Ministerial Statement No. 580.

6.0 IMPLEMENTATION STRATEGY

Table 5 presents a proposed schedule of all programmed activities for the pre-construction, construction and post-construction phases of the project relevant to this stage in the planning process.

Table 5: Implementation Plan

Issue	Action	Frequency	Responsibility
Pre-construction Phase			
Vegetation protection	Delineate POS areas containing retained trees with a road separation in subdivision plans.	Once	Planner (Developer)
	Clearly demarcate individual trees proposed for retention prior to works commencing onsite to ensure they are not accidentally impacted.	Once	Licensed Surveyor (Developer)
Acid Sulfate Soils (ASS)	Undertake an ASS Investigation to assess the likely risk of encountering ASS and any proposed management measures.	Once	Developer
Contamination	Undertake a Detailed Site Investigation (DSI) for DER approval, in accordance with the Sampling and Analysis Quality Plan (SAQP).	Once	Developer
	Contaminated Sites (CS) Auditor to prepare a Mandatory Auditors Report (MAR) after DSI is completed and remediation undertaken (if required). (Dependent on receipt of relevant subdivision condition).	Once	CS Auditor (Developer)
Urban Water Management Plan (UWMP)	Following approval of the LWMS, prepare a UWMP as a condition of subdivision approval.	Once	Developer
Construction Phase			
Fauna protection	Undertake clearing in the direction of existing bushland (west) to allow fauna to disperse.	Ongoing during construction phase.	Construction Contractor (Developer)
	Employ air horns or other loud alerts prior to clearing commencement.	Ongoing during construction phase.	Construction Contractor (Developer)
	All contractors to be advised of their responsibilities with regard to injured wildlife.	Ongoing during construction phase.	Developer
Aboriginal Heritage	All contractors to be advised of their responsibilities with regard to discovery of potential Aboriginal artefacts.	Ongoing during construction phase.	Developer

Issue	Action	Frequency	Responsibility
Post-construction Phase			
POS Management	Ensure ongoing maintenance of vegetation retained and fuel load management prior to handover.	Ongoing until handover.	Developer until hand over to the City of Rockingham.

7.0 CONCLUSION

This report has been prepared to provide a detailed description of the existing environment, and outline proposed management measures to effectively manage any potential environmental impacts resulting from the implementation of the development. It is considered that urban development of the subject area is an appropriate land use, given the current degraded environmental condition of the area, and in consideration of the proposed management strategies outlined in this report.

8.0 REFERENCES

Beard, J.S. (1981). Vegetation Survey of Western Australia. University of Western Australia Press, Crawley WA.

Bennett Environmental Consulting Pty Ltd (BEC) (2014). Botanical Assessment of Lots on McDonald Road, Baldivis. Final Version. Prepared for Coterra Environment.

City of Rockingham (CoR) (undated). Local Planning Policy 7.2 – *Local Bushland Strategy*. City of Rockingham, WA.

Coterra Environment (2014). Vegetation Management Plan. Lots 312 and 313 Fifty Road, and Lots 2, 4, 7 and 8 Eighty Road, Baldivis. Prepared for Spatial Property Group.

Coterra Environment (2015). Local Water Management Strategy. Lot 306 McDonald Road, Baldivis. Prepared for Spatial Property Group.

Del Marco. A, Taylor. R, Clarke. K, Savage. K, Cullity. J, and Miles. C. (2004). *Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region*. Perth Biodiversity Project. Western Australian Local Government Association. Perth. WA.

Department of Aboriginal Affairs (DAA) (2014). Aboriginal Heritage Inquiry System. http://maps.dia.wa.gov.au/AHIS2/. Accessed May 2014.

Department of Environment and Conservation (DEC) (2001-2010). Contaminated Sites Management Series. DEC, Perth.

Department of Environment and Conservation (DEC) (2008 - 2009). Acid Sulfate Soils Guidelines Series (2008 - 2009). Department of Environment and Conservation, Perth.

Department of Environment Regulation (2014). Contaminated Sites Database. https://secure.dec.wa.gov.au/idelve/css/. Accessed May 2014.

Department of Minerals and Energy (2000). Rockingham sheet (Gozzard JR 1983 Rockingham Sheet part of Sheets 2033 III and 2033 II. Environmental Geology Series. Geological Survey of Western Australia, Perth, Western Australia.)

Department of Parks and Wildlife (DPaW) (2014). NatureMap. http://naturemap.dpaw.wa.gov.au/default.aspx. Accessed May 2014.

Department of the Environment (DotE) (2014). EPBC Act Protected Matters Search Tool. http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf. Accessed May 2014.

Department of Water (DoW) (2014). Perth Groundwater Atlas online. Department of Water, Perth. http://www.water.wa.gov.au/idelve/gwa/. Accessed May 2014.

Department of Water (DoW) (2012). Serpentine Hydrological Studies. Department of Water, Science and Planning Division. Project code 33033508.

Department of Water (DoW) (2008). Better Urban Water Management. State of Western Australia.

Emission Assessments Pty Ltd (EAPL) (2014a). Preliminary Site Investigation and Sampling & Analysis Quality Plan. Lot 306 (No. 20) McDonald Road, Baldivis, WA. Report Number: 1314-125. Prepared for Coterra Environment. June, 2014.

Emission Assessments Pty Ltd (EAPL) (2014b). Detailed Site Investigation. Lot 313 Fifty Road, Lots 312 & 2 Eighty Road, Lot 4 Baldivis Road and Lots 5, 7 & 8 Ingram Road, Baldivis. Report Number: 1314-039 & 1314-037. Prepared for Spatial Property Group and Finepoint Investments Pty Ltd.

Environmental Protection Authority (EPA) (1992). Environmental Protection (*Peel Inlet – Harvey Estuary*) Policy. EPA, Perth.

Environmental Protection Authority (EPA) (2008a). Water Quality Improvement Plan for the Rivers and Estuary of the Peel – Harvey System – Phosphorus Management. EPA and Australian Government, Perth.

Environmental Protection Authority (EPA) (2008b). Environmental Guidance for Planning and Development. Final Guidance No. 33. Environmental Protection Authority, Perth.

Heddle, E.M. Loneragan, O.W, Havel, J.J (1980) Vegetation Complexes of the Darling System Western Australia, In. Atlas of Natural Resources, Darling System, Western Australia. Department of Conservation and Environment, Perth.

Keighery, B.J. (1994). Bushland Plant Survey: a Guide to Plant Community Surveys for the Community. Wildflower Society of Western Australia (Inc.) Nedlands, WA.

Landgate (2014). Acid Sulfate Soil Risk Map, Swan Coastal Plain. Department of Environment Regulation, Perth.

National Environment Protection Council (2013). National Environment Protection (Assessment of Site Contamination) Measure. National Environmental Protection Council, Adelaide.

Shepherd, D.P., Beeston, G.R., and Hopkins, A.J.M. (2002). Native Vegetation in Western Australia. Technical Report 249. Department of Agriculture, Western Australia, South Perth.

Strategen (2015). Fire Management Plan. Lot 306 McDonald Road, Baldivis. Prepared for Spatial Property Group.

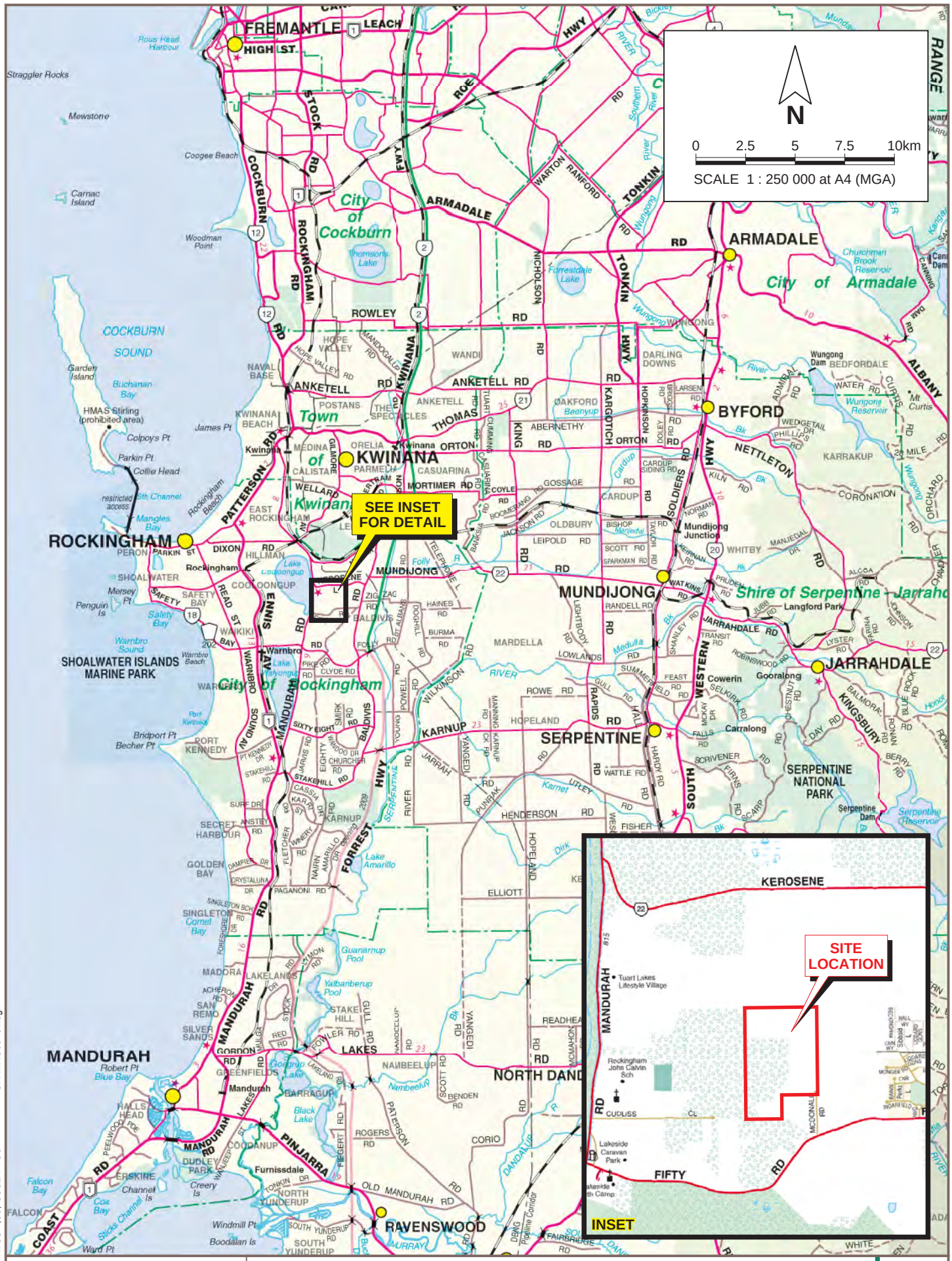
Water and Rivers Commission (WRC) (2001). Position Statement: Wetlands. WRC, Perth.

Western Australian Herbarium (2014). Florabase. Department of Parks and Wildlife. https://florabase.dpaw.wa.gov.au/.

Western Australian Planning Commission (WAPC) (2000). Bush Forever. WAPC, Perth, WA.

Western Australian Planning Commission (WAPC) (2003a). State Planning Policy 2.1: The Peel-Harvey Coastal Plain Catchment. State of Western Australia, Perth.

FIGURES



PINPOINT CARTOGRAPHICS (08) 9562 7136 SPAMAC03-f01.dgn

COTERRA ENVIRONMENT

Spatial Property Group
ENVIRONMENTAL ASSESSMENT REPORT
LOT 306 MCDONALD ROAD, BALDIVIS

Drawn: E. Bryce	Date: 4 Dec 2014
Job: SPAMAC03	Revision: A

SITE LOCATION

Figure 1

PINPOINT CARTOGRAPHICS (08) 9562 7136 SPAMAC03-f02.dgn

N

0 20 40 60 80 100m

SCALE 1 : 2 000 at A3 (MGA)

299

14

102

1

6 425 250mN

2

Lot 306

9002

12

6 425 000mN

34

16

MCDONALD ROAD

305

53

51

100

101

52

387 500mE

387 750mE

Legend

- Subject Area Boundary
- Lot 306 Boundary
- Cadastral Boundary
- Easement Boundary

MRS Zoning

- Urban
- Rural

CADASTRAL SOURCE: Landgate, March 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown December 2014.
MRS SOURCE: Department of Planning, Metropolitan Region Scheme, 18 March 2014.

COTERRA ENVIRONMENT

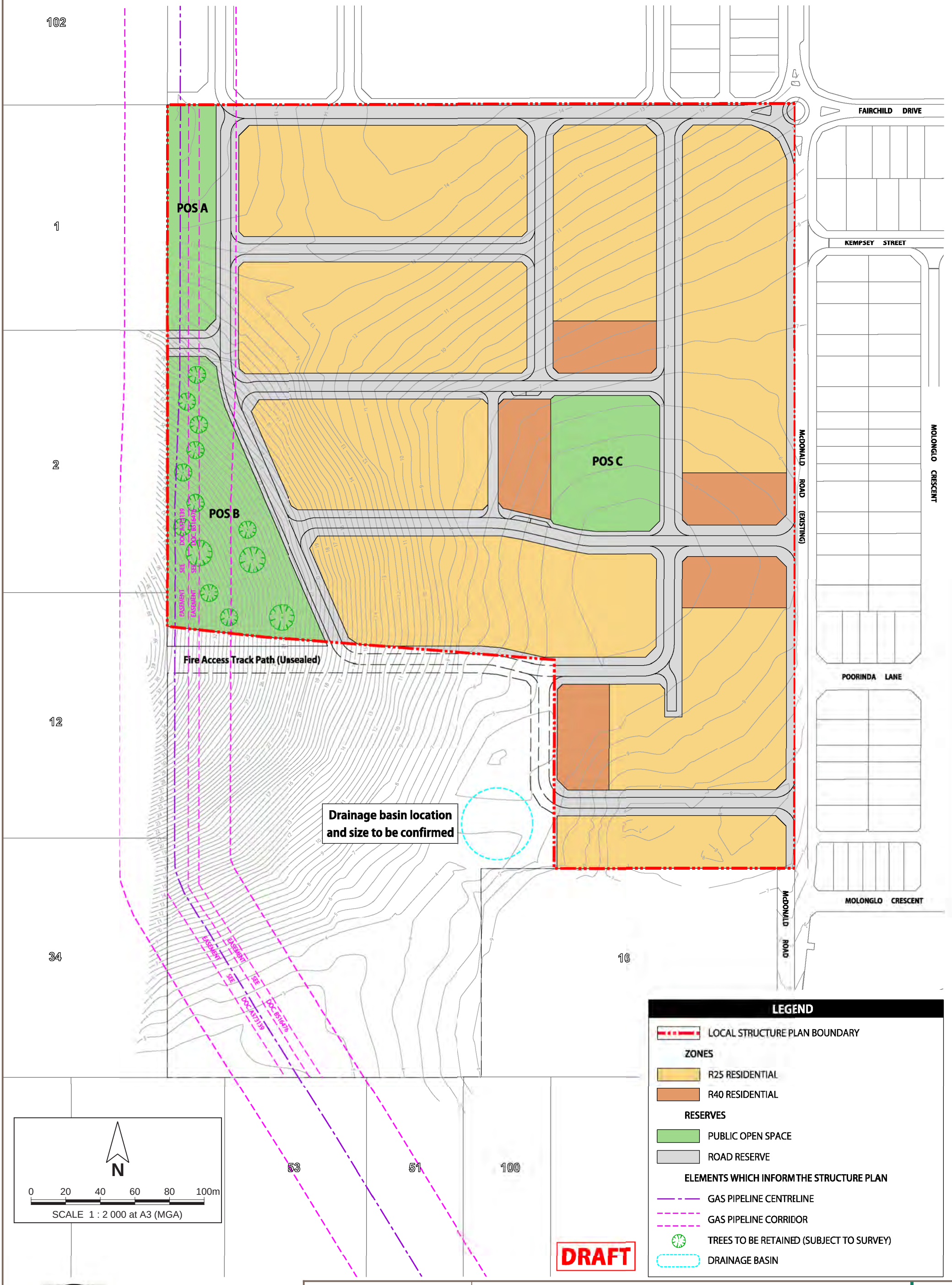
Spatial Property Group
ENVIRONMENTAL ASSESSMENT REPORT
LOT 306 MCDONALD ROAD, BALDIVIS

Drawn: E. Bryce | Date: 19 Mar 2015

Job: SPAMAC03 | Revision: A

SUBJECT AREA AND MRS ZONING

Figure 2



SOURCE: Creative Design and Planning, Dwg No. SPGBD-2-001D, 13-03-2015.

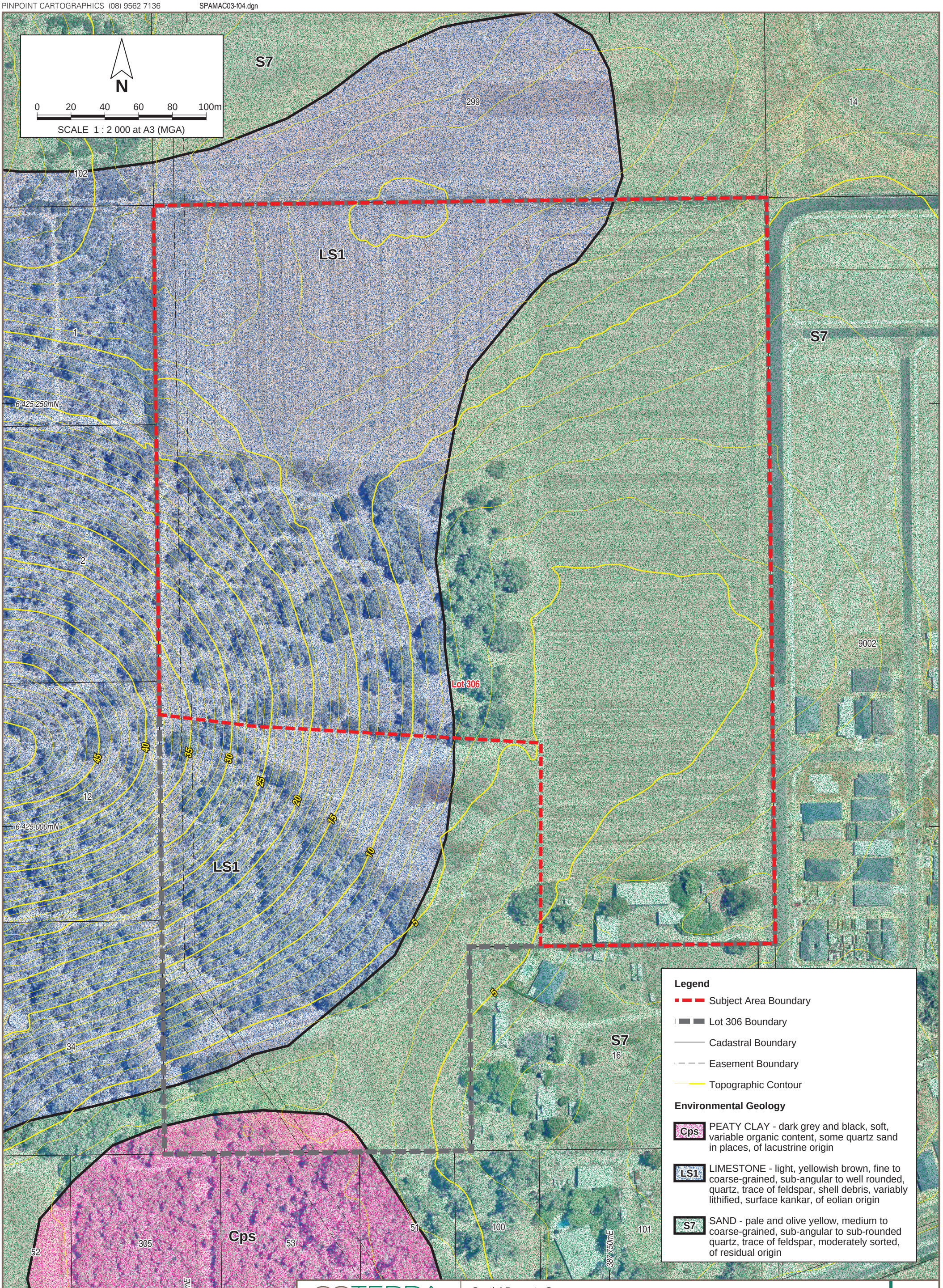
COTERRA ENVIRONMENT

Spatial Property Group
ENVIRONMENTAL ASSESSMENT REPORT
LOT 306 MCDONALD ROAD, BALDIVIS

Drawn: E. Bryce | Date: 31 Mar 2015
Job: SPAMAC03 | Revision: A

LOCAL STRUCTURE PLAN

Figure 3



CADASTRAL SOURCE: Landgate, March 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown December 2014.
GEOLOGY SOURCE: Geological Survey of WA 1:50,000. Environmental Geology Series.

COTERRA ENVIRONMENT

Spatial Property Group
ENVIRONMENTAL ASSESSMENT REPORT
LOT 306 MCDONALD ROAD, BALDIVIS

Drawn: E. Bryce | Date: 19 Mar 2015
Job: SPAMAC03 | Revision: A

TOPOGRAPHY AND GEOLOGY MAPPING

Figure 4

PINPOINT CARTOGRAPHICS (08) 9562 7136 SPAMAC03-f05.dgn

ASS SOURCE: DEC, January 2010.
CADASTRAL SOURCE: NearMap, flown December 2014.
AERIAL PHOTOGRAPH SOURCE: Landgate, flown November 2013.

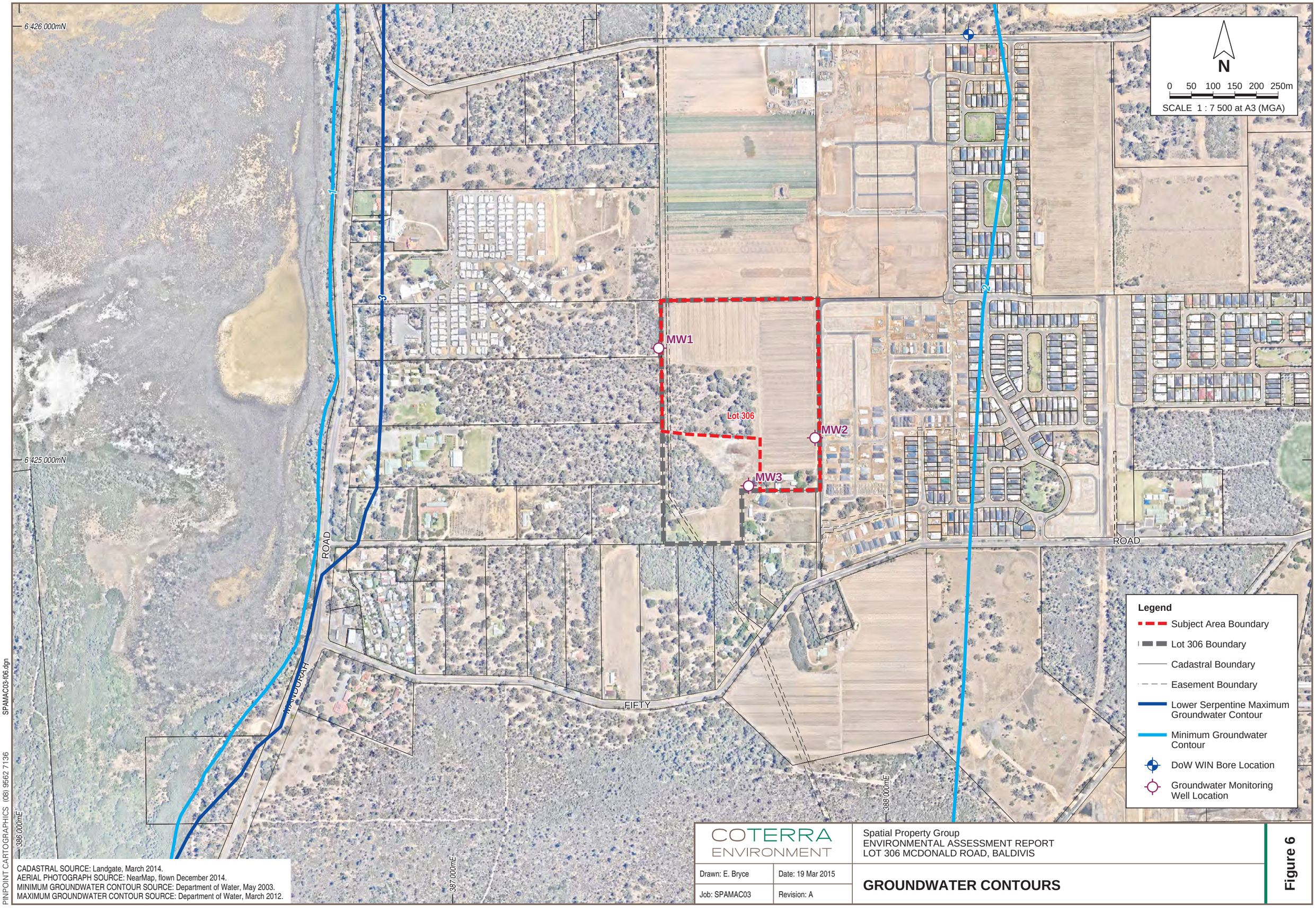
COTERRA ENVIRONMENT

Spatial Property Group
ENVIRONMENTAL ASSESSMENT REPORT
LOT 306 MCDONALD ROAD, BALDIVIS

Drawn: E. Bryce	Date: 19 Mar 2015
Job: SPAMAC03	Revision: A

ACID SULFATE SOILS RISK MAPPING

Figure 5



CADASTRAL SOURCE: Landgate, March 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown December 2014.
MINIMUM GROUNDWATER CONTOUR SOURCE: Department of Water, May 2003.
MAXIMUM GROUNDWATER CONTOUR SOURCE: Department of Water, March 2012.

COTERRA ENVIRONMENT

Spatial Property Group
ENVIRONMENTAL ASSESSMENT REPORT
LOT 306 MCDONALD ROAD, BALDIVIS

Drawn: E. Bryce	Date: 19 Mar 2015
Job: SPAMAC03	Revision: A

GROUNDWATER CONTOURS

Figure 6

PINPOINT CARTOGRAPHICS (08) 9562 7136 SPAMAC03-f06.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136 SPAMAC03-f07.dgn

N

0 20 40 60 80 100m

SCALE 1 : 2 000 at A3 (MGA)

299

14

102

1

6 425 250mN

2

Lot 306

9002

12

6 425 000mN

34

16

52

305

53

51

100

101

6400

387 500mE

387 750mE

Legend

- Subject Area Boundary
- Lot 306 Boundary
- Cadastral Boundary
- Easement Boundary

Geomorphic Wetlands

- Conservation Category
- 50m from CCW
- 6400 Wetland UFI

WETLAND SOURCE: DER, November 2013.
CADASTRAL SOURCE: Landgate, March 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown December 2014.

COTERRA ENVIRONMENT

Spatial Property Group
ENVIRONMENTAL ASSESSMENT REPORT
LOT 306 MCDONALD ROAD, BALDIVIS

Drawn: E. Bryce | Date: 19 Mar 2015

Job: SPAMAC03 | Revision: A

GEOMORPHIC WETLANDS AND BUFFERS

Figure 7

PINPOINT CARTOGRAPHICS (08) 9562 7136 SPAMAC03-f08.dgn

N

0 20 40 60 80 100m

SCALE 1 : 2 000 at A3 (MGA)

299

14

102

1

Market Garden

6 425 250mN

BD1

Cc

2

Eg

Market Garden

BD2

9002

Lot 306

12

6 425 000mN

34

MCDONALD ROAD

52

305

53

51

387 500mE

Vegetation Units

Eg
Tall Forest of *Eucalyptus gomphocephala* over Low Woodland A of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Scrub of *Jacksonia furcellat*a over Open Low Scrub B of *Acacia pulchella* var. *pulchella* and *Macrozamia riedlei* over Dense Tall Grass dominated by **Ehrharta calycina* and **Briza maxima*

Cc
Forest to Dense Forest of *Corymbia calophylla* over Low Woodland A of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Low Scrub B dominated by *Hakea lissocarpha, Xanthorrhoea preissii* and *Gompholobium tomentosum* over Open Dwarf Scrub D dominated by *Hibbertia hypericoides* and *Acacia pulchella* var. *pulchella*

Legend

- Subject Area Boundary
- Lot 306 Boundary
- Cadastral Boundary
- Easement Boundary
- Quadrat Location
- Vegetation Boundary
- Cc Vegetation Unit

CADASTRAL SOURCE: Landgate, March 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown December 2014.
VEGETATION MAPPING SOURCE: Bennett Environmental Consulting, 2014.

COTERRA ENVIRONMENT

Spatial Property Group
ENVIRONMENTAL ASSESSMENT REPORT
LOT 306 MCDONALD ROAD, BALDIVIS

Drawn: E. Bryce | Date: 19 Mar 2015
Job: SPAMAC03 | Revision: A

VEGETATION UNITS

Figure 8

PINPOINT CARTOGRAPHICS (08) 9562 7136 SPAMAC03-f09.dgn

N

0 20 40 60 80 100m

SCALE 1 : 2 000 at A3 (MGA)

299

14

102

1

6

6

6 425 250mN

4-5

5-6

5-6

4-5

4-5

5-6

5-6

4-5

4-5

5-6

5-6

2

6

Lot 306

9002

12

6 425 000mN

34

16

MCDONALD ROAD

100

52

305

53

51

387 500mE

Vegetation Condition

4 - Good
Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.

5-6 - Degraded
Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.

6 - Completely Degraded
The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

Legend

- Subject Aea Boundary
- Lot 306 Boundary
- Cadastral Boundary
- Easement Boundary
- Vegetation Condition Boundary
- 4 Vegetation Condition

CADASTRAL SOURCE: Landgate, March 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown December 2014.
VEGETATION MAPPING SOURCE: Bennett Environmental Consulting, 2014.

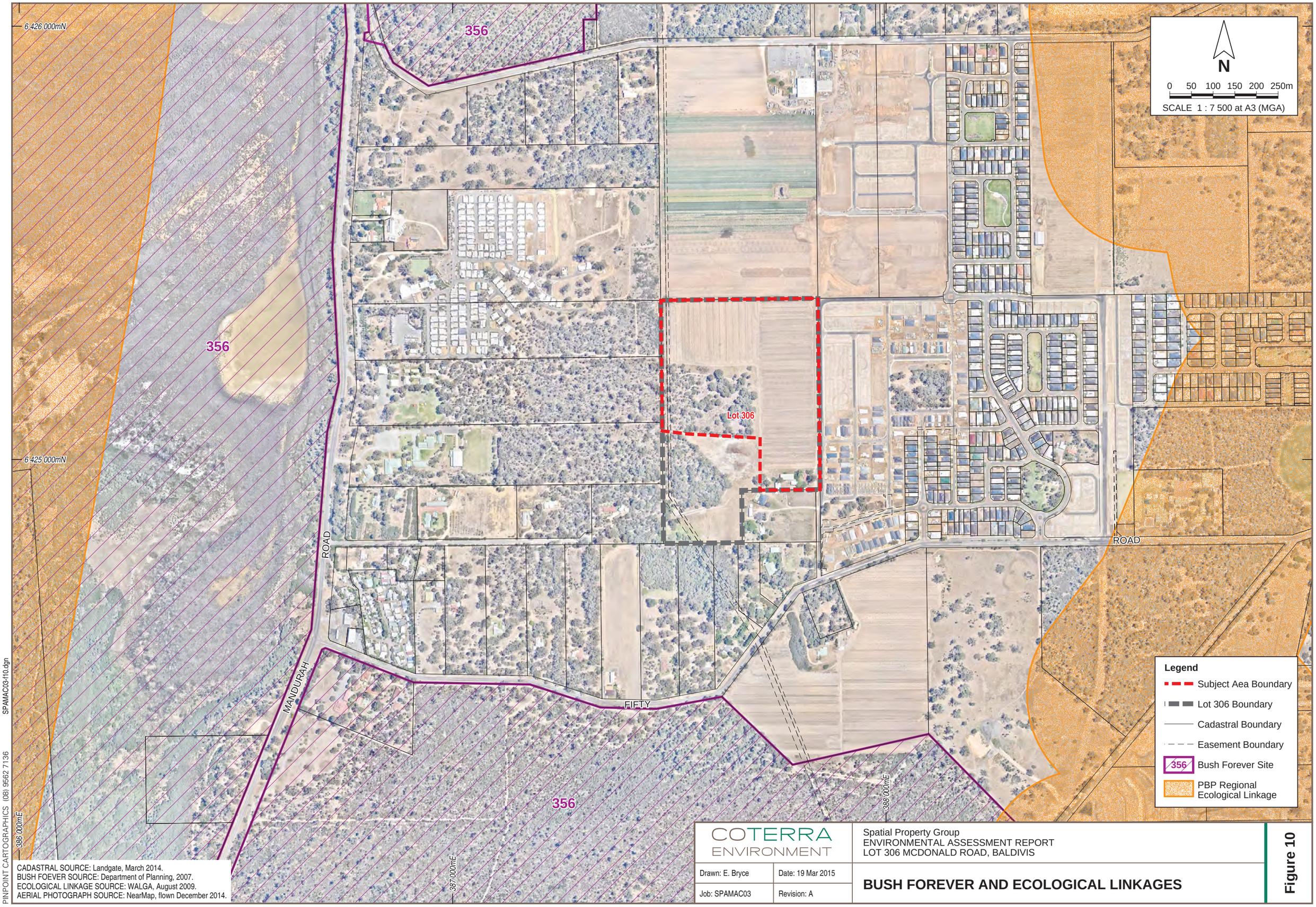
COTERRA ENVIRONMENT

Spatial Property Group
ENVIRONMENTAL ASSESSMENT REPORT
LOT 306 MCDONALD ROAD, BALDIVIS

Drawn: E. Bryce | Date: 19 Mar 2015
Job: SPAMAC03 | Revision: A

VEGETATION CONDITION

Figure 9



CADASTRAL SOURCE: Landgate, March 2014.
BUSH FOEVER SOURCE: Department of Planning, 2007.
ECOLOGICAL LINKAGE SOURCE: WALGA, August 2009.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown December 2014.

COTERRA ENVIRONMENT

Spatial Property Group
ENVIRONMENTAL ASSESSMENT REPORT
LOT 306 MCDONALD ROAD, BALDIVIS

Drawn: E. Bryce	Date: 19 Mar 2015
Job: SPAMAC03	Revision: A

BUSH FOREVER AND ECOLOGICAL LINKAGES

Figure 10

PINPOINT CARTOGRAPHICS (08) 9562 7136 SPAMAC03-f10.dgn

N

0 20 40 60 80 100m

SCALE 1 : 2 000 at A3 (MGA)

299

14

102

1

Market Garden

6 425 250mN

BD1

2

Cc

Eg

Market Garden

BD2

9002

Lot 306

12

6 425 000mN

34

51

305

53

52

387 500mE

Vegetation Units

Eg
Tall Forest of *Eucalyptus gomphocephala* over Low Woodland A of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Scrub of *Jacksonia furcellata* over Open Low Scrub B of *Acacia pulchella* var. *pulchella* and *Macrozamia riedlei* over Dense Tall Grass dominated by **Ehrharta calycina* and **Briza maxima*

Cc
Forest to Dense Forest of *Corymbia calophylla* over Low Woodland A of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Low Scrub B dominated by *Hakea lissocarpha, Xanthorrhoea preissii* and *Gompholobium tomentosum* over Open Dwarf Scrub D dominated by *Hibbertia hypericoides* and *Acacia pulchella* var. *pulchella*

Legend

- Subject Aea Boundary
- Lot 306 Boundary
- Cadastral Boundary
- Easement Boundary
- Quadrat Location
- Vegetation Boundary
- Cc Vegetation Unit

Potential Cockatoo Habitat Trees

- *Corymbia calophylla*
- *Eucalyptus gomphocephala*
- Tree Contains Hollows

CADASTRAL SOURCE: Landgate, March 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown December 2014.
VEGETATION MAPPING SOURCE: Bennett Environmental Consulting, 2014.

COTERRA ENVIRONMENT

Spatial Property Group
ENVIRONMENTAL ASSESSMENT REPORT
LOT 306 MCDONALD ROAD, BALDIVIS

Drawn: E. Bryce | Date: 19 Mar 2015
Job: SPAMAC03 | Revision: A

POTENTIAL COCKATOO HABITAT TREE MAPPING

Figure 11

APPENDIX A – MINISTERIAL STATEMENT NO. 580

MINISTER FOR THE ENVIRONMENT AND HERITAGE

Statement No.

000580

STATEMENT THAT A SCHEME MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF DIVISION 3 OF PART IV OF THE ENVIRONMENTAL PROTECTION ACT 1986)

CITY OF ROCKINGHAM TOWN PLANNING SCHEME NO. 1 AMENDMENT NO. 300 ("DEVELOPMENT" ZONE, PT LOTS 306 & 16, AND LOTS 313 & 774, FIFTY ROAD, BALDIVIS)

Scheme Purpose: To rezone Pt Lot 306, Pt Lot 16, and Lots 313 and 774 Fifty Road, Baldivis from "Rural" to "Development" zone.

Responsible Authority: City of Rockingham

Responsible Authority Address: PO Box 2142, Rockingham WA 6967

Assessment Number: 1227

Report of the Environmental Protection Authority: Bulletin 1018

Subject to the following conditions, there is no known environmental reason why the town planning scheme amendment to which the above report of the Environmental Protection Authority relates should not be implemented:

CONDITIONS TO BE INCORPORATED INTO THE SCHEME BY INSERTION OF PROVISIONS IN SCHEME TEXT

1 Environmental Management Plans

1-1 The following Environmental Management Plans shall be prepared in accordance with the specifications set out in Attachment 1 in the Minister for the Environment and Heritage's "Statement that a Scheme may be Implemented" No. [insert relevant Statement Number] published on [insert date], and shall be subsequently implemented in accordance with the provisions of the Plans:

Published on

19 DEC 2001

29th FLOOR, ALLENDALE SQUARE, 77 ST. GEORGE'S TERRACE, PERTH 6000 TELEPHONE: (08) 9220 5050 FACSIMILE: (08) 9221 4665/8
E-MAIL: judy-edwards@dpc.wa.gov.au

- Drainage and Nutrient Management Plan;
- Soil and Groundwater Contamination Investigation and Remediation Plan;
- Pipeline Protection Plan;
- Spray Drift Investigation and Management Plan; and
- Vegetation Management Plan.

2 High Pressure Natural Gas Pipeline

2-1 The following activities, land uses and developments are prohibited within the high pressure natural gas pipeline easement:

- Ground-disturbing activities, other than for the purposes for which the easement was created, and for uses and developments that comply with condition 2-2 below;
- Temporary residence (including caravans, camping and similar);
- Storage of materials and equipment;
- Fires and barbecues;
- Explosives, inflammables and corrosives (including storage of liquefied petroleum gas and fuel oil);
- Refuse disposal and landfill;
- Service stations, fuel lines and storage of fuel;
- Vegetation with an expected growth exceeding one metre in height, and plantings within one metre of the centre of the pipeline (with the exception of lawn); and
- Large obstructions to the line of sight along the easement.

Note: For the high pressure natural gas pipeline easement, the relevant Australian Standard is AS 2885.3.

2-2 The following land uses and developments may be permitted within the high pressure natural gas pipeline easement, with the written approval of the local government on advice of the pipeline operator, subject to compliance with the Pipeline Protection Plan referred to in condition 1-1 above:

- Cycleways and footpaths;
- Road crossings and services (with minimum depth of cover over the pipeline of 1.2 metres);
- Public open space;
- Signage and other facilities that are necessary to comply with the Pipeline Protection Plan referred to in condition 1-1 above; and
- Car parking during the time that the adjoining land is being developed (with minimum depth of cover over the pipeline of 1.2 metres).

2-3 Minimum setbacks for land uses and developments from the centre of the high pressure natural gas pipeline shall be:

- 96 metres, in the case of sensitive development as determined by the local government on advice of the Department of Environmental Protection and the pipeline operator, and including aged persons' accommodation, child care centres, schools and hospitals;
- 32 metres to the boundary of each residential lot, in the case of residential development; and
- at the local government's discretion, following consultation with the Department of Environmental Protection and the pipeline operator, in the case of all other land uses and developments which facilitate the gathering of people, within 96 metres of the centre of the pipeline.

3 Development in Proximity to Market Gardens

3-1 If the market gardens adjacent to Pt Lots 306 and 16 are continuing to operate at the time of subdivision, noise attenuation measures shall be designed and implemented so that noise impacts on the amendment area are in accordance with the *Environmental Protection (Noise) Regulations 1997.*

CONDITIONS TO BE INCORPORATED INTO THE SCHEME BY MODIFICATIONS TO THE SCHEME MAP

4 Scheme Map

4-1 The Scheme Map for the City of Rockingham Town Planning Scheme No. 1 shall be amended by inserting the symbol EC and an appropriate modification to the legend of the Scheme Map, to show that environmental conditions apply to part of Pt Lot 306, part of Lot 16, Lots 774 and 313 Fifty Road, Baldivis.

ATTACHMENT 1 - OF STATEMENT THAT A SCHEME MAY BE IMPLEMENTED - CITY OF ROCKINGHAM TOWN PLANNING SCHEME NO. 1 AMENDMENT NO. 300

SPECIFICATIONS FOR ENVIRONMENTAL MANAGEMENT PLANS

1 Drainage and Nutrient Management Plan

1-1 Prior to commencement of site works for subdivision or development, the subdivider or developer shall prepare a Drainage and Nutrient Management Plan to ensure that the rate, quantity and quality of water leaving the Amendment area will not adversely impact on Opwin and Spot Swamps, the Rockingham Groundwater Area groundwater supply, and the Peel-Harvey Estuarine System, to the requirements of the local government and on advice of the Water and Rivers Commission.

1-2 This Plan shall:

- Define the catchment of Opwin and Spot Swamps in relation to the Amendment area;
- Provide measures to facilitate the removal of pollutants and nutrients in accordance with the Water Sensitive Urban Design Best Practices;
- Incorporate Best Practice Water Sensitive Urban Design principles to maximise onsite water infiltration generally;
- Provide measures to prevent surface water runoff from entering the Opwin or Spot Swamps;
- Provide mechanisms to minimise erosion during and after the development phase;
- Provide a monitoring program, including definition of performance criteria and analysis procedures, to measure the performance of the Plan against objectives and performance criteria;
- Provide contingency plans in the event that criteria are not achieved; and
- Identify responsibilities for implementation of the Plan.

2 Soil and Groundwater Contamination Investigation and Remediation Plan

2-1 Prior to the commencement of site works for subdivision or development on any land that has previously been used for horticultural purposes, the subdivider or developer shall prepare and implement a Soil and Groundwater Contamination Investigation and Remediation Plan to the requirements of the local government and on advice of the Department of Environmental Protection.

2-2 This Plan shall

- Include soil and groundwater investigation procedures to define the nature and extent of any soil or groundwater contamination, and identify areas where

contamination levels exceed criteria recognised by the Department of Environmental Protection; and

- In the event that the investigation finds unacceptable soil or groundwater contamination, describe procedures for further investigation of contamination, a detailed methodology for remediation prior to development, the standards to which any contaminated soil or groundwater will be remediated, and a management plan for contaminated areas, where necessary.

3 Pipeline Protection Plan

3-1 Prior to subdivision or development on any land within or abutting the high pressure natural gas pipeline easement, the subdivider or developer shall prepare a Pipeline Protection Plan to ensure protection of the pipeline during construction activities, to the requirements of local government, on advice of the Department of Mineral and Petroleum Resources and the pipeline operator.

3-2 This Plan shall

- Detail measures to ensure public safety and protection of the high pressure natural gas pipeline in accordance with the *Petroleum Pipelines Act 1969-70*, the Australian Pipeline Code AS 2885-1997, SAA HB105 and the Environmental Protection Authority guidance statement for achieving its risk criteria for development in proximity to existing and proposed high pressure gas transmission pipelines, or the most recent equivalents recognised by the Environmental Protection Authority; and

- Identify responsibilities for implementation of the Plan.

4 Spray Drift Investigation and Management Plan

4-1 Prior to the approval of subdivision or development, the subdivider or developer shall prepare and implement a Spray Drift Investigation and Management Plan to the requirements of the local government, on advice of the Department of Health, the Department of Agriculture and the Department of Environmental Protection.

4-2 This Plan shall

- Require undertaking investigations of spray drift from all rural or semi-rural activities occurring within the proximity of the Amendment area, to clearly define impacts on the health and amenity of future residents; and

- In the event that the investigations find that unacceptable health or amenity impacts are likely to affect the residents within the Amendment area, provide

management strategies to ensure that impacts on the health and amenity of future residents are acceptable.

5 Vegetation Management Plan

5-1 Prior to subdivision approval, the subdivider shall prepare a Vegetation Management Plan that protects the regionally significant vegetation abutting the Amendment area, particularly *Bush Forever* Site No. 356, from direct and indirect impacts associated with the development, through the provision of a hard edge along the amendment boundary and the implementation of appropriate construction and access management measures.

5-2 The Vegetation Management Plan shall be prepared to the satisfaction of the local government and on advice of the Department of Conservation and Land Management and the Department of Environmental Protection.

Dr Judy Edwards MLA
MINISTER FOR THE ENVIRONMENT AND HERITAGE

19 DEC 2001

APPENDIX B – LEVEL 2 VEGETATION AND FLORA SURVEY (BEC, 2015)

Botanical Assessment of Lots on McDonald Road, Baldivis

Prepared for:
COTERRA ENVIRONMENT
2/460 Roberts Road,
SUBIACO WA 6008

Prepared by:
Bennett Environmental Consulting Pty Ltd

Sollya heterophylla

PO Box 341
KALAMUNDA 6926

January 2015

STATEMENT OF LIMITATIONS

Scope of Services

This 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 Eleanor Bennett ("the Author"). In some circumstances a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services.

Reliance on Data

In preparing the report, the Author has relied upon 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, the Author has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. The Author will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to the Author.

Environmental Conclusions

In accordance with the scope of services, the Author has relied upon 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.

The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

Within the limitations imposed by the scope of services, the field assessment 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, expressed or implied, is made.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. The Author 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 the Author or for any loss or damage suffered by any other party relying upon 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

The Author will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or 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.

INDEX

SUMMARY i
1 INTRODUCTION 1
1.1 Background 1
1.2 Scope of Works 2
2 BACKGROUND INFORMATION 2
2.1 Geology and Landform 2
2.2 Vegetation 2
2.3 Threatened Ecological Communities 3
2.4 Significant Flora 3
3. METHODS 5
4. RESULTS 5
4.1 Vegetation 6
4.2 Vegetation Condition 6
4.3 Significant Taxa 7
4.4 Weeds 7
5. DISCUSSION 7
6. REFERENCES 8
APPENDIX A 10
Quadrat Data 10
APPENDIX B 15
Maps 15

SUMMARY

Bennett Environmental Consulting Pty Ltd was commissioned to undertake a vegetation overview of a site in McDonald Road, Baldivis. Only a small section of remnant vegetation was retained most of the site was market gardens. A Level 1 (Environmental Protection Authority, 2004) autumn survey was undertaken in early March and a spring survey in early November 2014.
Two vegetation units were recorded.

- On the higher ground the vegetation unit was: Tall Forest of *Eucalyptus gomphocephala* over Low Woodland A of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Scrub of *Jacksonia furcellata* over Open Low Scrub B of *Acacia pulchella* var. *pulchella* and *Macrozamia riedlei* over Dense Tall Grass dominated by **Ehrharta calycina* and **Briza maxima; and*
- On the lower ground the vegetation unit was: Forest to Dense Forest of *Corymbia calophylla* over Low Woodland A of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Low Scrub B dominated by *Hakea lissocarpha, Xanthorrhoea preissii* and *Gompholobium tomentosum* over Open Dwarf Scrub D dominated by *Hibbertia hypericoides* and *Acacia pulchella* var. *pulchella.*

The remnant vegetation at the site was in good condition but the numerous tracks and cleared areas throughout were in degraded condition.

No Threatened or Priority Flora were recorded.

1 INTRODUCTION

1.1 Background

Coterra Environment commissioned Bennett Environmental Consulting Pty Ltd to undertake a vegetation overview of the site illustrated in Diagram 1. A Level 1 (Environmental Protection Authority, 2004) autumn survey and a Level 2 spring survey were to be undertaken. It is apparent that over 50% of the site is currently under market gardens. The whole site was surveyed but the report has only been prepared for the northern section outlined in red. .

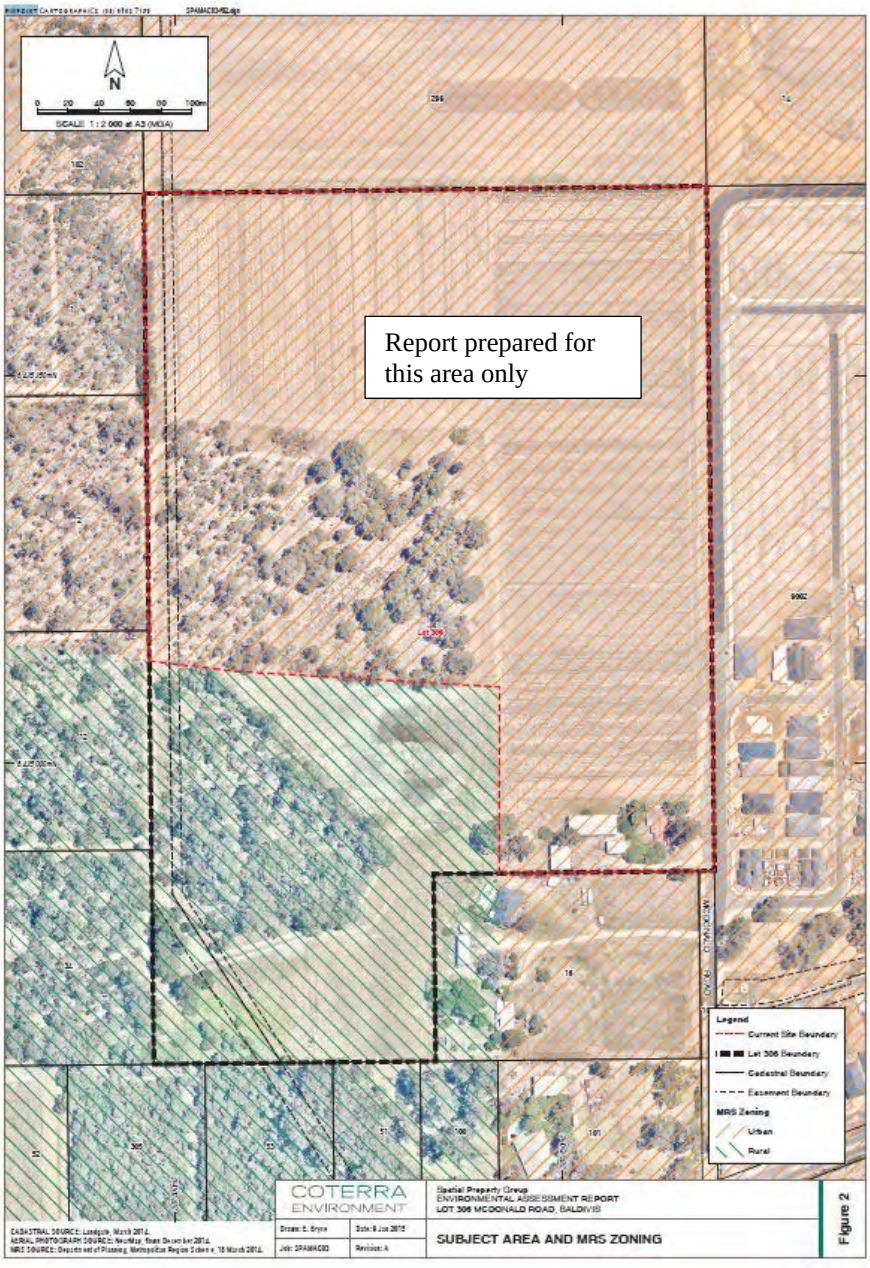


Figure 1. Location of the site to be surveyed - outlined in red

1.2 Scope of Work

The requirements for this project were to:

- Undertake a Level 1 vegetation survey (Environmental Protection Authority, 2004);
- Search for and record all significant species at the site; and
- In spring undertake a Level 2 vegetation survey.

2 BACKGROUND INFORMATION

2.1 Geology and Landform

The survey lots are included in the Spearwood Dunes, which consist of a core of limestone overlain by yellow sand. Differential wind erosion has produced two different landscapes but the site is within the Karrakatta unit, which is described as having deep yellow brown sands (Churchward and McArthur, 1980).

2.2 Vegetation

The Interim Biogeographical Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995) recognizes 85 bioregions. The IBRA is used as the common unit to compare biological and biophysical attributes. Bioregions represent a landscape-based approach to classifying the land surface and each region is defined by a set of major environmental influences, which shape the occurrence of flora and fauna and their interaction with the physical environment. Baldivis occurs in the Swan Coastal Plain, which has been subdivided into the northern section and the southern section. The study area is located in the southern section, abbreviated SWA2 (Mitchell, Williams and Desmond, 2002).

The survey lots are mapped as a Medium Woodland of *Eucalyptus gomphocephala* and *Eucalyptus marginata* (abbreviated e2,4Mi). Shepherd *et al.* (2002) determined the pre-European and current extent of the vegetation associations described by Beard (1981). In addition they have assessed the percentage of each vegetation association remaining, the amount in IUCN reserves and the percentage in other reserves. The pre-European area of e2,3Mi is estimated to be 79,001ha, the 2002 extent was 18,398ha which represents 23.2% remaining vegetated of which 38% is included in conservation.

Heddle *et al.* (1980) described the vegetation complexes of the Darling System at a scale of 1: 250 000. There was found to be a distinct pattern of plant distribution linked to landforms, soils and climate. The most obvious trend was associated with increasing aridity from west to east on the Darling Plateau. The vegetation changes observed were a decrease in height and percentage cover of the tallest stratum and a distinct change in floristics. Baldivis occurs between two vegetation complexes. These are:

- Karrakatta Complex – Central and South. The vegetation is predominantly an Open Forest of *Eucalytus gomphocephala – Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* and Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia* species.
- Cottesloe Complex – Central and South. The vegetation is a mosaic consisting of a Woodland of *Eucalyptus gomphocephala*; an Open Forest of *Eucalyptus gomphocephala – Eucalyptus marginata* subsp. *marginata – Corymbia calophylla*; and a Closed Heath on the limestone outcrops..

Bush Forever (Government of Western Australia, 2000) states that 18% of the original area of the Karrakatta Complex Central and South and 36% of the Cottesloe Complex Central and South remain vegetated within the Swan Coastal Plain. The area proposed for protection (Government of Western Australia, 2000) is 8% and 18% for Karrakatta Complex Central and South and Cottesloe Complex Central and South respectively.

2.3 Threatened Ecological Communities

An ecological community is a naturally occurring biological assemblage that occurs in a particular type of habitat. A Threatened Ecological Community is one which falls into one of the following categories, presumed totally destroyed, critically endangered, endangered or vulnerable (Department of Parks and Wildlife, 2014b).

A possibly significant ecological community which does not meet the above is added to the Priority Ecological Community List. Priorities 1, 2, and 3 are adequately known but are not currently believed to be threatened. Those that have recently been removed from the threatened list are listed as Priority 4. Conservation dependent ecological communities are placed in Priority 5.

2.4 Significant Flora

Prior to undertaking the field work a search was undertaken of the Department of Parks and Wildlife Threatened Flora Database using NatureMap (Department of Parks and Wildlife 2014c) for a 10km radius from 32°18'36"S and 115°48'56"E. The resulting species are listed in Table 3.

Table 1 presents the definitions of Declared Rare and the four Priority Flora ratings under the Wildlife Conservation Act (1950) as extracted from Department of Parks and Wildlife (2014a). Table 2 presents the definitions of the threatened species under the Environmental Protection and Biodiversity Conservation Act, 1999 (Department of Sustainability, Environment. Water. Populations and Communities, 2014).

Table 1. Code and description of Threatened and Priority Flora (Department Parks and Wildlife, 2014a)

Code	Declared Rare and Priority Flora Categories
T	T (Threatened) -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.
X	DRF (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.
1	Priority One -Poorly Known Taxa. Taxa, which are known from one or a few (generally <5) populations, which are under threat.
2	Priority Two -Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat.
3	Priority Three -Poorly Known Taxa. Taxa, which are known from several populations, at least some of which are not believed to be under immediate threat.
4	Priority Four -Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

Table 1 presents the definitions of Declared Rare and the four Priority Flora ratings under the Wildlife Conservation Act (1950) as extracted from Department of Parks and Wildlife (2013a). Table 2 presents the definitions of the threatened species under the Environmental Protection and Biodiversity Conservation Act, 1999 (Department of Sustainability, Environment. Water. Populations and Communities, 2013). Table 3 lists those taxa recorded from the Baldivis area.

Table 2. Categories of Threatened Flora Species (Department of Sustainability, Environment. Water. Populations and Communities , 2014)

Code	Declared Rare and Priority Flora Categories
Ex	Extinct Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of this species has died.
ExW	Extinct in the Wild Taxa which are known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	Critically Endangered Taxa which at any particular time if, at that time, it is 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, which is not critically endangered, and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	Vulnerable Taxa which is not critically endangered or endangered and is 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 at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Table 3. Threatened and Priority Flora Species List recorded from the area with the description extracted from Florabase (Western Australian Herbarium, 2014)

Taxon	Code	Description
Caladenia huegelii	T	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green & cream & red, Sep to Oct. Grey or brown sand, clay loam.
Diuris micrantha	T	Tuberous, perennial, herb, 0.3-0.6 m high. Fl. yellow & brown, Sep to Oct. Brown loamy clay. Winter-wet swamps, in shallow water.
Drakaea elastica	T	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red & green & yellow, Oct to Nov. White or grey sand. Low-lying situations adjoining winter-wet swamps.
Synaphea sp. Serpentine (G.R. Brand 103)	T	No description provided
Acacia lasiocarpa var. *bracteolata* long penducle variant (G.J.Keighery 5026)	1	Shrub, 0.4-1.5 m high. Fl. yellow, May or Aug. Grey or black sand over clay. Swampy areas, winter wet lowlands.
Boronia juncea subsp. *juncea*	1	Slender or straggly shrub, pedicels and sepals glabrous. Fl. pink, Apr. Sand. Low scrub.
Acacia benthamii	2	Shrub, ca 1 m high. Fl. yellow, Aug to Sep. Sand. Typically on limestone breakaways.
Acacia horridula	3	Harsh, slender, single-stemmed shrub, 0.3-0.6(-1) m high. Fl. yellow, May to Aug. Gravelly soils over granite, sand. Rocky hillsides.
Cyathochaeta teretifolia	3	Rhizomatous, clumped, robust perennial, grass-like or herb (sedge), to 2 m high, to 1.0 m wide. Fl. brown. Grey sand, sandy clay. Swamps, creek edges.
Dillwynia dillwynioides	3	Decumbent or erect, slender shrub, 0.3-1.2 m high. Fl. red & yellow/orange, Aug to Dec. Sandy soils. Winter-wet depressions.
Schoenus capillifolius	3	Semi-aquatic tufted annual, grass-like or herb (sedge), 0.05 m high. Fl. green, Oct to Nov. Brown mud. Claypans.
Sphaerolobium calcicola	3	Slender, multi-stemmed, scandent or erect shrub, to 1.5 m high. Fl. orange-red, Jun or Sep to Nov. White-grey-brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.

Taxon	Code	Description
Stylidium longitubum	3	Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. pink, Oct to Dec. Sandy clay, clay. Seasonal wetlands.
Aponogeton hexatepalus	4	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl. green-white, Jul to Oct. Mud. Freshwater: ponds, rivers, claypans.
Parsonsia diaphanophleba	4	Woody climber, to 10 m high. Fl. white/cream & pink, Jan to Feb or Apr to Jun or Sep. Alluvial soils. Along rivers.
Stylidium ireneae	4	Lax perennial, herb, (0.06-)0.1-0.28 m high, Leaves oblanceolate, 0.4-2 cm long, 1-3 (-5) mm wide, apex subacute to acuminate, margin entire, glandular. Scape glandular. Inflorescence racemose. Fl. pink, Oct to Dec. Sandy loam. Valleys near creek lines, woodland.

3. METHODS

Transects were walked through the remnant bushland listing the vegetation units in the area and the dominant taxa. As this was being undertaken the bushland was searched for Declared Rare and Priority Flora. In March a Level 1 vegetation survey was required so temporary quadrats were established and recorded. These quadrats have been remonitored in spring when a Level 2 survey wais undertaken.

The vegetation at the site is described using the vegetation classification of Muir (1977) as described in Table 4. Plants unknown in the field were collected, pressed and identified using the Reference Collection at the Western Australian Herbarium, which has limited collections and sometimes makes the positive identification difficult.

Table 4 Vegetation Classification (from Muir, 1977)

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

4. RESULTS

Field work was undertaken on 2nd April and 6th November 2014. The same two temporary quadrats were monitored in March and November as flagging at the NW corner had been left in March.

4.1 Vegetation

Two vegetation units were described. These were:
Tall Forest of *Eucalyptus gomphocephala* over Low Woodland A of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Scrub of *Jacksonia furcellata* over Open Low Scrub B of *Acacia pulchella* var. *pulchella* and *Macrozamia riedlei* over Dense Tall Grass dominated by **Ehrharta calycina* and **Briza maxima* in grey sand. This vegetation unit was represented by quadrat BD1 and occurred on middle to upper slope at the north and west of the property. This is abbreviated in Appendix B as Eg.

Forest to Dense Forest of *Corymbia calophylla* over Low Woodland A of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Low Scrub B dominated by *Hakea lissocarpha, Xanthorrhoea preissii* and *Gompholobium tomentosum* over Open Dwarf Scrub D dominated by *Hibbertia hypericoides* and *Acacia pulchella* var. *pulchella* in grey yellowy brown sand. This vegetation unit was represented by quadrat BD2 and occurred on the lower slope. This is abbreviated in Appendix B as Cc
A detailed species list for each quadrat is provided in Appendix A. A map of the vegetation units is provided in Appendix B, Map 2.

Between the areas of trees there was an open area which had previously been cleared and the trees removed. The dominant native species in this area was *Acacia pulchella* var. *pulchella* with a cover of up to 50%. **Ehrharta calycina* with a cover of 80% was the dominant weed. However the vegetation unit was the same.

4.2 Vegetation Condition

Bushland has been historically subject to ongoing degradation and is especially susceptible to disturbances arising as a result of indirect impacts from surrounding developments and human activity. Degradation is caused by a wide range of factors, including isolation, edge effects, weed invasion, plant diseases, changes in fire frequency, landscape fragmentation, increased predation on native fauna by feral animals, decrease in species richness and general modification of ecological function. Lot 2 has historically been used for stock grazing, phases of clearing and weed invasion. These issues affect the biodiversity rating and ecological viability of areas of remnant vegetation and should be assessed in line with conservation values.

Vegetation condition was rated according to the vegetation condition scale used in Keighery (1994). The vegetation condition of the site varied between good and degraded where vegetation was present to completely degraded in the cleared areas. The vegetation condition at the site is mapped in Appendix B Map 3.

Table 5. Explanation of Vegetation Condition Rating (Keighery, 1994)

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

4.3 Significant Taxa

During the current survey no priority flora were recorded.

4.4 Weeds

A total of 17 weeds were recorded from the remnant vegetation. All have been determined as weeds by the Western Australian Herbarium (2014) and Department of Parks and Wildlife (2014c). There are several ratings allocated to each weed in the Invasive Plant Prioritisation but only three have been selected to include in this report. These are ecological impacts, invasiveness and feasibility of control, which are shown in Table 6 for each of the non-endemic species recorded. Ten of the weeds are listed as having a high ecological impact on the environment and fourteen are listed having a rapid rate of dispersal.

Table 6. Ecological Impacts and Invasiveness of recorded weeds

Species	Ecological Impacts	Invasiveness	Control
	Ecological impact L – low impact species M – medium impact species H – high impact species U – unknown impact	Rate of dispersal R=rapid, M=moderate, S=slow U=unknown	Feasibility of control L=low M=moderate H= high U= unknown
**Briza maxima*	U	R	H
**Briza minor*	U	R	H
**Cenchrus clandestinus*	H	S	M
**Cerastium glomeratum*	U	R	U
**Ehrharta calycina*	H	R	M
**Ehrharta longiflora*	H	R	L
**Euphorbia terracina*	H	R	M
**Freesia alba × leichtlinii*	H	R	M
**Hypochaeris glabra*	H	R	L
**Lolium multiflorum*	H	R	L
**Lupinus cosentinii*	H	M	H
**Olea europaea*	H	R	H
**Pelargonium capitatum*	H	R	M
**Romulea rosea*	U	R	L
**Sonchus oleraceus*	U	R	L
**Trifolium campestre*	U	U	L
**Ursinia anthemoides*	U	R	L

5. DISCUSSION

Bennett Environmental Consulting Pty Ltd was commissioned to undertake a vegetation overview of a site in McDonald Road, Baldivis. There was only a small section of remnant vegetation at the site as most of the area was under market gardens. A Level 1 (Environmental Protection Authority, 2004) autumn survey was undertaken in early March.

Two vegetation units were recorded.

- On the higher ground the vegetation unit was: Tall Forest of *Eucalyptus gomphocephala* over Low Woodland A of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Scrub of *Jacksonia furcellata* over Open Low Scrub B of *Acacia pulchella* var. *pulchella* and *Macrozamia riedlei* over Dense Tall Grass dominated by **Ehrharta calycina* and **Briza maxima;* and

- On the lower ground the vegetation unit was: Forest to Dense Forest of *Corymbia calophylla* over Low Woodland A of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Low Scrub B dominated by *Hakea lissocarpha, Xanthorrhoea preissii* and *Gompholobium tomentosum* over Open Dwarf Scrub D dominated by *Hibbertia hypericoides* and *Acacia pulchella* var. *pulchella*.

The remnant vegetation at the site was in good condition but the numerous tracks and cleared areas throughout were in degraded condition.

No Threatened or Priority Flora were recorded.

6. REFERENCES

Beard, J.S. (1981). *Vegetation Survey of Western Australia Swan*. University of Western Australia Press, Crawley

Biggs, E.R. and Wilde, S.A. (1980). *Geology, Mineral Resources and Hydrology of the Darling System, Western Australia*. Department of Conservation and Environment, Perth, Western Australia

Churchward, H.M. and McArthur, W.M. (1980). *Landform and Soils of the Darling System* In *Atlas of Natural Resources, Darling System, Western Australia*. Department of Conservation and Environment, Perth, Western Australia

Department of Parks and Wildlife (2014a). *Declared Rare and Priority List for Western Australia.* Published list by the Department of Parks and Wildlife, Western Australia

Department of Parks and Wildlife (2014b). *List of Threatened Ecological Communities on the Department of Environment and Conservation Threatened Ecological Communities (TEC) Database endorsed by the Minister for the Environment.*
http://www.naturebase.net/plants_animals/watscu/pdf/tec/endorsed_tec_list_jan04.pdf

Department of Parks and Wildlife (2014c). *NatureMap*. http://naturemap.dec.wa.gov.au/

Department of Sustainability, Environment. Water. Populations and Communities (2014). *EPBC Act List of Threatened Flora.* http://www.deh.gov.au/

Environmental Protection Authority (2004). *Guidance for the Assessment of Environmental Factors, Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia. No. 51.* EPA, Perth

Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H. and Lyons, M.N. (1994). *A Floristic Survey of the southern Swan Coastal Plain.* Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)

Government of Western Australia (2000). *Bush Forever*. Department of Environmental Protection, WA

Heddle, E.M., Loneragan, O.W. and Havell, J.J. (1980). *Vegetation of the Darling System* In *Atlas of Natural Resources, Darling System, Western Australia*. Department of Conservation and Environment, Perth, Western Australia

Hussey, B.M.J., Keighery, G.J., Cousens, R.D., Dodd, J. and Lloyd, S.G. (1997). *Western Weeds – A guide to the weeds of Western Australia.* Plant Protection Society of Western Australia

Keighery, B.J. (1994). *Bushland Plant Survey: a Guide to Plant Community Surveys for the Community.* Wildflower Society of Western Australia (Inc.) Nedlands, Western Australia

Mitchell, D., Williams, K. and Desmond, A. (2002). *Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion)* In *A Biodiversity Audit of Western Australia's 53 Biogeographical subregions*. Department of Conservation and Land Management

Muir, B.G. (1977). *Biological Survey of the Western Australian Wheatbelt. Part II: Vegetation and habitat of Bendering Reserve.* Records of the Western Australian Museum, Supplement No. 3

Shepherd, D.P., Beeston, G.R. and Hopkins, A.J.M. (2002). *Native Vegetation in Western Australia Extent, Type and Status. Resource Management Technical Report 249*. Department of Agriculture, Government of Western Australia

Thackway, R. and Cresswell I. D. (1995). *An Interim Biogeographical Regionalisation for Australia: a Framework for Setting Priorities in the National Reserves System Cooperative Program.* Australian Nature Conservation Agency, Canberra, ACT

Western Australian Herbarium (2014). *Florabase*. Department of Environment and Conservation. https://florabase.dpaw.wa.gov.au/

APPENDIX A

Quadrat Data

Abbreviation	Explanation
sp.	Species used when the plant is vegetative
var.	Variety
subsp.	Subspecies
*	Weed
x	Hybrid
sp. Serpentine	Name allocated by Western Australian Herbarium

QUADRAT BD1

GPS: 387492E; 6425109N
Topography: Moderate slope, downhill to the east
Soil: Grey sand with a thin brown humic layer on surface
Vegetation Description: Tall Forest of *Eucalyptus gomphocephala* over Low Woodland A of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Scrub of *Jacksonia furcellata* over Open Low Scrub B of *Acacia pulchella* var. *pulchella* and *Macrozamia riedlei* over Dense Tall Grass dominated by **Ehrharta calycina* and **Briza maxima*
Vegetation Condition: Good to degraded
Notes: Large number of weeds. Area has been lightly logged. Some tree deaths but reason unknown

March 2014

November 2014

SPECIES	Height (cm)	% Cover
Acacia pulchella var. *pulchella*	170	2
Acanthocarpus preissii	30	<1
Allocasuarina fraseriana	150	Seedling
Banksia attenuata	400	2
**Briza maxima*	50	30
**Briza minor*	20	<1
Burchardia umbellata	40	<1
Conostylis aculeata	30	1
Corynotheca micrantha	40	2
Desmocladus flexuosus	15	1
Dichopogon capillipes	100	8
**Ehrharta calycina*	100	80
Eucalyptus gomphocephala	3000	30
Eucalyptus marginata subsp. *marginata*	800	6
Glischrocaryon aureum	70	5
Gompholobium tomentosum	30	1
Hardenbergia comptoniana	300	5
Lepidosperma sp.	40	<1
Lobelia rhytidosperma	30	<1
Lomandra maritima	60	<1
Macrozamia riedlei	150	4
Microtis media	30	<1
Opercularia hispidula	30	<1
Petrophile linearis	30	<1
**Sonchus oleraceus*	60	<1
**Trifolium campestre*	25	3
Dianella revoluta	Opportunistic	
**Euphorbia terracina*	Opportunistic	
Hakea lissocarpha	Opportunistic	
Hibbertia hypericoides	Opportunistic	
Jacksonia furcellata	Opportunistic	
Kennedia prostrata	Opportunistic	
Leucopogon racemulosus	Opportunistic	
Schoenus grandiflorus	Opportunistic	
Xanthorrhoea brunonis	Opportunistic	

QUADRAT BD2

GPS: 387664E; 6425138N
Topography: Lower slope almost flat
Soil: Brown grey sandy loam with reasonable humus layer on top
Vegetation Description: Forest to Dense Forest of *Corymbia calophylla* over Woodland of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus marginata* subsp. *marginata* over Open Low Scrub B dominated by *Hakea lissocarpha, Xanthorrhoea preissii* and *Gompholobium tomentosum* over Open Dwarf Scrub D dominated by *Hibbertia hypericoides* and *Acacia pulchella* var. *pulchella*
Vegetation Condition: Good to degraded
Notes: Many weeds. Trees healthy and no deaths noted

March 2014

November 2014

SPECIES	Height (cm)	% Cover
**Briza maxima*	40	3
**Cenchrus clandestinus*	60	50
**Cerastium glomeratum*	30	<1
Conostylis aculeata	20	<1
Corymbia calophylla	25	90
Desmocladus flexuosus	30	1
Dianella revoluta	20	<1
Dichopogon capillipes	100	1
**Ehrharta calycina*	100	10
**Ehrharta longiflora*	90	<1
**Euphorbia terracina*	40	1
**Freesia alba × leichtlinii*	30	<1
Hovea trisperma	25	<1
Jacksonia furcellata	300	3
**Lolium multiflorum*	50	<1
Macrozamia riedlei	100	2
Microtis media	30	<1
**Romulea rosea*	30	1 (dead)
Xanthorrhoea preissii	70	1
Acacia pulchella var. *pulchella*	Opportunistic	
Allocasuarina fraseriana	Opportunistic	
Banksia attenuata	Opportunistic	
Banksia sessilis	Opportunistic	
Burchardia congesta	Opportunistic	
Corynotheca micrantha	Opportunistic	
Eucalyptus gomphocephala	Opportunistic	
Eucalyptus marginata subsp. *marginata*	Opportunistic	
Gompholobium tomentosum	Opportunistic	
Hakea lissocarpha	Opportunistic	
Hibbertia hypericoides	Opportunistic	
**Hypochaeris glabra*	Opportunistic	
Kennedia prostrata	Opportunistic	
Laxmannia grandiflora	Opportunistic	
Leucopogon racemulosus	Opportunistic	
Lomandra suaveolens	Opportunistic	
**Lupinus cosentinii*	Opportunistic	
Lyginia barbata	Opportunistic	
**Olea europaea*	Opportunistic	
**Pelargonium capitatum*	Opportunistic	
Pimelea rosea	Opportunistic	
**Ursinia anthemoides*	Opportunistic	

APPENDIX B

Maps

Map 1. Location of quadrats

Map 2. Vegetation units

Map 3. Vegetation condition of remnant vegetation at the site

COTERRA
ENVIRONMENT

2/460 Roberts Road
SUBIACO WA 6008

T (08) 9381 5513
F (08) 9381 5514

www.coterra.com.au
info@coterra.com.au