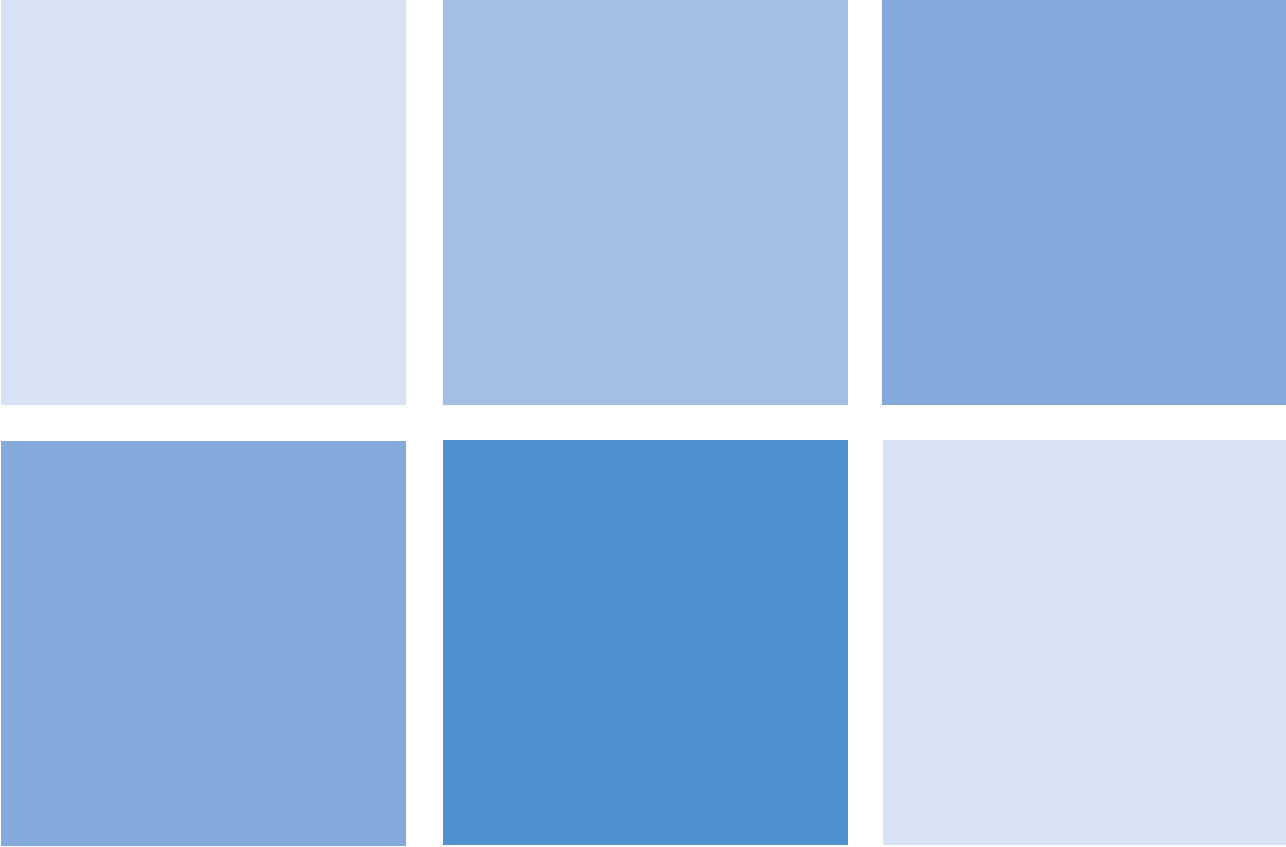




# Structure Plan

**Lot 601 Old Pinjarra Road,  
Greenfields**





# Structure Plan

**Lot 601 Old Pinjarra Road, Greenfields**

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Prepared by:

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
First Draft	Structure Plan Report	C. Hearn	M. Young	04.12.14
Draft	Structure Plan Report	C. Hearn	M. Young	19.12.14
Final	Structure Plan Report	C. Hearn	D. Drown	05.01.15
Final	Structure Plan Report for Approval	C. Hearn	M. Young	25.05.16

Approval for Issue

Name	Signature	Date
Matt Young		25.05.15

This structure plan is prepared under the provisions of the City of Mandurah Town Planning Scheme No.3

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON: 27 July 2016

Signed for and on behalf of the Western Australian Planning Commission



\_\_\_\_\_ an officer of the Commission duly authorised by the Commission pursuant to Section 16 of the *Planning and Development Act 2005* for that purpose, in the presence of:



\_\_\_\_\_ Witness

\_\_\_\_\_ 27. 7. 2016

\_\_\_\_\_ Date

Date of Expiry: 27 July 2026

# Table of Amendments

Amendment No.	Summary of the Amendment	Amendment Type	Date Approved by the WAPC

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## Appendices

- Appendix 1: Certificate of Title and Survey
- Appendix 2: Vegetation & Significant Fauna Investigation prepared by Ecosystem Solutions
- Appendix 3: Geotechnical and Acid Sulfate Soils Study prepared by Galt Geotechnics
- Appendix 4: Preliminary Civil Works Assessment prepared by McDowall Affleck
- Appendix 5: Bushfire Management Plan prepared by Ecosystem Solutions

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## Executive Summary

RPS acts on behalf of Rivergreen Pty Ltd in respect to Lot 601 Old Pinjarra Road Greenfields (the subject land). This report is intended to provide detailed planning justification for the proposed Structure Plan, which applies to Lot 601 Old Pinjarra Road.

This Structure Plan has been prepared in accordance with the provisions of both section 4.9 and 7.11 of the City of Mandurah Town Planning Scheme No. 3, and is compliant with all State and local strategies, schemes, policies and legislation. The Structure Plan provides a responsive and appropriate layout over the subject site which will serve as a guide to future development to ensure appropriate and integrated land use over the wider locality.

The land is appropriately zoned and all service infrastructure is available to future development. No negative off-site impacts are anticipated.

Lot 601 Old Pinjarra Road Greenfields is zoned 'Urban Development' under City of Mandurah Town Planning Scheme No. 3, which requires the preparation of an Outline Development Plan (now Structure Plan) in order to facilitate appropriate planning and urban design outcomes. The purpose of this report is to provide supporting information which will justify the layout of the Structure Plan in accordance with Section 7.11 of the Scheme.

This information will provide justification for the proposed Structure Plan and demonstrate the compliance of the design with the relevant State and local planning framework and other applicable legislation.

The Structure Plan comprises the following:

- Part One – Implementation
- Part Two – Explanatory Section; and
- Appendices – Technical reports, plans, maps and supporting documents.

Part One includes only the Structure Plan map and statutory planning provisions and requirements.

Part Two of the Structure Plan is used as a reference guide to interpret and justify the implementation of Part One.



# **PART ONE**

# **IMPLEMENTATION**

## I.0 Structure Plan Area

This Structure Plan shall apply to Lot 601 Old Pinjarra Road, Greenfields being the land contained within the inner edge of the line denoting the Structure Plan boundary (**Figure 1**).

The subject site is legally described as Lot 601 on Deposited Plan 40808 Volume 2567, Folio 800. A copy of the Certificate of Title is contained in **Appendix 1**.

The lot is 1.5423 hectares in area with a 127m frontage to Old Pinjarra Road.

Lot 601 currently comprises a single dwelling and the southern portion of the lot is extensively vegetated.



600

R40

R60

600

201

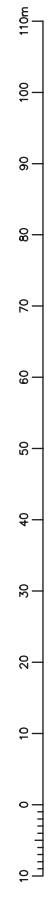
Asset Protection Zone (no development or subdivision within this zone until the land to the east is developed and it is demonstrated that the subject asset protection zone is no longer required.

Area subject to future ODP/Structure Plan design

OLD PINJARRA ROAD

**Legend**

- Site Boundary
- R Code boundary
- Residential
- Asset Protection Zone
- Access and Landscaping
- Indicative Road Alignment



**Note:**  
All Lot Numbers, Dimensions and Areas are approximate only, and are subject to survey and Council approval.  
  
The boundaries shown on this plan should not be used for final detailed engineers design.  
  
**Source Information:**  
Site boundaries: Landgate.  
Adjoining information: Landgate.

RPS Australia East Pty Ltd  
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Sheet **A3** Plan Ref **123894-1-001**

Scale **1:750** Rev

**RIVERGREEN PTY LTD**

STRUCTURE PLAN

<b>PROJECT</b> Lot 601 Old Pinjarra Road Greenfields	CLIENT
Job Ref. 123894	Date 09 MAY 2016
Comp By. LCFV	DWG Name. 123894-1-001_SP.dwg
Locality GREENFIELDS	Local Authority CITY OF MANDURAH

## 2.0 Operation

In accordance with section 7.11 of the Scheme, this Structure Plan shall come into operation when it is certified by the Western Australian Planning Commission (WAPC) pursuant to section 7.11 of the Scheme or adopted, or signed and sealed by the Council pursuant to section 7.11 of the Scheme, whichever is the latter.

### 3.0 Land Use and Subdivision

The City of Mandurah Town Planning Scheme No. 3 zones this land Urban Development. Within the Urban Development zone preparation of a Structure Plan is required. Specifically, Clause 4.9.1 of the Scheme specifies the intent of the Urban Development Zone as follows:

*“4.9.1 Purpose and Intent of Zone*

*The intent of the Urban Development Zone is to provide for future residential and urban related development after comprehensive planning of the relevant areas has been carried out resulting in an approved Outline Development Plan. The Outline Development Plan shall conform with any Structure Plans or Guide Plans, any Planning Policies and Retail Structure Plan adopted by Council and the Western Australian Planning Commission. Where no Outline Development Plan exists the following Use and development standards shall apply. Land uses that are likely to adversely affect the potential for urban development shall not be permitted (e.g. uses that require the intensive use of pesticide or other chemical).”*

Clause 4.9.2.1 of the Scheme requires that the use and development should comply with the relevant “standards as specified for the corresponding zone or zones included in this Scheme in the Zoning and Reserves Tables and the specific provisions and general provisions relating to zones in this Scheme”. Clause 4.9.2.2 however allows the development standards to be varied provided the variations are contained in an approved Outline Development Plan (now Structure Plan).

Town Planning Scheme No. 3 Clause 7.11, in addition to defining requirements for preparation and the contents of Structure Plans, also defines the requirements for Technical Guidelines. The Technical Guidelines define servicing, land use and development requirements for the land the subject of the Structure Plan.

#### 3.1 Land Use Permissibility and Density

Land use permissibility within the Structure Plan area shall be in accordance with the Residential zoning under the Scheme up to a R60 density.

It is anticipated that the net developable area will be around 8,500m<sup>2</sup> and this could yield around 57 grouped dwellings or around 120 multiple dwellings, assuming a plot ratio area of 10,796m<sup>2</sup> and 90m<sup>2</sup> unit size.

## 4.0 Additional Information

Prior to the lodgement of subdivision applications to the WAPC, the following management plans are to be prepared, as applicable, to the satisfaction of the relevant authority and provided with the application for subdivision:

### **Acid Sulfate Soil Investigation and Management Plan**

The majority of the subject land is defined as Class 1 high to moderate risk of Acid Sulfate Soils (ASS) within 3m of natural soil surface, with the balance being defined as Class 2 moderate to low risk of ASS beyond 3m of natural soil surface.

A due diligence survey and accompanying report compiled by Galt Geotechnics Pty Ltd confirms the presence of potential Acid Sulfate Soils.

A detailed ASS investigation and management plan will need to be prepared prior to development and/or subdivision.

### **Urban Water Management Plan**

An Urban Water Management Plan (UWMP) is to be prepared as a condition of subdivision and adhered to throughout the development process. The UWMP is to be prepared in accordance with the *Better Urban Water Management (2008)* guidelines, and will be required by both the Department of Water (DoW) and the City of Mandurah.

Provision has been made in the Structure Plan for communal open space and car parking areas within the front setback. This will also accommodate on-site stormwater and also to take into consideration flooding levels and impacts from the Serpentine River.

### **Mosquito Management Plan**

Mosquito management in the Peel Region is vital to quality of lifestyle, health and safety of both residents and visitors. The Peel Mosquito Management Group is a regional partnership between the State government and the City of Mandurah, Shire of Murray, City of Rockingham, Shire of Waroona and the Department of Health. The Peel Mosquito Management Group provides an extensive management program, of which the primary activities are as follows:

- Ongoing monitoring and assessment of tides and weather patterns
- Survey of breeding sites (larvae counts, location data, growth stage and site conditions)
- Treatment (predominately Larvicide)
- Surveillance of post treatment outcomes
- Adulticide (Mist spray for mobile adult Mosquitoes)
- Public information and education initiatives and providing advice for minimisation of nuisance and disease risk measures.

Even though the Peel Mosquito Management Group provides effective and comprehensive mitigation activities, on site mosquito management throughout the construction phase and as part of the built form is also required. The subject site is located within a three kilometres radius of tidal wetlands and as a result is subject to a significant level of adult mosquito activity throughout the year, especially in times of low flow with slow moving and shallow waters that comprise the tributaries to the Serpentine River. A direct consequence of this activity is the increased potential risk for humans to contract Ross River Virus and Barmah Forest Virus which can be passed on from female mosquito bites.

Given the significant issues with mosquito management in the area, the following measures should be undertaken as part of the proposed development:

- All vents and pipes to be screened;
- All water tanks to be screened to prevent breeding;
- Outdoor entertaining areas should be screened to avoid nuisance;
- Screened door entrances;
- Landscaping to avoid hedging, vines and creepers, and be regularly pruned to prevent favourable breeding conditions;
- Screens fitted to windows;
- Draft and pest excluders fitted to entry doors and windows; and
- Eaves to be enclosed/screened to prevent pest infiltration.

Notifications will also be placed on all titles advising prospective purchasers of the presence of mosquitoes and the potential public health risks that they carry.

Mosquito Management measures are to be incorporated into each stage of the planning and development process for Lot 601, ensuring best practice management policy in order to manage the effects of the elevated mosquito population in the locality.

### Bushfire Matters

No development or subdivision shall occur within the identified Asset Protection Zone identified on the Structure Plan along the eastern boundary until the land to the east is developed for urban purposes and/or it is demonstrated that the Asset Protection Zone is no longer required on Lot 601 Old Pinjarra Road.

Additional Information	Approval Stage	Consultation Required
Bushfire Attack Level Assessment	As part of Subdivision or Development Application	Department of Fire and Emergency Services/ City of Mandurah
Bushfire Management Plan	Prior to Subdivision or Development Application	Department of Fire and Emergency Services/ City of Mandurah
Acid Sulfate Soils Management Plan	Subdivision or Development Application	City of Mandurah

Additional Information	Approval Stage	Consultation Required
Urban Water Management Plan	Subdivision Application	City of Mandurah/ Department of Water
Mosquito Management	Subdivision or development application	City of Mandurah
Fauna Relocation/Management Plan	As a condition of subdivision or development approval	City of Mandurah

**4.1 Public Open Space**

Public open space to be provided in accordance with WAPC Policy.



# **PART TWO**

## **EXPLANATORY SECTION**

## 1.0 Planning Background

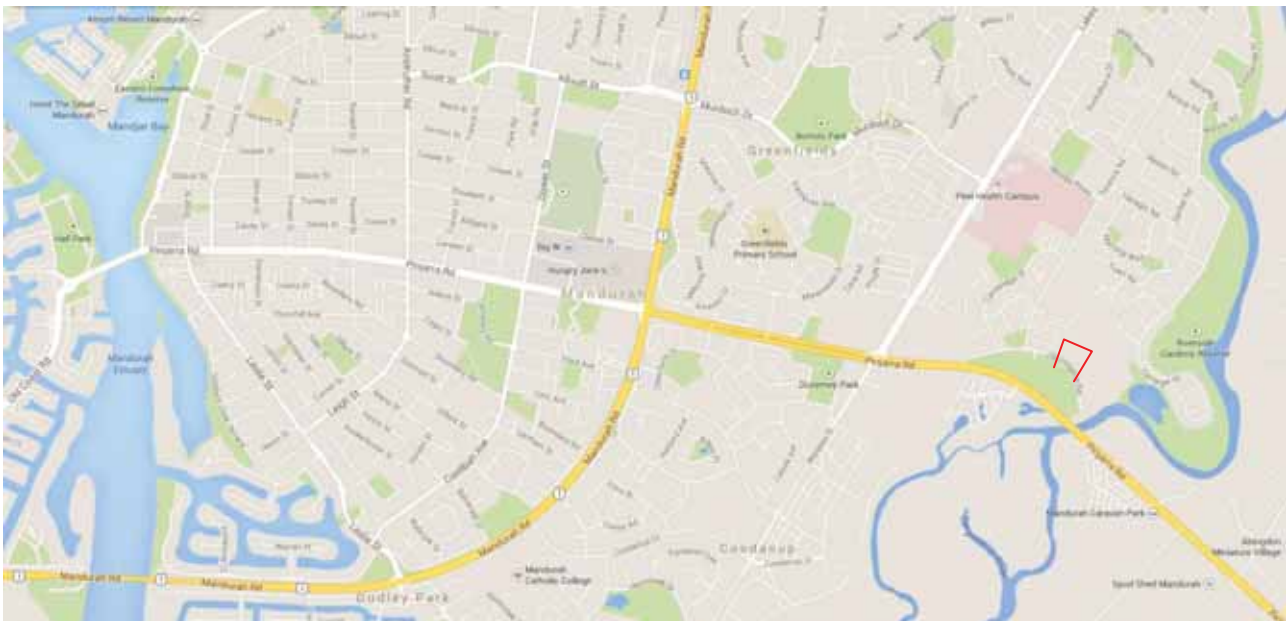
### 1.1 Introduction and Purpose

This Structure Plan (ODP) has been prepared as required for land zoned Urban Development under the City of Mandurah Town Planning Scheme No.3, and is consistent with the requirements of section 7.11 of the Scheme. The purpose of this ODP is to provide an overall guide to the layout, staging and statutory requirements of the development of the subject land to ensure that development is appropriate for the location and complies with the various strategies, schemes and policies applicable to this locality. The proposed residential development will benefit the locality, providing infill development within close proximity to public transport routes, a mixed use/commercial centre and employment opportunities offered by the Strategic Centre of Mandurah.

### 1.2 Land Description

#### 1.2.1 Location

The subject land is located approximately 3.5kms to the south east of the Mandurah Strategic Centre. The site is bound by Old Pinjarra Road to the south, constructed residential lots to the north and west, and a rural residential standard development abutting the Serpentine River to the east (refer **Figure 2**). The subject land is located strategically within the locality to provide for a high quality urban development located in close proximity to the Mandurah Strategic Centre.



**Figure 2:** Location Plan (Source: Google Maps)

#### 1.2.2 Area and Land Use

The total area of Lot 601 is 1.5423 hectares, and currently comprises a single dwelling and the southern portion of the lot contains extensive vegetation. The ODP covers the entirety of Lot 601, and has a net developable area of around 8500m<sup>2</sup> for residential development, to facilitate infill development in the Urban Development zone as identified by the Scheme and higher level strategic documents (see section 1.3 Planning Framework).

### 1.2.3 Legal Description and Ownership

The subject site is legally described as Lot 601 on Deposited Plan 40808 Volume 2567, Folio 800. A copy of the Certificate of Title is contained in **Appendix 1**.

The lot has a 127m frontage to Old Pinjarra Road and approximate depth of 98m to the rear, northern boundary.

## 1.3 Statutory Planning Framework

### 1.3.1 Peel Region Scheme

The Peel Region Scheme (PRS) provides a high level strategic direction for the promotion of sustainable development in the region through regulation of subservient schemes, strategies and policies. The PRS provides regional scale land allocation and mapping in order to guide the zoning of land, provision of infrastructure, protection of environmental assets, areas of regional open space, location of industrial areas, extraction of resources and protection of productive agricultural land.

The subject site is zoned Urban under the PRS. The purpose of the Urban zone is “*to provide for residential development and associated local employment, recreation and open space, shopping schools and other community facilities*”. This development will provide a high quality residential development providing for a greater variety of affordable infill development in the Urban zone.

This ODP acts to ensure that the proposed development will further the objectives of the PRS, by providing a high quality medium density development in a well serviced urban infill location.

### 1.3.2 City of Mandurah Town Planning Scheme No. 3

The City of Mandurah Town Planning Scheme No.3 provides the planning framework to achieve sustainable development in the locality, by integrating economic, social and environmental aspirations. The Scheme outlines the applicable zoning and related objectives for each zone, of which the subject site is zoned ‘Urban Development’ (refer **Figure 3**).

The Purpose and intention of the Urban Development zone as set out in Clause 4.9.1 of TPS3 is:

*“The Urban Development Zone is intended to provide for future residential and urban related development after comprehensive planning of the relevant areas has been carried out resulting in an approved Outline Development Plan. The Outline Development Plan should conform with any Outline Development Plans or Guide Plans, any Planning Policies and Retail Outline Development Plan adopted by Council and the Western Australian Planning Commission.”*

The ODP is considered consistent with the TPS3 zoning, and is required under section 7.11 of the Scheme.



**Figure 3** – Zoning – City of Mandurah Town Planning Scheme No, 3 (Source: City of Mandurah Intramaps)

## 1.4 Strategic Planning Framework (State and Local)

### 1.4.1 Directions 2031 and Beyond

Directions 2031 and Beyond provides a high level framework and strategic plan for the future growth of the Perth metropolitan and Peel Regions. The strategy identifies a range of desired outcomes in supporting a 'Connected City' form of development, with those relevant to this ODP listed as follows:

- Protecting and enhancing the natural environment, agricultural land, open spaces and our heritage and community wellbeing;
- Promoting a better balance between Greenfield and infill development;
- Planning for an adequate supply of housing and land in response to population growth and changing community needs;
- Facilitating increased housing diversity, adaptability, affordability and choice;
- Ensuring that economic development and accessibility to employment inform urban expansion; and
- Planning and developing key public transport corridors, urban corridors and transit oriented developments to accommodate increased housing needs and encourage reduced vehicle use.

Central to the aims of Directions 2031 is the goal to achieve a 50% increase on current infill residential development, which is currently between 30% and 35% for the region. The predicted population growth from 88,000 to 133,000 in 2031 will require an additional 26,000 dwellings, with a focus on mitigating environmental impacts and providing infill development opportunities.

The proposed development will assist in achieving the Directions 2031 vision and objectives by providing the following positive outcomes:

- A high quality urban form guided by sufficiently robust statutory planning frameworks that will improve the physical amenity of the centre and appropriately embrace and activate the surrounding street network;
- Provision of sensitive infill development, providing a high quality residential development in a strategically beneficial location.
- Enhancement of the local streetscape and natural environment generally through the establishment of street trees in appropriate locations, and retention of identified trees.

The proximity of the subject site to the Mandurah Strategic Centre and the fact that this site has been designated for urban development make the subject land a highly desirable location for residential infill development. In addition, the proximity of the site to a range of compatible land uses, open space, commercial/mixed use precincts, sporting facilities, health care and public transport means that medium density development options are considered appropriate.

### **1.4.2 Liveable Neighbourhoods**

Liveable Neighbourhoods aims to achieve sustainable neighbourhood development, with particular emphasis on the planning of residential areas. Liveable Neighbourhoods is the preferred design and assessment tool for the preparation of ODP's for new and infill urban areas throughout the metropolitan area and regional centres, as well as section 7.11 of the City of Mandurah Town Planning Scheme. The core objectives of Liveable Neighbourhoods are outlined as follows:

1. To provide for an urban structure of walkable neighbourhoods clustering to form towns of compatible mixed uses in order to reduce car dependence for access to employment, retail and community facilities.
2. To ensure that walkable neighbourhoods and access to services and facilities are designed for all users, including those with disabilities.
3. To foster a sense of community and strong local identity and sense of place in neighbourhoods and towns.
4. To provide for access generally by way of an interconnected network of streets which facilitate safe, efficient and pleasant walking, cycling and driving.
5. To ensure active street-land use interfaces, with building frontages to streets to improve personal safety through increased surveillance and activity.
6. To facilitate new development which supports the efficiency of public transport systems where available, and provides safe, direct access to the system for residents.
7. To facilitate mixed-use urban development which provides for a wide range of living, employment and leisure opportunities, capable of adapting over time as the community changes and which reflects appropriate community standards of health, safety and amenity.
8. To provide a variety of lot sizes and housing types to cater for the diverse housing needs of the community at a density that can ultimately support the provision of local services.
9. To ensure the avoidance of key environmental areas and the incorporation of significant cultural and environmental features of a site into the design of an area.
10. To provide for a more integrated approach to the design of open space and urban water management.

11. To ensure cost-effective and resource-efficient development to promote affordable housing.
12. To maximise land efficiency wherever possible. In order for the principal aims of Liveable Neighbourhoods to be addressed eight specific elements which are to be considered and implemented through the Structure Plan and subdivision design.

Each element has objectives, which describe the principal aims and requirements which present a range of qualitative and quantitative responses to meeting the objectives. The eight elements of Liveable Neighbourhoods comprise:

Element 1: Community Design;	Element 2: Movement Network;
Element 3: Lot Layout;	Element 4: Public Parkland;
Element 5: Urban Water Management;	Element 6: Utilities;
Element 7: Activity Centres and Employment; and	Element 8: Schools

The proposed R60 density on this site is appropriate given the land's close proximity of local centres, activity centres, employment opportunities, high frequency public transport, urban parklands and open space. The subject site is within:

- 2.5km's of Mandurah Station, accessible from Old Pinjarra Road via bus routes 597 and 598;
- Under 1 km from a local centre, service commercial precinct and numerous areas of public open space;
- On the opposite side of Old Pinjarra Road from future tourism development;
- 600m from the Peel Health Campus;
- Approximately 1.5km's from the nearest school (Coodanup Community College); and
- Approximately 2km's of Rushton Park Sports Precinct.

This ODP has been prepared in accordance with the objectives of Liveable Neighbourhoods and the layout and design is a combination of the specific site characteristics, its location and the strategic objectives of Liveable Neighbourhoods.

The subject land is located within a strategic area for infill development, and acts to enhance the amenity of the locality by providing residential development within close proximity of a local centre and the Strategic Activity Centre of Mandurah. The combination of the close proximity to public open space, high frequency public transport with regional connections, local centres, sports precincts and is within the urban development zone, provides the ideal location for infill development of R60 density.

#### **1.4.3 State Planning Policy No.3 Urban Growth and Settlement**

The objectives of State Planning Policy No. 3 – Urban Growth and Settlement (as SPP No. 3), include:

- To promote a sustainable and well planned pattern of settlement across the State, with sufficient and suitable land to provide for a wide variety of housing, employment, recreation facilities and open space;
- To manage the growth and development of urban areas in response to the social and economic needs of the community and in recognition of relevant climatic, environmental, heritage and community values and constraints; and

- To promote the development of a sustainable and liveable neighbourhood form which reduces energy, water and travel demand whilst ensuring safe and convenient access to employment and services by all modes, provides choice and affordability of housing and creates an identifiable sense of place for each community.

SPP No. 3 is a broad policy, and is intended to be implemented more specifically by smaller scale policies. As such it draws upon aims and objectives covered in greater detail in other related strategies and policies, which are addressed specifically in sections to follow.

This proposals consistency with the provisions of the various elements of the state planning framework, and the statutory and strategic planning provisions of the City of Mandurah, will be examined in following sections of this report as necessary. However, some core sustainability requirements of SPP No.3 that are met by the proposed development are as follows:

- A strong, diversified and sustainable economic base, coordinated with the efficient and economic provision of transport;
- Variety and choice in the size, type and affordability of housing;
- Supporting higher residential densities in the most highly accessible locations, and adjacent to high amenity areas such as regional open space; and,
- Clustering retail, employment, recreational and other activities so as to reduce the need to travel, encourage non-vehicular transport modes and create attractive, high quality and amenity driven development with a diverse mix of land uses.

Given the quality built form and the close proximity to employment, transport, education, open space, healthcare, retail and local centres, the proposed ODP could be considered consistent with the intent of SPP No. 3. This consistency will be reflected in the fulfilment of more specific strategies relating to the key desired outcomes of SPP No.3, resulting in a well placed infill development that has capacity to provide a high standard of living to future residents.

#### **1.4.4 State Planning Policy 2.1 Peel Harvey Coastal Catchment Policy**

The Peel-Harvey Coastal Plain Catchment Policy (SPP 2.1) ensures that land use changes within the Peel-Harvey estuarine system likely to cause environmental damage to the estuary are brought under planning control and prevented. Given the proximity of Lot 601 Serpentine River, potential impacts on the Peel-Harvey catchment system must be considered. Given that Lot 601 does not directly front the Serpentine River foreshore impacts of weed invasion and the export of nutrients will be limited, however these issues have been carefully considered as part of this ODP.

As all lots in the ODP area will be connected to reticulated sewerage, it is consistent with section 6 of SPP 2.1. The Urban Water Management Plan will localise stormwater retention, which will further limit the potential for nutrient export. This will be further supported by the selection and retention of native species in public open space, road verge and foreshore areas. Stormwater collection areas can include nutrient stripping vegetation that will screen out nutrients and other pollutants collected by within the water system.

#### **1.4.5 Mandurah Planning Strategy**

The Mandurah Planning Strategy (draft 2013) provides strategic planning direction and context for the future development of Mandurah. The Strategy integrates State and regional planning policies and rationalises the designation of specific zones and planning provisions of the City of Mandurah Planning Scheme No.3. This Strategy provides an integrated approach to land use planning by combining previously prepared plans and strategies, creating objectives and desired outcomes for the future built form of Mandurah.

The Mandurah Planning Strategy includes the Mandurah Structure Plan, which is intended to provide and overarching summary of the provisions of the strategy (refer **Figure 4**). The subject site falls within the Mandurah East district under the strategy, and is in a favourable position with relation to an existing local centre, existing residential development and a Business Precinct.

As stated in the Strategy, further suburban/residential development achieves the best possible outcomes for Mandurah, as long as it is provided in appropriate locations and pays respect to existing environmental assets. This ODP responds to the strategy by providing increased housing supply, quality urban design outcomes, diverse and affordable housing and ensuring a higher density of development than is typical in the locality, which is designated as a future suburban zone.

#### **1.4.6 Mandurah East Structure Plan**

The Mandurah East Structure Plan (2008) shows this site as 'Residential Development', with lot sizes, density, POS and road layout to be determined through this ODP (refer **Figure 5**). The subject land is in close proximity to existing suburban areas, a retirement village, mixed business/employment areas and adjacent tourism zoned land. This ODP provides for a residential development which is consistent with the objectives and zoning requirements outlined in the Mandurah East Structure Plan, however a higher density (R60) is proposed given the proximity to services, open space, employment, retail and mixed use centres, future tourism uses and high frequency public transport. Given the lack of opportunities for infill development of this nature, and the strategic location of this site, the provision of R60 density residential development is considered a more effective outcome than the R40 stipulated in the Mandurah East Structure Plan.

The subject site is accessed from Old Pinjarra Road and there is no need to provide a physical connection to the key pedestrian linkage to the east as this land can be developed at some time in the future without any impact from development on Lot 601. The provision of this ODP is in accordance with the requirements of the Mandurah East Structure Plan's Residential Development zone, which requires an ODP to be prepared prior to subdivision and commencement development.

#### **1.4.7 Furnissdale West Outline Development Plan**

The recently released Furnissdale West ODP in the Shire of Murray (Rowe Group, November 2014) proposes residential development up to R60 on Urban zoned land. The Furnissdale West ODP is situated south of Pinjarra Road, some 800m south-east of the subject site (Refer **Figure 6**). This ODP also reflects sound planning rational to consolidate and intensify urban development in similar such areas, within relatively close proximity to regional centres.

#### **1.4.8 Local Planning Policies**

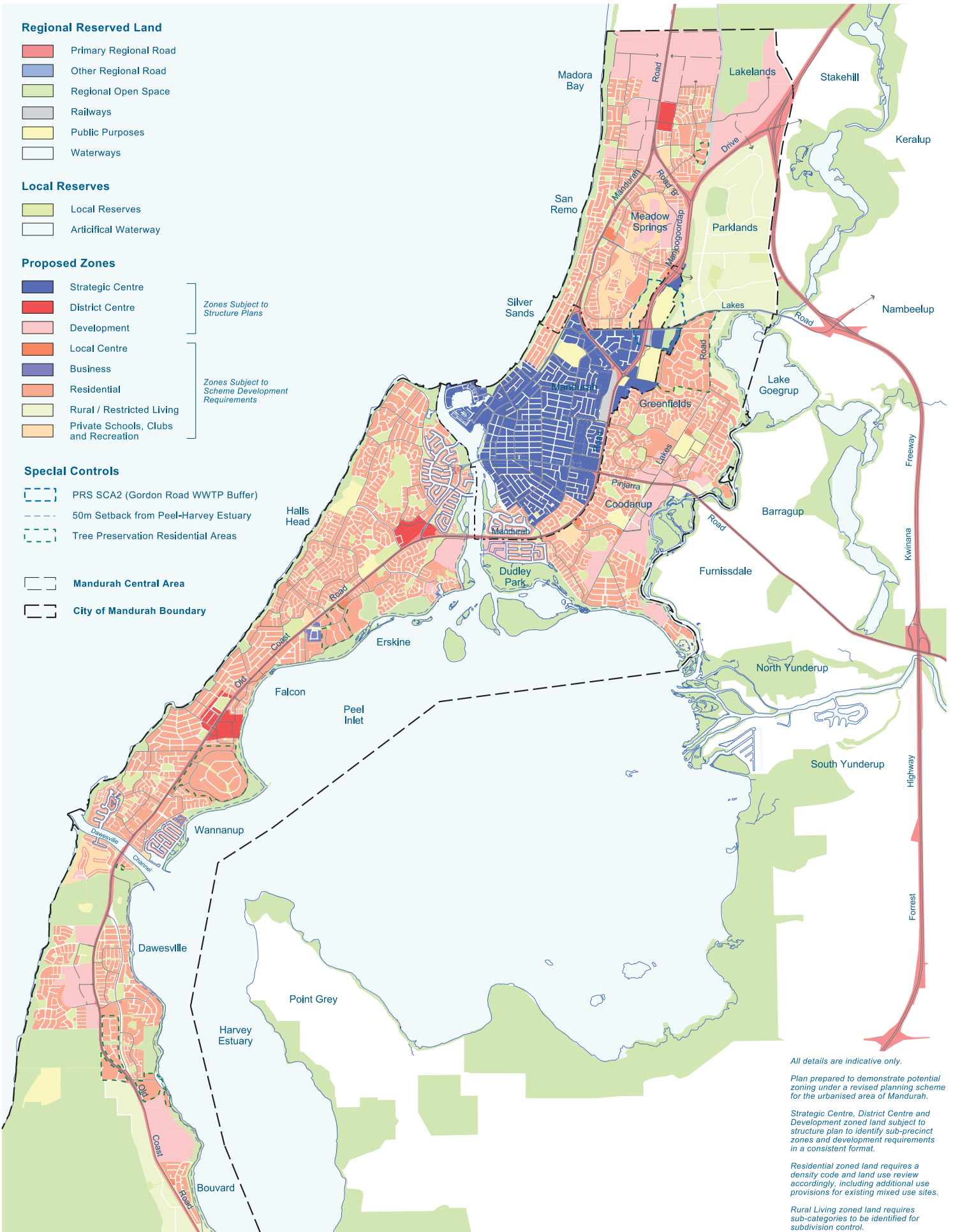
##### **1.4.8.1 LPP4 Urban Design Policy**

Local Planning Policy 4 Urban Design Policy (LPP4) is intended to provide an effective urban design tool for the application of Council, developers and the public. This policy is intended to enhance the standard of urban design within the City of Mandurah, and ensure that the development of Mandurah occurs in a sustainable and aesthetically pleasing manner.

This ODP seeks to achieve the objectives of LPP4 by:

- Providing built form of appropriate height and bulk
- Enhancing the amenity and aesthetics of the locality
- Encouraging a greater variety, intensity and diversity of appropriate land uses





All details are indicative only.

Plan prepared to demonstrate potential zoning under a revised planning scheme for the urbanised area of Mandurah.

Strategic Centre, District Centre and Development zoned land subject to structure plan to identify sub-precinct zones and development requirements in a consistent format.

Residential zoned land requires a density code and land use review accordingly, including additional use provisions for existing mixed use sites.

Rural Living zoned land requires sub-categories to be identified for subdivision control.

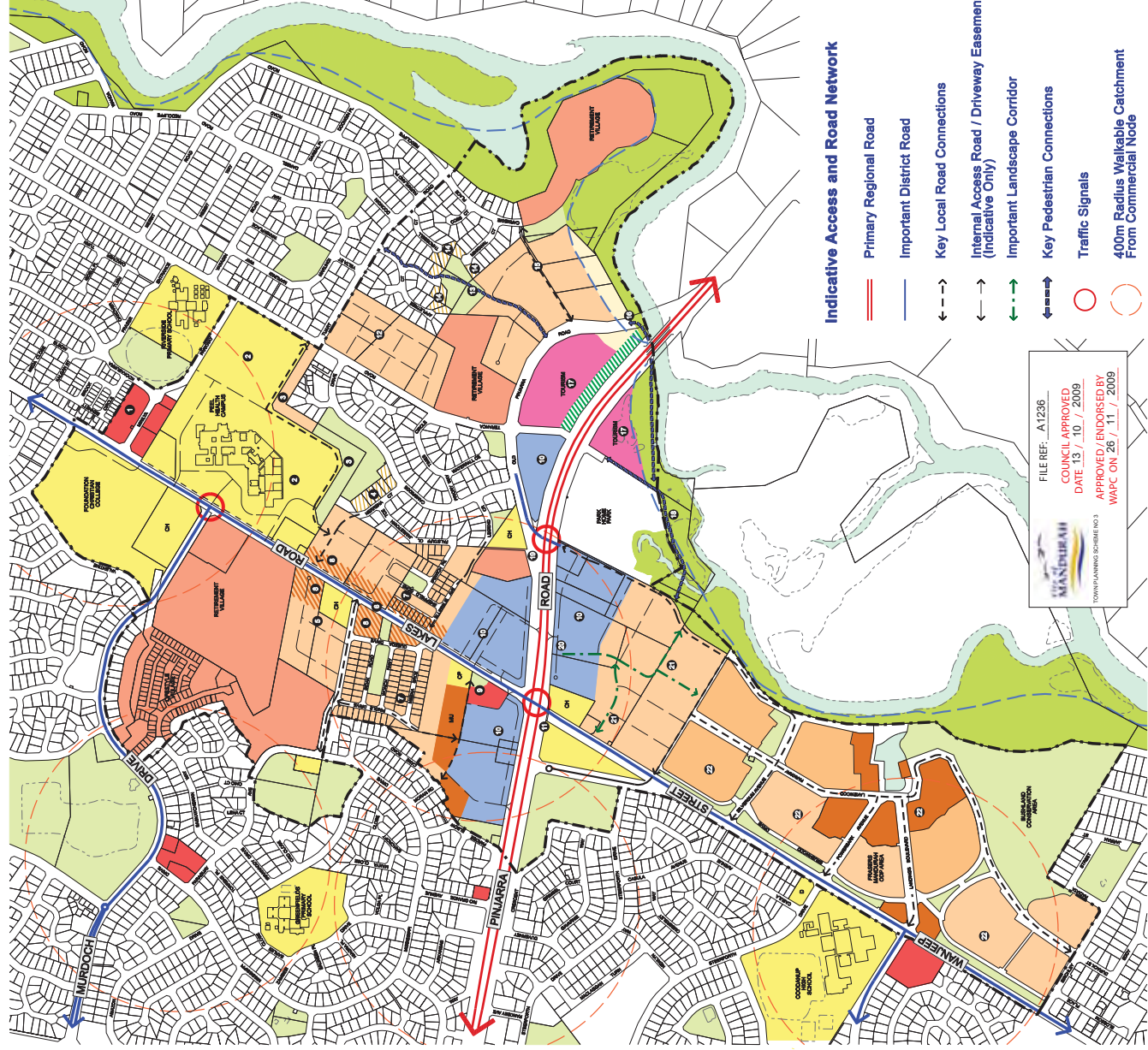
Plan 14 - Mandurah Planning Scheme Map Summary



18 November 2011 | 1048664014A | 17:00 000 @ A3 | 1:35 000 @ A1

## Structure Plan Notes

- 1 Neighbourhood Centre development (Maximum retail floorspace of 2500m<sup>2</sup>) with buildings addressing street corners, with Minilya Parkway forming a main-street which includes on-street parking.
- 2 Future development of vacant Peel Health Campus land as per approved Structure Plan, with improved and upgraded access, including access from Murdoch drive to form a four-way signalised intersection.
- 3 Possible residential development (including possible extension of existing public open space) around edge of development to provide improved and safer vehicular and pedestrian access to health facilities.
- 4 Long-term medium-density residential redevelopment to provide dwellings overlooking Cambridge Reserve.
- 5 Possible group dwelling development, with potential density bonus, dependent on form of development. No development to back onto Lakes Road.
- 6 Lakes Road widened by 5m on eastern side to provide for cycle lanes and safe turning movements. Frontage to Lakes Road provided through service/parallel roads. No development to back onto Lakes Road.
- 7 Predominantly R30 and R40 development within 400m radius catchment of new Local Centre.
- 8 Lots adjacent to Lakes Road having the opportunity to provide for non-residential land uses, integrated into residential area through building design and site layout.
- 9 Local Centre node incorporating retail (1500m<sup>2</sup> maximum), community purpose facility, small public space, and on-street parking and rear parking areas. Community Purpose facility subject to further review by City of Mandurah.
- 10 Mixed-Business/Employment Nodes:
  - Buildings to address key intersections and streets;
  - Service goods to be provided adjacent to Pinjarra Road;
  - Create good interface with residential by changing the land use at rear boundary;
  - Buildings and car parking to be designed around important trees to retain landscape quality of location
  - Design guidelines prepared.
- 11 Pinjarra Road/Lakes Road four-way signalised intersection.
- 12 Possible layout providing for shared area of public open space for Lots 500, 501 and 21.
- 13 Provide direct, legible pedestrian connection between Tuart Road and Old Pinjarra Road.
- 14 Long-term medium-density residential development to provide for a range of lot sizes and lot shapes. Development of irregular-shaped lots best achieved in pairs if possible. Rezoning and design guidelines required.
- 15 New street link between Old Pinjarra Road and Carnegie Place. Potential to amend Rural Zoning in Peel Region Scheme (subject to confirmation of floodway) to enable R20 lots along southern edge of new road.
- 16 Utilise cash-in-lieu for public open spaces from adjacent development to upgrade and enhance public foreshore area.
- 17 High quality tourist development at Serpentine River gateway, providing for a landscaped entrance to Mandurah from the east. Potential to include corner store and community purpose facility.
- 18 Provide safe, legible pedestrian connections to foreshore and facilities.
- 19 New access road to the south creating a four-way signalised intersection with Pinjarra Road and Old Pinjarra Road, providing access to mixed business/employment node. Developer Contributions Plan required.
- 20 Shared access through car parking areas for lots fronting Pinjarra Road.
- 21 Residential development designed around significant trees, with key landscape corridors providing a linkage between Wanjeep Street and Serpentine River.
- 22 Development as per Frasers Mandurah ODP.



## Structure Plan Vision

A high quality urban place for a diverse community, with a wide variety of land uses, employment, housing choice and community focal points.

A place that maximises enjoyment of the area's natural features with tree retention. In numerous parks, well landscaped streets and access to enhanced river foreshore areas.

## Key Principles

1. Provision of legible and direct vehicular connections
2. Provision of safe & attractive pedestrian connections
3. Provision of local retail centre on Lakes Road
4. Provision of employment opportunities in well designed, appropriately scaled mixed business development
5. Landscape entrance to Mandurah from the east

## Structure Plan Purpose (Planning Requirements)

To provide guidance in the assessment of planning proposals and Outline Development Plans as required under Town Planning Scheme No 3.

All details are indicative only. Final design and lot layouts upon receipt of relevant details.

Assessment of proposals to be against key principles outlined on Structure Plan.

## Indicative Land Use / Zoning Category

- Mixed Business / Employment Node
- Retail / Local Centre Node
- Mixed Use Commercial / Residential
- Tourism Development
- Retirement Village (Existing)
- Rural Residential
- Residential Development  
(Details regarding lot size, density, open space and road layout to be determined through ODP)
- Potential Mixed Use Opportunities
- Potential Long Term Increase in Residential Density
- Landscape Buffer
- Regional Open Space
- Local Open Space (Existing and Approved)
- Community and Public Purpose  
CH - Church; D - Drainage; CP - Community Purpose
- Floodway
- Structure Plan Boundary

## Indicative Access and Road Network

- Primary Regional Road
- Important District Road
- Key Local Road Connections
- Internal Access Road / Driveway Easement (Indicative Only)
- Important Landscape Corridor
- Key Pedestrian Connections
- Traffic Signals
- 400m Radius Walkable Catchment From Commercial Node

FILE REF: A1236  
**COUNCIL APPROVED**  
 DATE 13 / 10 / 2009  
**APPROVED/ENDORSED BY**  
 WAPC ON 26 / 11 / 2009

# MANDURAH EAST - STRUCTURE PLAN

### 1. PURPOSE

The purpose of these Design Guidelines is to provide some indicative criteria to the design of development within the 'Mixed Business' precinct contained within the Mandurah East Plan, as the area identified with Note 9 and Note 10 on the approved Structure Plan.

This Precinct provides for the development of a small retail node, together with Mixed Business/Showroom Development around the intersection of Lakes Road and Pinjarra Road.

### 2. APPLICATION

These Guidelines form part of the Mandurah East Structure Plan, which has been adopted by Council and the Western Australian Planning, which means Council must give due regard to their provisions in considering any planning proposal in the area.

It is intended that these Guidelines will be further developed as part of an Outline Development Plan(s) which will be required for the Precinct, due to the 'Urban Development' zoning of the land.

### 3. GENERAL PROVISIONS

As noted on the Mandurah East Structure Plan, the following will apply to the areas notated by Notes 1, 9 and 10 respectively:

**NOTE 1:**  
*Neighbourhood Centre development (Maximum retail floorspace of 2500m<sup>2</sup>) with buildings addressing street corners, with Minilya Parkway forming a 'main-street' which includes on-street parking.*

**NOTE 9:**  
*Local Centre Node Incorporating Retail (1500m<sup>2</sup> Maximum), Community Purpose Facility, Small Public Space, and On-Street Parking and Rear Parking Areas. Community Purpose Facility Subject To Further Review by City Of Mandurah*

Within the Specific Provisions, this area will be known as the 'Local Centre Precinct'.

**NOTE 10:**  
*Mixed-Business/Employment Node:*

- Buildings to Address Key Intersections and Streets;
- Create Good Interface With Residential By Changing the Land Use at Rear Boundary;
- Buildings and Car Parking to be Designed around important trees to retain landscape quality of location;
- Design Guidelines Prepared.

Within the Specific Provisions, this area will be known as the 'Mixed Business Precinct'.

### 4. SPECIFIC PROVISIONS

#### 4.1 MIXED BUSINESS PRECINCT

Subdivision and Development Standards within this Precinct shall be generally in accordance with the 'Service Commercial' zone (including Table 4) of Town Planning Scheme No 3, with the exception of the following, which provide further details in regard to building design and land use.

##### 4.1.1 Subdivision

Subdivision of this Precinct into smaller lots will generally not be supported by the City of Mandurah, unless it can be demonstrated that the proposal will not have a detrimental impact on the function and design of the Precinct, in regard to:

- Efficiency of land use;
- Impact of servicing (Waste etc);
- Vehicle Access and Parking (Crossovers, Reciprocal Access Easements);
- Size of Buildings (Floorspace Areas).

##### 4.1.2 Development Standards

Development Standards, specifying setbacks, the car parking and landscaping (etc), shall generally be in accordance with Table 4 of Town Planning Scheme No 3, however the following will also be considered:

- Setbacks should relate to the site layout in regard to the location of car parking, servicing and landscaping areas, rather than being relative to the sites boundaries;
- Car parking requirements should be based on the needs of the Precinct Area rather than separate site (as maybe subdivided);
- The focus on landscaping will be on the quality and the quantity.

##### 4.1.3 Land Use & Floorspace Size

The predominant land use within this Precinct will be '**Showrooms**' as defined in Town Planning Scheme No 3 (as highlighted below).

Whilst listed in Table 4 of Scheme 3, the following uses **are not** considered appropriate for this Precinct, and shall be further reviewed as part of an Outline Development Plan for the site(s):

- Car Wash;
- Hire Service;
- Industry – Service;
- Motor Vehicle Sales, Repair and Hire;
- Office;
- Restaurant;

The definition of Showroom in Scheme 3 generally provides for goods being offered for wholesale or retail sale **goods of a bulky nature** (amongst others).

This definition does not allow for the retail sale of goods in bulk quantities. As a result, such land uses, which have a large floor area but sell retail items are

# MANDURAH EAST □ STRUCTURE PLAN

## DESIGN GUIDELINES



considered a 'shop' as defined under Scheme 3 and are not permitted within this Precinct.

In addition, in order to ensure that Showrooms are the predominant land use within the Precinct, a minimum floorspace size of 200 square metres per tenancy will be required.

### 4.1.4 Building Design and Site Layout

A high quality built form is required for the Precinct due to its exposure and location. As shown on the graphics, the following aspects are required in this context:

- Articulation to elevations through variety of materials, height, setbacks and awnings covering pedestrian walkways around the building. Walls with no articulation and no variety of materials will not be accepted;
- Buildings are to address public spaces, through the provision of windows and control of signage on this windows in order to provide for surveillance and security. The blanking out of windows with signage is not acceptable;
- Landscaping is to be of a high quality through the use of mature trees within parking areas, the street verge and around buildings, complimented by extensive low rise native landscaping, ensuring the buildings exposure is maintained. Expansive areas of lawn will not be accepted within the site and street verge as a suitable form of landscaping;
- Variety of paving being provided adjacent to the building and within the car parking areas to demarcate pedestrian crossings and driveway accesses, ensure that the extent of bitumen is reduced.
- Car parking areas are to be designed to wrap around the site and/or buildings, to form internal accessways around the Precinct. Large expanses of car parking areas are not appropriate.

- The extent and amount of signage shall be controlled and minimised and shall have regard to the following:
  - An area on the building's façade shall be designed to incorporate the appropriate signage for individual tenancies, in a manner that does not detract from the building's design.
  - The painting of the building in a tenants 'corporate colours' is considered a form of signage and should not detract from the building's design.
  - The use of pylon and free-standing A-frame signs is discouraged, due to the sites exposure to Pinjarra Road. The building design shall ensure that adequate 'advertising' of the business is provided for.

### 4.2 LOCAL CENTRE PRECINCT

Subdivision and Development Standards within this Precinct shall be generally in accordance with the 'Commercial' zone (including Table 2) of Town Planning Scheme No 3, together with the details provided in Section 4.1 of these Design Guidelines, noting the development shall be designed in the context of a 'main-street' form of development with the following features:

- Buildings shall address the street through their design in regard to window treatments and placement of signage;
- A nil setback to both streets (with the exception of providing for the 'town square' area of public open space);
- Awnings to be provided over the pedestrian footpaths within the road reserve;
- On-street parking to be provided and used as part of the car parking ratios. Additional parking shall be provided at the rear of buildings, with spaces provided between buildings to provide access to the front of the buildings.

### MIXED BUSINESS PRECINCT EXAMPLES



High Quality Landscaping & Footpaths

Articulation, Control of Signage



Articulation, Use of Materials, Control of Signage, Awnings & Location of Parking



Street trees, pavement, relationship of development to the street



- RESIDENTIAL**
  - Residential - R20
  - Residential - R30
  - Residential - R40
  - Residential - R60
- PARKS, RECREATION & CONSERVATION**
  - Public Open Space
  - Conservation (OEPA Vegetation)
- TRANSPORT**
  - Neighbourhood Connector
  - Access Street - Local Road
- OTHER**
  - Outline Development Plan Boundary
- ADDITIONAL INFORMATION**
  - Building Protection Zone

1:0 1:25 250 Metres

REVISIONS		
Rev	Date	Drawn
A	2014.05.19	K. Trenberth
F	2014.10.23	K. Trenberth



w: www.rowegroup.com.au  
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p: 08 9221 1991

Date Drawn: 2014-05-19  
Job Ref: 5527  
Scale: 1:5000 @ A3  
Client: Coodo Pty Ltd  
Designer: P. Fitzgerald  
Drawn: K. Trenberth  
Projection: MGA50 GDA94  
Plan ID: 5227-LSP-03-F  
Cadastral supplied by LANDSAT



Furnissdale West (Figure 12)

# Outline Development Plan

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- Providing quality landscaping, architectural detail and vegetation retention
- Ensuring public and private safety as well as passive surveillance as part of the overall design

#### 1.4.8.2 LPP15 Water Sensitive Urban Design

The Water Sensitive Urban Design policy (LPP15) is concerned with achieving 'total water cycle management' via the planning and approvals process, as directed by State Planning Policy 2.6 Water Resources. The City of Mandurah is located within the Peel-Harvey Estuary catchment which makes the effective application of Water Sensitive Urban Design principles vital to the ongoing quality of the surrounding waterways.

The soils on the site are sandy and are relatively permeable, however as recommended in the Survey report by Galt Geotechnics, in its current state the site is not suitable for onsite disposal. This is due to the relatively low elevation of the site and the high groundwater level. It is recommended that by raising the elevation of the site to 1.2m above the average annual maximum groundwater level, disposal of stormwater by on site filtration would be possible.

A Stormwater Management Plan is to be prepared prior to subdivision/development of the subject site, demonstrating compliance with the Stormwater Management Manual for Western Australia and the provisions of LPP15.

## 2.0 Site Conditions and Constraints

### 2.1 Biodiversity and Natural Area Assets

Ecosystems Solutions surveyed the subject site in October 2014 to determine the species present and the condition of the ecosystem within the “Environmentally Sensitive Area” over the southern portion of Lot 601. The flora/fauna survey conducted found that the quality of the vegetation present on site is of “very poor quality”, highly degraded, densely populated by invasive species and environmental weeds (refer **Figure 7** herein and **Appendix 2** for full report). No evidence of priority flora or fauna during the survey directly or through other sign of historical use of the habitat present, including tree hollows. The results of the survey and associated report state clearly that there are no matters of environmental significance within the study area, with the vegetation remaining on site being degraded.

Ecosystems Solutions has concluded that there is no basis for the remaining vegetation on site being classified as an environmentally sensitive area, and it is likely that the classification is an overlap resulting from the proximity to the Serpentine River. According to the report, this proposal would not adversely affect the environmental values of the Serpentine River, as there is a buffer of 270m between the subject site and the river. The report recommends that based on the criteria identified by the Commonwealth, the proposed development and associated works do not comprise a significant impact on threatened species, and therefore do not require referral under the EBPC Act.

### 2.2 Landform and Soils

A due diligence study was undertaken by Galt Geotechnics Pty Ltd with a scope to:

- Broadly assess subsurface soil and groundwater conditions across the site
- Provide a preliminary site classification in accordance with AS 2870-2011 “Residential Slabs and Footings”
- Recommend preliminary site preparation procedures that may be necessary to amend the site classification
- Assess the permeability of soils at the site for potential on-site disposal of stormwater by infiltration, and
- Broadly assess the nature and extent of ASS (if any) within the site and assess the need or otherwise for further studies.

The Pinjarra Sheet of the 1:50000 scale Urban Geology series map indicates the site is underlain by “Tamala (Coastal) Limestone: predominantly sand”. Based on the materials encountered within the test pits and hand auger boreholes, the spoils appear to be relatively consistent across the site and general site conditions can be summarised as comprising:

- SAND (SP), fine to coarse grained, sub angular to sub-rounded, grey at surface, becoming white, locally pale brown, localised trace organic fines/rootlets/roots (up to 50mm) in top 150mm to 300mm, generally loose to medium dense, moist to wet, present from surface down to the maximum depth of investigation of 2.3m.

Further findings of the due diligence study will be addressed briefly below, for the full version refer to **Appendix 3**.



**Map 6**      **Vegetation Condition**

Site	Lot 601 Old Pinjarra Rd Greenfields
Project	Significance Survey and Analysis
Client	Rivergreen Pty Ltd
Scale	1: 750

## Legend



Boundary

Vegetation Condition



Completely Degraded



Degraded



Prepared by Gary McMahon  
Ecosystem Solutions  
December 2014  
Projection - MGA50  
Datum - GDA94

NOTE: This drawing is not to scale and has not been derived from survey.





## 2.3 Civil Engineering Works

Preliminary civil works have been assessed by McDowall Affleck as an investigation into site developments costs (refer **Appendix 4**). It is proposed to fill the site to a minimum of 0.5m above the flood level, in accordance with the IPWEA Guidelines (2009), this will result in 0.5m clearance to the 100 year flood level of 2.1 AHD. On-site stormwater is to be disposed of by the of soak wells, with an overland flow path onto Old Pinjarra Road. The construction of retaining walls will also be necessary to achieve the desired levels, which will be constructed as necessary to retain fill on site. Reticulated sewer, water, underground power and telecommunications will also be provided for the proposed development.

## 2.4 Acid Sulfate Soils

A portion at the north of the site is identified by Department of Environment Regulation (DER) mapping as having a “high to moderate risk of ASS occurrence within three metres of the natural ground surface that could be disturbed by most land development activities”. Galt Geotechnics have undertaken field testing in accordance with AS 4482.1 (2005) *Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil Part 1 Non Volatile and Semi Volatile Compounds*, DEC (2013) *Identification and Investigation of Acid Sulphate Soils and Acidic landscapes* and DEC (2011) *Treatment and Management of Soil and Water in Acid Sulfate Soils Landscapes*.

The investigation confirmed that Acid Sulfate Soil (ASS) is present within the site. Soils have been classified as either non-acid sulfate soil (NASS) or potential acid sulfate soil (PASS) based on the following criteria:

- Net acidity
- Titratable sulphuric acidity
- Soil type, and
- Location relative to the groundwater table.

Levels of net acidity exceeded the DER action criterion of 0.03%S at over half of the sampling locations across the site. The exceedances were identified in soils characterised as described above (section 2.2).

The presence of ASS does not necessarily mean that management and treatment is required. The need for this will be determined based on the volume of material required to be excavated in bulk earthworks and civil works. If less than 100m<sup>3</sup> of ASS material is to be removed, there is no need to treat ASS. Where the need for management and treatment of ASS material could be required would be in deeper excavations commonly required for sewer installation. This will need to be addressed once the details of the development have been determined.

## 2.5 Groundwater and Surface Water

The site is relatively low lying and within about 250m of the Serpentine River. Groundwater was encountered in 6 of the 7 test pits and 3 of the 4 hand augers, at depths of between 0.6m and 1.1m. This relatively high groundwater level will have an influence on the development.

The southern two-thirds of Lot 601 are affected by major flooding, with the 100 ARI flood level estimated to be 2.1m AHD. The Department of Water has recommended that a minimum habitable floor level of 2.6m AHD is necessary to ensure adequate flood protection during these major events.

Tests undertaken as part of this study show that the sandy soil on the site is relatively permeable, however, on-site disposal of stormwater over the majority of the site (in its current state) is not advisable due to its relatively low elevation and the shallow depth to groundwater. If the ground elevation was raised to 1.2m above the average annual maximum groundwater level (AAMGL), disposal by on site infiltration would be acceptable.

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## 2.6 Heritage

Department of Aboriginal Affairs (DAA) site 3338 (Taranga Road, Mandurah) is an artefact scatter which was recorded in 1973. The place has not been formally assessed under the Aboriginal Heritage Act 1972 (AHA), which is reflected by the 'Lodged' status. DAA notes there has been some historic disturbance which has previously occurred within Lot 601.

The DAA does not believe there is a requirement for reporting or survey conditions with respect to this matter. In order to assist with ensuring compliance with this legislation the DAA recommends that the subdivider should:

- Refer to the State's Aboriginal Heritage Due Diligence Guidelines in order to assess the risk the proposed development has on impacting on Aboriginal heritage sites (as defined by the AHA).
- The developer is to contact this department for specific advice relating to the proposed development and what may be required to ensure compliance with the AHA when development occurs.

## 3.0 Land Use and Subdivision Requirements

### 3.1 Land Use

The subject land is to be used for a residential development, which is in line with the Urban Development zoning and strategic guidance from other City Strategies and the Mandurah East Structure Plan. A summary of the overall layout and ODP provisions are contained in **Figure 1**.

The purpose of this Structure Plan is to provide an overall guide to the layout, staging and statutory requirements of the development of the subject land to ensure that development is appropriate for the location and complies with the various strategies, schemes and policies applicable to this locality. Given the Urban zoning in all high level planning strategies and the local planning scheme/strategy, providing medium density residential infill development accords with the strategic intentions for both the site and the locality. The proximity of the site to major transport corridors, mixed use/commercial precincts and a future tourist site further justifies the appropriateness of the proposed residential development.

### 3.2 Residential

This Structure Plan demonstrates the general land use intentions for the subject site, which comprises a residential development over the entirety of Lot 601 Old Pinjarra Road, Greenfields. The majority of the site is to be developed at a density of R60, with a smaller portion of the site (along the northern boundary) to be developed at a density of R40 to provide a suitable interface with surrounding development. All future subdivision/development shall comply with the Residential Design Codes, in terms of built form outcome, car parking, open space, communal living areas etc.

The total area of proposed residential land to be provided is approximately 8500m<sup>2</sup> to be developed to a maximum plot ratio of 0.7 in accordance with Table 4 of the R-codes (for the R60 coding). It is anticipated that this could yield around 57 grouped dwellings or around 120 multiple dwellings - assuming a plot ratio area of 10,796m<sup>2</sup> and 90m<sup>2</sup> unit size.



### 3.3 Open Space

The subject site comprises a total area of 1.54ha of which around 2400m<sup>2</sup> will be provided as communal open space for use by all residents (refer **Figure 8**). While it is not compulsory to provide communal open space, given the proposed R40/60 coding, drainage and water management considerations, tree retention and landscaping it is considered a good urban design outcome to provide such open space for the amenity of residents. There are numerous areas of public open space within 1km of the subject site including numerous recreation areas such as Bortolo and Fowler Park and the Serpentine River foreshore.

### 3.4 Movement Networks

The subject site will incorporate only private access roads to service the proposed residential buildings, access to the site will be from Old Pinjarra Road. The road network surrounding the subject site has a large capacity, and given the relatively small scale of the proposed development, it is highly unlikely that the road networks would need to be upgraded as a result.



-  Site Boundary
-  Open Space

**Disclaimer**  
 The contents of this plan are conceptual only, for discussion purposes. All areas and dimensions are approximate only subject to relevant studies, Survey, Engineering and Council approval.



**Lot 601, Old Pinjarra Road, Greenfields**  
 Open Space Plan

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### 3.5 Water Management

#### Peel Harvey Water Quality Improvement Plan

The EPA's Peel Harvey Water Quality Improvement Plan takes the "findings of the seven supporting projects and recommends a combination of management measures to reduce phosphorus loss from land uses within the coastal sections of the three catchments-the Serpentine, Murray and Harvey-draining to the estuary". The key relevant components include:

- Use of low water soluble fertiliser in urban areas;
- Connections to sewerage for all homes and properties in new urban developments;
- Undertake soil remediation in all new urban developments with sandy soils; and
- Incorporation of water sensitive urban design in all new developments.

Development on this site will uphold the objectives of the Water Quality Improvement Plan, and will avoid any significant impacts upon the nearby Serpentine River, which will be aided by a considerable buffer (270m) from the river. Particular consideration must be given to limiting the application of fertilisers post development, as the soils of the subject site have a low capacity for phosphorous retention and have a relatively close proximity to the Serpentine River.

## 4.0 Conclusion

The proposed Structure Plan for a Lot 601 Old Pinjarra Road, Greenfields accords with the provisions and strategic objectives of Directions 2031 and Beyond, the Peel Region Scheme, relevant State Planning Policies, the City of Mandurah TPS 3, the draft City of Mandurah Planning Strategy and relevant local planning policy provisions. The proposed Structure Plan also accords with the Mandurah East Structure Plan and is consistent with the long term planning context for this part of Mandurah.

The proposed development will achieve a high standard of built form and will make a positive contribution to the amenity of the locality, as well as providing an increased range of housing type and density. The parking and access arrangements align with the R Codes and access will be provided from Old Pinjarra Road, with the existing road network being more than capable of accommodating additional traffic generated by this proposal. The strategic position of this development is ideal for the proposed R60 density, being in close proximity to; schools, high frequency public transport, future tourism development, local centres, public open space, the Peel Health Campus and service commercial development.

In broad terms this proposal:

- is consistent with existing policy
- is consistent with the orderly and proper planning of the locality
- can be connected to all necessary infrastructure services and is capable of residential development, and
- will not prejudice the environmental values of the immediate locality.

On the basis of the above, it is requested the City of Mandurah and the Western Australian Planning Commission adopt the Structure Plan for future residential R60 development as it is consistent with the State and local planning framework and Urban zone under the Peel Region Scheme.

**APPENDIX I**

Certificate of Title Volume 2567 Folio 800

Deposited Plan 40808

WESTERN



AUSTRALIA

REGISTER NUMBER <b>601/DP40808</b>	
DUPLICATE EDITION <b>1</b>	DATE DUPLICATE ISSUED <b>12/7/2004</b>

**RECORD OF CERTIFICATE OF TITLE**  
UNDER THE TRANSFER OF LAND ACT 1893

VOLUME  
**2567**

FOLIO  
**800**

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

REGISTRAR OF TITLES



**LAND DESCRIPTION:**

LOT 601 ON DEPOSITED PLAN 40808

**REGISTERED PROPRIETOR:**  
(FIRST SCHEDULE)

MALTAB PTY LTD OF 1 DONNELLY GARDENS, MANDURAH  
(AF I936797 ) REGISTERED 30 JUNE 2004

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

1. THE RIGHT TO MINES OF COAL OR OTHER MINERALS BEING EXCLUDED FROM PORTION OF THE SAID LAND
2. \*I936794 MEMORIAL, TOWN PLANNING AND DEVELOPMENT ACT 1928. REGISTERED 30.6.2004.

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

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

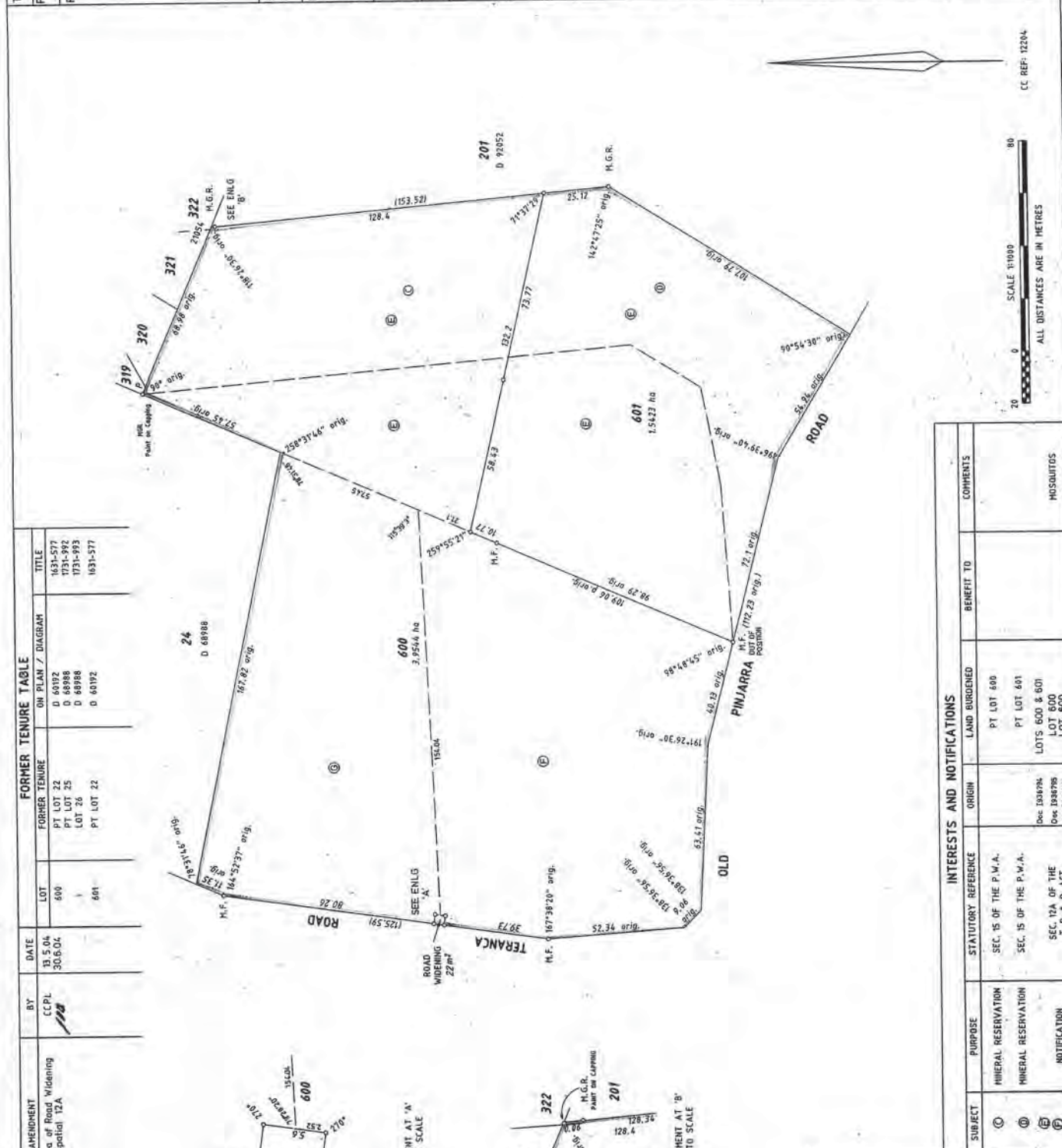
**STATEMENTS:**

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

SKETCH OF LAND: DP40808.  
PREVIOUS TITLE: 1631-577.  
PROPERTY STREET ADDRESS: 22 OLD PINJARRA RD. GREENFIELDS.  
LOCAL GOVERNMENT AREA: CITY OF MANDURAH.



TYPE	FREEHOLD
PURPOSE	SUBDIVISION
PLAN OF	
<b>LOTS 600-601 (INC.) AND ROAD WIDENING</b>	
DISTRICT	COCKBURN SOUND
TOWNSITE	
FILE	FORMER TENURE SEE TABLE
LOCALITY	GREENFIELDS
LOCAL AUTHORITY	CITY OF MANDURAH
INDEX	8632 (2) 08.39 9632 (2) 08.40
SCALE	1:1000
SURVEYOR'S CERTIFICATE - Reg 54 A. PASH Herby survey task This plan of survey is a correct representation of the survey and/or conditions from measurements recorded in the field book lodged for the relation to which it is lodged. Licence Surveyor: <i>Andrew Park</i> Date: 24-04-04 Murray District Surveyors 17 Parkmore Court, Mandurah WA 6250 Phone: 08 9421 3111 Fax: 08 9421 3112	
LOGGED	DATE 16/11/04
DATE	24-04-04
TYPE OF VALUATION	APPROVED BY PLANNING COMMISSION
FULL NAME	DATE 12/05/03
COMPONENT	DATE 11/4/97
INDEXED	DATE 05/05/04
CONVEYED	DATE 05/05/04
ADDRESS NO.	DATE 16/11/04
SEC.	DATE 16/11/04
SUBJECT TO <b>TWO CHARGES</b> S. 28(3), T.P. & A. Act S. 12 A, T.P. & A. Act	
APPROVED 30-6-04 DIRECTOR OF LAND SURVEYS / AUTHORIZED LAND OFFICER	
Department of Land Information	
DEPOSITED PLAN <b>40808</b>	
SHEET	1 OF 1 SHEETS
VERSION	1 OF 3



LOT	FORMER TENURE	ON PLAN / DIAGRAM	TITLE
400	PT LOT 22	D 60192	1631-577
601	PT LOT 25	D 68988	1731-392
	PT LOT 26	D 68988	1731-395
	PT LOT 22	D 60192	1631-577

ED/VER	AMENDMENT	DATE	BY
1/3	Increase area of Road Widening	13.5.04	CC/PL
1/3	Addition of spatial 12A notification.	30.6.04	

INTERESTS AND NOTIFICATIONS			
SUBJECT	PURPOSE	STATUTORY REFERENCE	ORIGIN
①	MINERAL RESERVATION	SEC. 15 OF THE P.W.A.	PT LOT 600
②	MINERAL RESERVATION	SEC. 15 OF THE P.W.A.	PT LOT 601
③	NOTIFICATION	SEC. 12A OF THE T.P. & A. ACT	LOTS 600 & 601
④			LOT 600
⑤			LOT 601

CC REF: 1224  
SCALE 1:1000  
ALL DISTANCES ARE IN METRES



## **APPENDIX 2**

Vegetation and Significant Fauna Investigation and Analysis

Prepared by Ecosystem Solutions

December 2014

# Report

**Lot 601 (No.22) Old Pinjarra  
Road, Greenfields, WA**



## **Vegetation & Significant Fauna Investigation & Analysis**

Prepared by

**ECOSYSTEM SOLUTIONS PTY LTD**

**A.B.N. 19115287593**

For

**Rivergreen Pty Ltd &  
RPS Australia Asia Pacific**

**2<sup>nd</sup> December 2014**



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## **Limitations Statement**

This report has been solely prepared for Rivergreen Pty Ltd and RPS Australia Asia Pacific.

No express or implied warranties are made by Ecosystem Solutions Pty Ltd regarding the findings and data contained in this report. No new research or field studies were conducted other than those specifically outlined in this report. All of the information details included in this report are based upon the research provided and obtained at the time Ecosystem Solutions Pty Ltd conducted its analysis.

In undertaking this work the authors have made every effort to ensure the accuracy of the information used. Any conclusions drawn or recommendations made in the report are done in good faith and the consultants take no responsibility for how this information and the report are used subsequently by others.

Please note that the contents in this report may not be directly applicable towards another organisation's needs. Ecosystem Solutions Pty Ltd accepts no liability whatsoever for a third party's use of, or reliance upon, this specific report.

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## 1. Introduction

Rivergreen Pty Ltd contracted Ecosystem Solutions to conduct a Flora and Vegetation Assessment and a Significant Fauna Survey of Lot 601 (No. 22) Old Pinjarra Road, Greenfields, near Mandurah in WA (the Study Area).

The purpose of this report is to assess the site for significant native flora, vegetation and identify any fauna within the subject site. The owners of the land wish to advance a multi dwelling development on the site (Figure 1).

The aim of the survey and report is to evaluate the conservation and environmental significance of the Study Area and consider any impacts from the development that may necessitate a referral under the *Environmental Protection and Biodiversity Conservation Act* (EPBC Act). A significant impact on any of the matters of National Environmental Significance would require a referral to the Department of Environment (DoE).

This report outlines the methodology and results of these surveys and summarises the findings of each of these parameters.

## 2. Site Details

The Study Area is located approximately 5 kms east of Mandurah in the south-west of Western Australia (Map 1). The Study Area consist of approximately 1.5 ha of land adjoining Old Pinjarra Road in Greenfields and is within the City of Mandurah local government area. The site includes a single dwelling and areas of vegetation covering approximately 6,673 m<sup>2</sup> (0.6ha) (Map 2).

The Study Area is situated within an area of urban development on the eastern edge of the town of Mandurah. The lots to the south and east are still small rural/residential lots. The Serpentine River is located approximately 270m to the south east of the site. The southern section of the Study Area is designated by the Department of Environmental Regulations (DER) as part of an Environmentally Sensitive Area (Map 2). Environmentally sensitive areas are protected under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and are selected for their values at a state or national level. They include:

- Defined vegetation within 50m of a wetland or riparian area;
- Areas covered by Threatened Ecological Communities;
- Areas of vegetation within 50 m of a Declared Rare Flora site;

- Bush Forever sites; and
- World Heritage property sites.

The small area within Lot 601 would appear to be related to its proximity to riparian vegetation as well as its proximity to a Threatened Ecological Community.

The Study Area lies on a flat section of the old Serpentine River flood plain area. The site lies at approximately 5m Australian Height Datum (AHD) in the northern area and drops by 1-1.5 m towards the southern boundary.

A number of the existing trees in the southern section of the Study Area are proposed to be retained during the future development (Figure 1).

### **3. Flora and Vegetation.**

#### **3.1. Landscape, Soils & Vegetation**

Soil-Landscape systems are areas with recurring patterns of landforms, soils and vegetation and are used by the Department of Agriculture to maintain a consistent approach to land resource surveys.

The site is situated in the Spearwood Dunes Soil landscape system within the Swan Coastal Plain (Tille and Lantzke, 1990). This is generalised as:

*Dune systems of intermediate age, in between the Bassendean and Quindalup dunes systems. They consist of yellowish brown siliceous sands overlying limestone at varying depths. They are more hilly and elevated, often separated from other systems by a series of lakes or swamps. The Spearwood system also encompass flat to gently undulating terrain overlying marine limestones which is associated with coastal lakes (Wells, 1989).*

The area has been mapped by Churchward and McArthur (1978) and Tille and Lantzke (1990). The Study Area is a single subsystem (Map 3):

- Spearwood System S4a Phase (211 Sp\_S24a) which is described as flat to gently undulating sand plain of deep, pale and sometimes bleached sands, with yellow-brown subsoils

The vegetation has been described regionally by Heddle *et al* (1978) as comprising a single vegetation complex (Map 4). This is described as:

- Vasse Complex Type – Closed Scrub Fringing Woodland & Open Forest Structure – Typically consists of closed scrub of *Melaleuca* species fringing

woodland of *Eucalyptus rudis* – *Melaleuca* spp. and open forest of *Eucalyptus gomphocephala* – *E marginata* – *Corymbia calophylla*.

Within the City of Mandurah, 507 ha (38%) of this complex remains from its pre-European extent. Overall, 32% of this complex remains within in the Swan Coastal Plain, with 14% being protected within formal reserves (WALGA, 2007).

## **4. Flora, Vegetation and Community Survey**

### **4.1. Objectives**

To assess the flora and vegetation of the site with regard to its conservation value and report on these.

### **4.2. Methods**

A formal extract from the Department of Parks and Wildlife (DPAW rare flora and communities databases was obtained to determine if records of any rare or threatened flora are known within the boundary or vicinity of the site. A preliminary reconnaissance survey of the results of the desktop study was conducted, consistent with a Level 1 Flora and Vegetation Survey (EPA, 2004).

The Study Area was surveyed on 30<sup>th</sup> October 2014 by Gary McMahon (B.Sc. M. Env Mgmt) with botanical advice from Nathan McQuoid, a well-respected and highly qualified botanist. The site was walked in a systematic manner to cover all of the area. Zones with consistent vegetation structure and composition were noted and the main species in each of the strata were identified. The vegetation condition of the vegetation based on Keighery (1994) was also recorded using Global Positioning System (GPS). Vegetation communities and condition maps were prepared.

The Study Area was also inspected for flora species of significance and Threatened Ecological Communities, based on the DPaw database records.

The vegetation was assessed using the releve method whereby the following information was collected at unmarked survey sites;

- GPS coordinates,
- Dominant or important plant species within approximately 10 m radius of the observer,
- Notes on vegetation structure using the method of Muir (1977),
- Vegetation condition score (Keighery, 1994),
- Surface soil texture and colour.



A list of all native flora species observed was compiled. Taxa not able to be identified in the field were collected or photographed for later determination. Taxonomy and conservation status of flora was checked against the database Max 3.3 (Department of Parks and Wildlife, 2013).

### **4.3. Declared Rare and Priority Flora**

Species of flora and fauna are defined as Declared Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes. DPAW recognizes these threats of extinction and consequently applies regulations towards population and species protection. Declared Rare Flora species are gazetted under subsection 2 of section 23F of the Wildlife Conservation Act (1950) and therefore it is an offence to “take” or damage rare flora without Ministerial approval. Section 23F of the Wildlife Conservation Act (1950-1980) defines “to take” as “... to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means” (Government of Western Australia, 2010).

Priority List Flora are under consideration for declaration as “rare flora”, but are in urgent need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). Table 1 presents the definitions of Declared Rare and the four Priority ratings under the Wildlife Conservation Act (1950) (Department of Environment and Conservation, 2010a).

**Table 1 : Rare and Priority Flora Categories**

CONSERVATION CODE	CATEGORY
<b>R</b>	"Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such."
<b>P1</b>	"Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
<b>P2</b>	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. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
<b>P3</b>	"Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey."
<b>P4</b>	"Taxa which are considered to have been adequately surveyed and which, while being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years."

## 4.4. Results and Discussion

### 4.4.1. Native Flora

Nine rare or priority flora species are listed as being within 10 kilometres of the Study Area (Table 2).

**Table 2: Rare and Priority Flora within 10 km of the site.**

SPECIES	STATUS	LIFE FORM	HABITAT
<i>Diuris micrantha</i>	DRF	Herb	Winter wet swamps, shallow water. Flowering Aug-Oct
<i>Drakea elastica</i>	DRF	Herb	Low lying areas near winter wet swamps. White or grey sand. Flowering Oct -Nov
<i>Darwinia terricola</i>	P1	Shrub	Wetter areas
<i>Acacia benthamii</i>	P2	Shrub	Sand or limestone breakaways
<i>Grevillea manglesii</i> subsp. <i>ornithopoda</i>	P2	Shrub	In gravelly soil, sand or clay, along creek beds
<i>Eryngium pinnatifidum</i> subsp. <i>Palustre</i> (G.J. Keighery 13459)	P3	Herb	Winter wet areas, Claypans, sandy rises. Sandy clay, grey or place peaty sand. Flowers Aug-Nov.
<i>Dillwynia dillwynioides</i>	P3	Shrub	Winter Wet Depressions, Sandy soils Flowering Aug – Dec.
<i>Eucalyptus rudis</i> subsp. <i>cratyantha</i>	P4	Tree	Flats and Hillsides, loam soils
<i>Jacksonia sericea</i>	P4	Shrub	Calcareous and sandy soils

None of these species were identified during the field surveys within the Study Area, despite intensive survey, however given the highly degraded nature the vegetation, it is unlikely that any rare flora would exist on the site itself.

37 species of flora were identified in the Study Area (Appendix A), 25 of these are considered weed species. Poaceae species were dominant in number, however the weeds overtaking the most area were Victorian Tea Tree and Sydney Golden Wattles, which are known highly invasive environmental weeds.

#### **4.4.2. Vegetation Communities**

Finer scale mapping of the broad communities revealed three main vegetation types within the Study Area plus two planted areas to the north of the site. (Map 5). Dominant species at each stratum were identified to determine the different vegetation communities.

The vegetation types are described below using the structural classification of Muir (1977).

- Vegetation Community 1 (3,556 m<sup>2</sup>) (Figure 2) – Low Woodland of *Eucalyptus rudis* (Flooded Gum) over Tall Shrubland of *Acacia longifolia*\* (Sydney Golden Wattle) and *Leptospermum laevigatum*\* (Victorian Tea Tree) over Open shrubland of *Viminaria juncea*, over scattered sedgeland of *Juncus pallidus*, over grassland of *Avena barbata*\*, *Ehrharta calycina*\*, *Eragrostis curvula*\* over dense areas of *Lotus subbiflorus*\*. Other species present in this section include *Melaleuca raphiophylla*, *Hypochaeris spp*, and *Lupinus cosentinii*\*. The area is dominated with introduced plant species including a significant number of highly invasive Environmental Weeds. Note that the *E. rudis* species present within all of the site, is the standard variety and not the larger fruited *cratyantha* sub species.
- Vegetation Community 2 (243 m<sup>2</sup>) (Figure 3) – Low Woodland of *Eucalyptus rudis* (Flooded Gum) over Tall Shrubland of *Acacia longifolia*\* (Sydney Golden Wattle) and *Leptospermum laevigatum*\* (Victorian Tea Tree) over Closed Sedgeland of *Juncus pallidus*. Other species present include *Lepidosperma squamatum*, *Briza maxima*\*, *Desmocladius fasciculatus*, *Arctotheca calendula*\* and *Monadenia bracteata*\*. Apart from the few *E. rudis* and pale rushes, the area's mid and understory is dominated by introduced weed species.

- Vegetation Community 3 (1,309 m<sup>2</sup>) (Figures 4) – Tall Open Scrub of *Kunzia ericifolia* and *Jacksonia furcellata* over grassland to closed grassland of *Briza species*, *Avena barbata*\*, *Ehrharta calycina*\*, *Eragrostis curvula*\* and *Lotus subbiflorus*\*.
- Vegetation Community 4 (660 m<sup>2</sup>) (Figure 5) – this is an area near the existing house where mixed plantings of Eucalypt species have been established along with a few native trees. It is described as Low Open Woodland of *Corymbia calophylla*, *E. rudis* and planted ornamental eucalypts (for example *E. maculata*) over weedy grassland of *Avena barbata*\*, *Ehrharta calycina*\*, *Eragrostis curvula*\* and *Pennisetum clandestinum*\*.
- Vegetation Community 5 is a very small row (115 m<sup>2</sup>) of mixed plantings among native regrowth on the northern border fence line. It is described as Shrubland of *Kunzia ericifolia* and *Acacia saligna*, with some ornamental *Melaleuca* varieties planted, over closed grassland of *Avena barbata*\*, *Ehrharta calycina*\*, *Eragrostis curvula*\* and large areas of *Lotus subbiflorus*\*.

Note the individual trees next to the existing house were not categorised as a vegetation community as they comprised individual trees.

Utilising the scale of condition developed by Keighery (1994, Table 3), all the areas with native vegetation would be considered as Degraded while the cleared areas would be classified as Completely Degraded (Map 6). This classification is reached due to the significant domination of highly invasive Environmental Weeds particularly Victorian Tea Tree and Sydney Wattle and the lack of any representative level of local native species in the lower strata of the vegetation. The cleared areas are dominated by introduced annual and perennial grass weed species.

The DPaW database showed that the buffer zone for the Priority 1 level, Priority Ecological Community (PEC) Subtropical and Temperate Coastal Saltmarsh, extends over the site (Map 7). The Environmental Protection and Biodiversity Conservation Act 1999 Conservation Advice for this ecological community, states that for Western Australia, the following major vegetation units generally corresponded the Coastal Saltmarsh Ecological Community:

- Samphire shrublands dominated by *Tecticornia* species or *Sarcocornia* saltmarsh complex
- Grasslands dominated by *Sporobolus virginicus*;
- Sedgelands dominated by *Boloboschoenus caldwellii* or *Gahnia trifida*;

- Rushlands dominated by *Juncus kraussii*; and
- Herblands dominated by *Wilsonia humilis*/*W. backhousei* with *Frankenia* spp. and *Triglochin striata* or *Samolus repens*.

None of these species were present in the site, and most of the genera are not present within the site. The soil and surrounding elements are not consistent with those of this PEC. Given this, it is not considered that the PEC Subtropical and Temperate Coastal Saltmarsh exists within the Study Area.

**Table 3: Keighery Condition Scale.**

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

(Keighery. 1994).

## 5. Fauna

### 5.1. Objectives

The objective of this survey was to identify significant fauna or signs of significant fauna, including Black Cockatoo species, within the property.

### 5.2. Methodology

A desktop study and analysis of the records of DPAW and the WA Museum (Nature Map) were made to determine the presence or likely presence of fauna or faunal assemblages at the property. The analysis primarily targeted threatened vertebrate species listed under the Environmental Protection and Biodiversity Conservation Act 1999 (Cwth), (EPBC Act) and the Western Australian Wildlife Conservation Act (WA) 1950 (WC Act).

With these species in mind, a field study of the site was conducted. The approach adopted for this survey was:

- A LandSat Satellite Image of the property was acquired from Landgate (previously Department of Land Information).
- A day time visual inspection of the property and adjoining vegetation for any signs of fauna (e.g. scats, diggings, dreys, nests, burrows, feeding signs) was conducted.
- Hollow bearing trees or trees suitable for black cockatoos were recorded.
- Direct observations of fauna and signs of fauna were recorded using a Trimble GPS and Arcpad © (Version 9 ESRI, 2013).
- A single night time spotlight surveys to determine fauna activity. A 40 w LightForce hand-held spotlight was used with white light. Observations were recorded using GPS and ArcPad ©.
- A single pre-dawn and sunset survey was conducted to determine Black Cockatoo activity.
- Field observations were analysed and mapped with ArcGis (ArcMap V10.3 ©).

This type of survey has minimal impact on the fauna within the property and provides sufficient data on the presence and relative abundance and distribution of taxa. During the field surveys, the habitat at the site was assessed to determine its potential suitability to host any of the anticipated threatened or rare species. This approach is consistent with a Level 1 survey under the EPA's Guideline No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (2004) which

specifies a minimum requirement of a background research or desktop study to gather information on the subject site and a reconnaissance survey to verify the accuracy of the background study and delineate fauna and faunal assemblages.

The survey's protocol is also consistent with the requirements outlined in the Development Planning Guidelines for Western Ringtail Possums (CALM 2003, now DPAW).

Guidelines for the three black cockatoo species (Department of Sustainability, Environment, Water, Populations and Communities, 2011) outline requirements for appropriate level of surveys for these species. This survey's intensity and design comply with these guidelines.

### **5.3. Fauna**

#### **5.3.1. Conservation Significant Fauna**

The conservation status of fauna within Western Australia is determined by criteria outlined within two acts of legislation: the Environmental Protection and Biodiversity Conservation Act 1999 (Cwth), (EPBC Act) and the State-based Western Australian Wildlife Conservation Act (WA) 1950 (WC Act).

Under Section 179 of the EPBC Act, fauna may be listed in one of the following categories (in decreasing degree of threat of extinction):

- Extinct;
- Extinct in the wild;
- Critically Endangered;
- Endangered;
- Vulnerable; and
- Conservation Dependant.

These categories are consistent with the International Union for Conservation of Nature (IUCN) classifications and therefore link into a global ranking system for taxa at risk of extinction.

The WC Act also uses these categories, but uses a set of schedules to define extinction risk (Table 4).

**Table 4: Conservation Categories in the Wildlife Conservation Act (WA) 1950.**

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

The Department of Parks and Wildlife also produce a supplementary list of possible threatened species that do not meet the criteria for listing in the above categories. These species are not considered threatened under the WC Act, but due to a lack of knowledge or where species are poorly represented in conservation reserves, some concern for their long term survival exists. Table 5 shows the priority classifications.

**Table 5: Priority Classifications used in WA.**

Category	Code	Description
<b>Priority 1</b>	P1	Taxa with a few, poorly known populations on lands not managed for conservation (e.g. agricultural lands, urban areas etc.).
<b>Priority 2</b>	P2	Taxa with few, poorly known populations on conservation lands (e.g. national parks, nature reserves etc.).
<b>Priority 3</b>	P3	Taxa with several, poorly known populations, some on conservation lands, but where known threats could affect them.
<b>Priority 4</b>	P4	Rare, near threatened and other species in need of monitoring.
<b>Priority 5</b>	P5	Conservation Dependant species: species that are not threatened, but are subject to a specific conservation project that if stopped, would result in the species becoming extinct within 5 years.



The EPBC Act also requires the compilation of a list of migratory species that are recognised under international treaties including the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA), and the Bonn Convention (The Convention on the conservation of Migratory Species of Wild Animals). Species listed under JAMBA are also protected under Schedule 3 of the WC Act.

The conservation status of all vertebrate species listed as occurring within, near or likely to occur within the property, were assessed using the most recent lists of the relevant legislation and DPAW priority lists (current as at 6/12/2014).

### 5.3.2. Expected Fauna

A list of fauna expected to occur within a 10 km radius of the property was compiled from searches conducted on the WA Museum database and DPAW fauna database (Nature Maps), the Department of Environment (DoE) websites, Commonwealth EPBC database and the Birds Australia Atlas project database.

The results of the native fauna database search for species likely to still be within or utilise the Study Area include:

- *Calyptorhynchus banksii subsp. naso* (Forest Red Tailed Black Cockatoo - Vulnerable (Cwth) & Schedule 1(WA));
- *Calyptorhynchus baudinii* (Baudin's White Tailed Black Cockatoo - Vulnerable (Cwth) & Schedule 1(WA));
- *Calyptorhynchus latirostris* (Carnaby's White Tailed Black Cockatoo - Endangered (Cwth) & Schedule 1(WA));
- *Isodon obesulus subsp. fusciventer* (Southern Brown Bandicoot, Quenda) (P5-WA).

Other species listed that, due to the quality of the remaining habitat, are unlikely to utilise the site are:

- *Calidris ferruginea* (Curlew Sandpiper) –Vulnerable (Cwth) & Schedule 1(WA);
- *Calidris tenuirostris* (Great Knot) - Vulnerable (Cwth) & Schedule 1(WA);
- *Dasyurus geroffroi* (Chuditch) - Vulnerable (Cwth) & Schedule 1(WA);
- *Myrmecobius fasciatus* (Numbat) - Vulnerable (Cwth) & Schedule 1(WA);
- *Numenius madagascariensis* (Eastern Curlew) - Vulnerable (Cwth) & Schedule 1(WA);
- *Setonix brachyurus* (Quokka) – (Vulnerable – Cwth);

Twenty three (23) bird species, protected under international agreements, have been historically found within the 10 radius of the Study Area and still has the potential to utilise the site (Marine Bird species, such as Albatross and Petrels have been excluded as the Study Area does not have habitat for these species). Note that the site is near the Ramsar Listed Peel Harvey Estuary System, which does support a vast number of migratory species.

- *Actitis hypoleucos* (Common Sandpiper);
- *Anous tenuirostris melanuops* (Australian Lesser Noddy)
- *Ardea alba* (White Egret)
- *Ardea ibis* (Cattle Egret)
- *Ardea modesta* (Eastern Great Egret);
- *Apus pacificus* (Fork-tailed Swift)
- *Arenaria interpres* (Ruddy Turnstone);
- *Calidris acuminata* (Sharp-Tailed Sandpiper);
- *Calidris canutus* (Red Knot);
- *Calidris melanotos* (Pectoral Sandpiper);
- *Calidris ruficollis* (Red-necked Stint);
- *Calidris subminuta* (Long-toed Stint);
- *Charadrius leschenalutii* (Greater Sand Plover
- *Haliaeetus leucogaster* (White-bellied Sea-Eagle)
- *Limosa lapponica* (Bar Tailed Godwit);
- *Limosa limosa* (Black- Tailed Godwit);
- *Merops ornatus* (Rainbow Bee-eater)
- *Numenius phaeopus* (Whimbrel)
- *Pluvialis sqatarola* (Grey Plover);
- *Tringa brevipes* (Grey Tailed Tattler);
- *Tringa glareola* (Wood Sandpiper);
- *Tringa nebularia* (Common Greenshank);
- *Tringa stagnatilis* (Marsh Sandpiper).

### **5.3.3. Limitations**

Field surveys were confined to a single day survey with one pre-dawn and one dusk surveys for black cockatoos and a single night survey for other fauna. No seasonal survey work was conducted. The night surveys were conducted with a single operator utilising a head torch and a hand-held spotlight, therefore it is likely that not all animals potentially present were observed.

The site was traversed by foot in a systematic way, however it was not possible to examine every tree for evidence of fauna, and therefore the listing of foraging evidence found will only present a subset of the actual evidence that is present for the site.

All large trees of suitable size were examined from the ground for the presence of hollows. It should be noted however, that all of the prerequisites that determine the suitability of a hollow for use by cockatoos are difficult to assess. In addition to entrance size, the depth, floor and orientation of the hollow are important factors. The presence of suitable hollows, even in breeding areas, does not make them available for breeding as hollows must be spatial, structurally and temporally correct (Johnstone and Johnston, 2004). The listing of potential nesting hollows is therefore likely to be an over estimation of those actually suitable.

#### **5.4. Results**

The day survey was conducted on 30<sup>th</sup> October 2014 by Gary McMahon (B.Sc, M. Env Mgmt) from Ecosystem Solutions.

The site was traversed on foot, in a systematic fashion to cover all the vegetation and areas suitable for habitat.

No signs of any animals were observed during any of the field survey events.

All trees with large hollows were inspected for any signs of use by cockatoos. These include wear around the hollow, chewing, scarring and scratch marks on the trunks or branches. All hollow assessments were conducted from ground level, with the suitability for use by black cockatoos based on the size of the hollows entrance. Hollows that appeared large enough to allow the entry of a cockatoo were recorded as a potential nest site. Hollows with an entrance of less than about 12 cm in diameter were considered unsuitable for cockatoos.

Old or recent evidence of cockatoo's feeding or roosting sites (feathers, droppings etc.) were also searched for.

Six trees were found that had a diameter in excess of 550 mm or had potential hollows that meet the criteria. These are listed in Table 6. Height was determined using a Sunto Clinometer and the Diameter at Breast Height (DBH) and other elements were directly measured and recorded. Their location is shown in Map 8.

**Table 6: Fauna or Fauna Sign (including Hollow Bearing Trees) on the site (Map 8).**

No	SPECIES	HEIGHT (m)	DBH (mm)	CANOPY (m)	STRUCTURE	LOCATION	HOLLOW	STATUS
1	<i>E. rudis</i>	9	1340	14	Multi stemmed	Isolated	None Obvious	Healthy
2	<i>E. rudis</i>	13	1330	14	Multi stemmed	<10 Trees	None Obvious	Healthy
3	<i>E. rudis</i>	17	1060	12	Multi stemmed	<10 Trees	None Obvious	Healthy
4	<i>E. rudis</i>	8	1310	6	Multi stemmed	<10 Trees	None Obvious	Healthy
5	<i>E. rudis</i>	21	720	18	Multi stemmed	<10 Trees	None Obvious	Healthy
6	<i>E. rudis</i>	17	1320	20	Multi stemmed	<10 Trees	None Obvious	Healthy

The nocturnal survey was conducted on 5<sup>th</sup> December 2014 from 5.30 pm to 8.50 pm. This included a pre-dusk and dusk survey for any sign of black cockatoos. Official sunset time was 6.46 pm with dusk (last light) at 7.12 pm. The night was fine and clear, with a temperature of approximately 17°C during the survey and a Relative Humidity (RH) of 61 % and a slight SW breeze of less than 5 km/h.

The site was traversed by foot in a systematic plan to cover the area thoroughly.

No black cockatoos were seen or heard during the dusk observations and no animals of significance were observed during the spotlighting survey. The only animals observed were European Rabbits (*Oryctolagus cuniculus*).

The pre-dawn survey for Black Cockatoo activity occurred on 6<sup>th</sup> December 2014 from 4.10 am til 6.25 am. The temperature was 16°C, the wind was slight from the Sw and the RH was 54 %. Dawn (first light) was at 4.47 am and Sunrise was at 5.14 am.

No birds were seen or heard on or near the property.

## 5.5. Discussion

The vegetation of the Study Area consist primarily of *Eucalyptus rudis* with some *Corymbia calophylla* trees species with a Victorian Tea Tree and Sydney Wattle mid strata and mixed annual grass ground layer. The quality of the habitat is very poor. Given the high degree of degradation of the vegetation, dearth of species present and the density of highly invasive environmental and grassy weed species, it would be anticipated that the habitat value of the Study area would be considered marginal to poor.

Six trees had girths large enough to potentially develop hollows were identified and measured during the survey (Map 8).

No black cockatoos were seen or heard during any of the surveys. There were no signs of feeding or feathers within the Study Area. This is probably due to the site having minimal Marri trees, which is a preferred food source for the animals. Better quality food and roosting sites exist to the north and east of the site. The Study Area does not appear to contain any nesting or frequently used roosting site for black cockatoos.

Other animals of significance were not observed, either directly or through signs, during the survey of the subject site. The lack of this data should not be taken directly as an indication that the species is absent from the site. No trapping or seasonal sampling was conducted. Table 5 summarises their likely presence based on habitat availability and the potential impact of the development on them within the subject site.

**Table 7: Other Significant Fauna Likelihood and Impact**

<b>Species</b>	<b>Potential impact in site</b>
<b>Baudin's White Tailed Black Cockatoo</b>	No nest hollows are being used and minimal foraging habitat is present in the site. No impact is anticipated.
<b>Carnaby's White Tailed Black Cockatoo</b>	No nest hollows are being used and minimal foraging habitat is present in the site. No impact is anticipated.
<b>Forest Red Tailed Black Cockatoo</b>	No nest hollows are used and minimal foraging habitat is present in the site. No impact is anticipated.
<b>Chuditch</b>	Given large home range required and minimal vegetation on site. It is unlikely that the species frequents the site. No impact is anticipated.
<b>Quenda</b>	No diggings were found. Given lack of suitable habitat and any signs of activity the impact on this species in this stage of the development would be none.
<b>Quokka</b>	The species is unlikely to utilise or visit the site due to lack of suitable habitat. No impact is anticipated.
<b>Curlew Sandpiper</b>	The species is unlikely to utilise or visit the site due to lack of suitable habitat. No impact is anticipated.
<b>Great Knot</b>	The species is unlikely to utilise or visit the site due to lack of suitable habitat. No impact is anticipated.
<b>Eastern Curlew</b>	The species is unlikely to utilise or visit the site due to lack of suitable habitat. No impact is anticipated.
<b>Numbat</b>	Given large home range required and minimal vegetation on site. It is highly unlikely that the species frequents the site. No impact is anticipated.

None of the bird species protected under international agreements were seen during the surveys. The degraded nature of the site would result in the area within it as unsuitable habitat for breeding for these species and it is highly unlikely that they would be occasional opportunistic visitors to the site.

## 6. Significance

Under the EPBC Act, an action that has, will have, or is likely to have, a significant impact on a matter of national environmental significance, requires approval from the Minister. A significant impact is defined as an impact which is important or of consequence, having regard for its context or intensity (Commonwealth of Australia, 2009).

Matters of environmental significance are:

- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Ramsar wetlands of international importance
- The Commonwealth marine environment
- World Heritage properties
- National Heritage places
- Great Barrier Reef Marine Park, and
- Nuclear actions.

For this development, there are no matters of environmental significance within the Study Area.

Referral guidelines for three threatened black cockatoos species (Commonwealth of Australia, 2011) uses a decision tree and a set of criteria to determine whether actions significantly impact on black cockatoos. These are set out below based on the details of the development and the data obtained from the surveys. Notes on the flow chart follow.

Question	Answer
1. Could the impacts of your action occur within the modelled distribution of the black cockatoos?	Yes – Action occurs within the distribution area of all three species.
2. Could the impacts of your action affect any black cockatoo habitat or individuals?	Unlikely. No signs of animal utilisation of the site was found.
3. Have you surveyed for black cockatoos using the recommended methods?	Yes
4. Could your actions have an impact on black cockatoos or their habitats?	No. No signs of animal activity was found within the site.
5. Is your impact mitigation best practice so that it may reduce the significance of your impacts on black cockatoos?	No significant impact is anticipated due to lack of evidence of activity on site.
6. Could your action require a referral to the federal environmental Minister for significant impact on black cockatoos?	No as there are no signs of any of the three species present within or adjoining the Study Area. It is unlikely that the species is dependent on the site.

<p><b>High Risk of Significance – Referral Recommended</b></p> <ul style="list-style-type: none"> <li>• Clearing of any known nesting tree</li> <li>• Clearing of any part or degradation of breeding habitat</li> <li>• Clearing more than 1ha of quality foraging habitat</li> <li>• Creating a gap of greater than 4 km between patches of habitat</li> <li>• Clearing or degradation of known roosting site.</li> </ul>
<p><b>Uncertainty – Referral Recommended or contact Department</b></p> <ul style="list-style-type: none"> <li>• Degradation of more than 1 ha of foraging habitat.</li> <li>• Clearing or disturbance in areas surrounding habitat that has the potential to degrade through introduction of threats.</li> <li>• Actions that do not directly affect species but have potential to introduce indirect impacts.</li> <li>• Actions with potential to introduce known plant diseases.</li> </ul>
<p><b>Low risk of significant impacts – referral may not be required.</b></p> <ul style="list-style-type: none"> <li>• Actions that do not affect black cockatoo habitat or individuals</li> <li>• Actions whose impact occurs outside modelled distribution.</li> </ul>



The summary of these responses are:

- 1- The development is within the area of modelled distribution of black cockatoo species.
- 2- The proposed actions will not impact black cockatoo individuals or habitat.
- 3- The site has been surveyed using the recommended methods from the guideline.
- 4- It is unlikely that any actions will impact on any animals or habitat as no evidence of use or visitation by the specie were found on site.
- 5- No evidence on site of utilisation and the highly unlikely presence of any of the three species of black cockatoos would mean that no mitigation measures are required.
- 6- Using the flow chart and criteria it is determined that there is a low risk of actions resulting in an impact upon black cockatoos within the subject site.

It is recommended that a referral pursuant to the EPBC Act is not required for the components of the development within the subject site as actions involved do not constitute a significant impact on any of the threatened species present.

## 7. Summary and Recommendations

Based on the results of the analysis of site, the following conclusions and recommendations are made.

- No rare or priority flora was found on the site.
- The vegetation that remains is classified as Degraded with very high densities of identified environmental weed species. A number of the large flooded gums on site are earmarked to be retained within the future development.
- A significant majority of plant species found on the site are weed species.
- No Ecological Communities of significance were found within the Study Area.
- Six trees with a DBH over 550mm with a potential for suitable habitat for black cockatoos were found, however no signs of nesting, roosting, socialising or feeding were found.
- Black cockatoo species are highly mobile and may utilise the site opportunistically as a feeding site within their range although their preferred food source is not dominant in the remaining vegetation. The species would not presently be relying on the site for habitat.
- No animals of significance were observed, either directly or by signs of their utilisation of the site. Given the degraded nature of the site, it is highly unlikely that any of the significant fauna within a 10 km radius of the site, would be utilising the site.
- The area marked as Environmentally Sensitive, is within the area of high weed infestation and ecological degradation. While a number of *E. rudis* trees are present over the site, there are no elements within the Study Area that would indicate that there significant values to warrant this demarcation. It is therefore assumed that this area of overlap is the result of the sites proximity to the Serpentine River, not from any explicit values known on the site. The development proposed would not adversely impact on the values of the River as there is a 270 m separation buffer between the Site and the river itself.
- Using the criteria outlined by the Commonwealth, the actions within this development do not constitute as having a significant impact on threatened species and as such referral under the EPBC Act is not required.

## 8. Figures



Figure 1: Proposed Development



Figure 2: Vegetation Community 1 – Note Victorian Tea Tree and Sydney Wattle.



**Figure 3: Vegetation Community 2**



**Figure 4: Vegetation Community 3, northern section/**



**Figure 5: Vegetation Community 4, mainly planted eucalypts.**

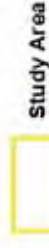




## Map 2 Site Details

Site	Lot 601 Old Pinjarra Rd Greenfields
Project	Significance Survey and Analysis
Client	Rivergreen Pty Ltd
Scale	1: 750

## Legend



Study Area



Contours (m AHD)



Environmentally Sensitive Area (DER)



Prepared by Gary McMahon  
 Ecosystem Solutions  
 December 2014  
 Projection - MGA50  
 Datum - GDA94

NOTE: This drawing is not to scale and has not been derived from survey.





**Map 3** Soil Landscapes

Site	Lot 601 Old Pinjarra Rd Greenfields
Project	Significance Survey and Analysis
Client	Rivergreen Pty Ltd
Scale	1: 750

**Legend**

-  Study Area
- Soil Landscapes**
-  211Sp\_\_S4a
-  211Va\_\_V1



Prepared by Gary McMahon  
 Ecosystem Solutions  
 December 2014  
 Projection - MGA50  
 Datum - GDA94  
 NOTE: This drawing is not to scale and has not been derived from survey.



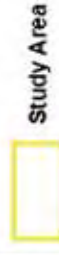




**Map 4**      **Vegetation Types**

Site	Lot 601 Old Pinjarra Rd Greenfields
Project	Significance Survey and Analysis
Client	Rivergreen Pty Ltd
Scale	1: 750

## Legend



Study Area

Vegetation Types (Heddlie, et al)



Vasse Complex



Bassendean Complex-Central And South



Yoongarillup Complex



Prepared by Gary McMahon  
Ecosystem Solutions  
December 2014  
Projection - MGA50  
Datum - GDA94

NOTE: This drawing is not to scale and has not been derived from survey.





**Map 5**      **Vegetation Communities (Mapped)**

Site	Lot 601 Old Pinjarra Rd Greenfields
Project	Significance Survey and Analysis
Client	Rivergreen Pty Ltd
Scale	1: 750

### Legend

- Study Area
- Vegetation Communities Mapped**
- 1
- 2
- 3
- 4
- 6



Prepared by Gary McMahon  
 Ecosystem Solutions  
 December 2014  
 Projection - MGA50  
 Datum - GDA94  
 NOTE: This drawing is not to scale and has not been derived from survey.





**Map 6**      **Vegetation Condition**

Site	Lot 601 Old Pinjarra Rd Greenfields
Project	Significance Survey and Analysis
Client	Rivergreen Pty Ltd
Scale	1: 750

# Legend

 Boundary

## Vegetation Condition

 Completely Degraded

 Degraded



Prepared by Gary McMahon  
Ecosystem Solutions  
December 2014  
Projection - MGA50  
Datum - GDA94  
NOTE: This drawing is not to scale and has not been derived from survey.








**Map 7**      **TEC/PEC Buffer Sites**

Site	Lot 601 Old Pinjarra Rd Greenfields
Project	Significance Survey and Analysis
Client	Rivergreen Pty Ltd
Scale	1: 750

**Legend**

-  Boundary
-  PEC Buffer Areas (DPaW)
-  Subtropical and Temperate Coastal Saltmarsh



Prepared by Gary McMahon  
 Ecosystem Solutions  
 December 2014  
 Projection - MGA50  
 Datum - GDA94  
 NOTE: This drawing is not to scale and has not been derived from survey.

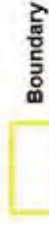




**Map 8** Potential Hollow Bearing Trees

Site	Lot 601 Old Pinjarra Rd Greenfields
Project	Significance Survey and Analysis
Client	Rivergreen Pty Ltd
Scale	1: 750

## Legend



Boundary

### Potential Significant Trees



Trees > 550 mm



Prepared by Gary McMahon  
 Ecosystem Solutions  
 December 2014  
 Projection - MGA50  
 Datum - GDA94

NOTE: This drawing is not to scale and has not been derived from survey.



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## Appendices

### Appendix A: Vascular Plants found in the Study Area

FAMILY NAME	LATIN NAME	COMMON NAME
<b>Arecaceae</b>	* <i>Washingtonia filifera</i>	Cotton Palm
<b>Asparagaceae</b>	<i>Sowerbaea laxiflora</i>	Purple Tassels
<b>Asteraceae</b>	* <i>Arctotheca calendula</i>	Capeweed
	* <i>Hypochaeris glabra</i>	Smooth Catsear
	* <i>Hypochaeris radica</i>	Flatweed
<b>Cyperaceae</b>	* <i>Cyperus congestus</i>	Dense Flat Sedge
	<i>Lepidosperma squamatum</i>	
<b>Fabaceae</b>	<i>Jacksonia furcellata</i>	Grey Stinkwood
	* <i>Lotus subbiflorus</i>	
	* <i>Lupinus cosentinii</i>	WA Blue Lupin
	<i>Viminaria juncea</i>	Swishbush
<b>Juncaceae</b>	<i>Juncus pallidus</i>	Pale Rush
<b>Mimosaceae</b>	* <i>Acacia longifolia</i>	Sydney
	<i>Acacia saligna</i>	Golden Wreath Wattle
<b>Myrtaceae</b>	<i>Corymbia calophylla</i>	Marri
	* <i>Eucalyptus maculata</i>	Spotted Gum
	* <i>Eucalyptus citriodora</i>	Lemon Scented Gum
	<i>Eucalyptus rudis</i>	Flooded Gum
	* <i>Eucalyptus spp (ornamental)</i>	
	<i>Kunzea glabrescens</i>	Spearwood
	* <i>Leptospermum laevigatum</i>	Victorian Tea Tree
	<i>Melaleuca raphiophylla</i>	Swamp Paperbark
	* <i>Melaleuca spp (ornamentals)</i>	
<b>Orchidaceae</b>	* <i>Monadenia bracteata</i>	South African Orchid
<b>Poaceae</b>	* <i>Aira caryophyllea</i>	Silvery Hairgrass
	* <i>Avena barbata</i>	Bearded Oats
	* <i>Briza maxima</i>	Blowfly Grass
	* <i>Briza minima</i>	Shivery Grass
	* <i>Bromus diandrus</i>	Great Brome
	* <i>Cynodon dactylon</i>	Couch
	* <i>Ehrharta calycina</i>	Perennial Veldt Grass
	* <i>Eragrostis curvula</i>	African Love Grass
	* <i>Lagurus ovatus</i>	Hare's Tail Grass
	* <i>Pennisetum clandestinum</i>	Kikuyu
<b>Restionaceae</b>	<i>Desmocladus fasciculatus</i>	
<b>Solanaceae</b>	* <i>Solanum nigrum</i>	Blackberry Nightshade

\* denotes Weed or Introduced Species.

**APPENDIX 3**

Geotechnical Report and Acid Sulfate Soils Study

Prepared by Galt Geotechnics

August 2014

**Report on**  
DUE DILIGENCE LEVEL  
GEOTECHNICAL AND ACID SULFATE SOILS STUDY  
PROPOSED RESIDENTIAL DEVELOPMENT  
LOT 601 OLD PINJARRA ROAD  
GREENFIELDS

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**TABLES (ATTACHED)**

Table A1: Summary of Acid Sulfate Soils Testing

**FIGURES**

Figure 1: Site and Location Plan

**APPENDICES**

APPENDIX A:	SITE PHOTOGRAPHS
APPENDIX B:	TEST PIT REPORTS
APPENDIX C:	SUMMARY HAND AUGER BOREHOLE REPORTS
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## 1. INTRODUCTION

This report presents the outcomes of Galt Geotechnics Pty Ltd (Galt's) geotechnical and acid sulfate soils (ASS) study for the proposed residential development at Lot 601 Old Pinjarra Road, Greenfields ("the site"). The location of the site relative to the surrounding area is shown on Figure 1, Site and Location Plan.

The investigation was requested by Rohan Vaughan of Property Edge WA and authorised in a Client Authorisation Form dated 18 July 2014 signed by Mike Kelly on behalf of Property Edge WA.

## 2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Based on the supplied information, the site is predominantly undeveloped and is roughly rectangular (140 m by 110 m) in plan. A residence and associated outbuildings are present in the northwest part of the site.

The northern half of the site is mostly clear whereas the southern half of the site is covered with medium dense to dense tree growth. Published information shows that the site is relatively flat, with surface elevations varying from about RL 4 m AHD in the northwest corner, to about RL 1.5 m AHD in the south east corner.

We understand that the site is being considered for purchase to develop as a residential subdivision. The investigation has been scoped to provide a broad appreciation of the site and to assess whether there are any geotechnical and environmental aspects to the site that may impact adversely on development of the site.

## 3. PROJECT OBJECTIVES

Based on our experience with similar developments, we consider the objectives of the study are to:

- ✦ broadly assess subsurface soil and groundwater conditions across the site;
- ✦ provide a preliminary site classification(s) in accordance with AS 2870-2011 "Residential Slabs and Footings";
- ✦ recommend preliminary site preparation procedures that may be necessary to amend the site classification;
- ✦ assess the permeability of the soils at the site for potential on-site disposal of stormwater by infiltration (including requirements to raise the site level to achieve stormwater disposal, if necessary); and
- ✦ broadly assess the nature and extent of ASS (if any) within the site and assess the need or otherwise for further studies.

## 4. FIELDWORK

Fieldwork was carried out on 22 July 2014 and comprised:

- ✦ excavation of test pits at 7 locations (TP01 to TP07), extending to depths of between 1.0 m and 2.3 m;
- ✦ collection of soil samples at 0.25 m intervals until the termination of the test pit;
- ✦ field testing ( $\text{pH}_f$  and  $\text{pH}_{f_{ox}}$ ) of all soil samples for preliminary ASS screening;
- ✦ testing with a Perth sand penetrometer (PSP) adjacent to each test pit location, extending to a depth of 0.9 m in each instance;
- ✦ drilling of hand auger boreholes at 4 locations (HA01 to HA04), extending to depths of between 1.3 m and 2.0 m; and
- ✦ infiltration tests using the 'inverse auger hole' technique at 2 locations (HA01 and HA02), at depths of between 0.54 m and 0.56 m.

## General

A geotechnical engineer and an environmental scientist from Galt located the test positions, observed the test pitting, drilled the hand auger boreholes, logged the materials encountered in the test pits and boreholes, and performed the infiltration and penetrometer testing.

The test locations are shown on Figure 1, Site and Location Plan and details are summarised in Table 1, Summary of Tests. Photographs of the site are presented in Appendix A, Site Photographs.

**Table 1: Summary of Tests**

Test Names	Test Depth (m)	Depth to Groundwater (m)	Reason for Termination	Stratigraphy
TP01	2.2	1.1	Collapse	SAND
TP02	1.0	CND <sup>3</sup>	Refusal on pipe	SAND
TP03	2.3	GNE <sup>4</sup>	Collapse	FILL: SAND overlying SAND
TP04	2.0	0.7	Collapse	SAND
TP05	2.0	0.6	Collapse	SAND
TP06	2.0	0.6	Collapse	SAND
TP07	1.8	0.7	Collapse	SAND
HA01	1.7	CND	Presence of groundwater	SAND
HA02	2.0	GNE	Target depth	FILL: SAND overlying SAND
HA03	1.3	CND	Presence of groundwater	SAND
HA04	1.8	CND	Presence of groundwater	FILL: SAND overlying SAND

### **Notes**

1. All of the test pits were terminated prior to target depth generally due to collapse of the test pit walls.
2. A slight sulfidic odour was noted within 3 of the test pits.
3. CND: Could not be determined due to collapse of hole
4. GNE: groundwater not encountered

## Test Pits

Test pits were excavated using a 7 tonne John Deere 310D backhoe fitted with a 600 mm wide toothed bucket. The excavator was supplied and operated by Eddie's Backhoe Hire.

Test pit reports are presented in Appendix B, Test Pit Reports, along with a method of soil description and cementation classification, and a list of explanatory notes and abbreviations used on the reports. A photograph of each test pit excavation is included with each of the test pit reports.

## Boreholes

Boreholes were hand-augered using an 80 mm diameter auger. Borehole reports are included in Appendix C, Summary Hand Auger Borehole Reports, along with the method of soil description used on the reports.

## Perth Sand Penetrometer Testing

PSP tests were carried out adjacent to each test pit. Results of the PSP testing are presented in Table 2: PSP Test Results. The tests were conducted in accordance with test method AS 1289 6.3.3, although to a greater depth than the 0.45 m given by the standard.



**Table 2: PSP Test Results**

Depth (m)	Test Number/Blows per 0.15 m Penetration										
	TP01	TP02	TP03	TP04	TP05	TP06	TP07	HA01	HA02	HA03	HA04
0.0 – 0.15	-	-	-	-	-	-	-	-	-	-	-
0.15 – 0.3	3	2	1	3	2	2	2	2	2	2	3
0.3 – 0.45	4	3	3	2	3	2	3	2	3	1	5
0.45 – 0.6	4	2	2	2	3	3	3	3	6	2	6
0.6 – 0.75	4	3	2	3	3	3	3	3	8	1	8
0.75 – 0.9	5	2	3	3	3	3	3	3	7	2	7

### **Permeability Testing**

The permeability testing was undertaken using the inverse auger hole method described by Cocks<sup>1</sup>. The results of the permeability testing are presented in Appendix D, Permeability Test Results, and the results are summarised in Table 3: Summary of Permeability Test Results.

**Table 3: Summary of Permeability Test Results**

Test No.	Soil Description	Test Depth (m)	Minimum Unsaturated Permeability, k (m/day)		
			Test 1	Test 2	Test 3
HA01	SAND	0.56	19.5	13.2	11.7
HA02	FILL: SAND	0.54	5.8	4.3	4.3

**Note:** The minimum unsaturated permeabilities shown are typically recorded towards the end of the test, with pressure head varying between about 0.1 m and 0.24 m

## **5. ASS LABORATORY TESTING**

### **5.1 Field Testing**

Soil samples for the ASS assessment were collected in accordance with the following Australian Standards and guidelines:

- AS 4482.1 (2005) *Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil Part I Non Volatile and Semi Volatile Compounds.*
- DEC (2013) *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes.*
- DEC (2011) *Treatment and Management of Soil and Water in Acid Sulfate Soils Landscapes.*

Samples for ASS field testing were collected using dedicated nitrile gloves and placed in laboratory-supplied plastic clip lock sample bags. The plastic clip lock sample bags were placed in an ice chilled cooler until field testing (pH<sub>F</sub> and pH<sub>FOX</sub>) was conducted.

Selected recovered samples down the profile of test pits were tested for pH before (pH<sub>F</sub>) and after (pH<sub>FOX</sub>) rapid oxidation with hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>). The field tests were undertaken to provide an indication of soil types likely to have the potential to generate acidity as a result of oxidation during earthworks.

Generally, field pH values (pH<sub>F</sub>) of <3 to 4 indicate the presence of actual acid sulfate soil (AASS), thus indicating acids in the soil profile have oxidised.

<sup>1</sup> Cocks, G (2007), "Disposal of Stormwater Runoff by Soakage in Perth Western Australia", Journal and News of the Australian Geomechanics Society, Volume 42 No. 3, pp 101-114

Unoxidised acids or potential acid sulfate soils (PASS) are potentially present if:

- ✦ a strong reaction with hydrogen peroxide is observed;
- ✦ the  $pH_{FOX}$  is at least 1 pH unit below  $pH_F$ ; or
- ✦ the  $pH_{FOX}$  is <3 to 4 and one or both of the above conditions apply.

The test results are presented in Table A1 at the end of the text of this report.

## 5.2 Confirmatory Testing

Confirmatory laboratory analysis was undertaken on selected ASS samples using the suspended peroxide oxidation and combined acidity sulfur (SPOCAS) method. The selection of samples for laboratory analysis was based on the results of field tests and was conducted to provide laboratory information on all strata types encountered at the site.

Laboratory test results along with the test methods followed are included in Appendix E and are summarised in Table A1 at the end of the text. The results are discussed in Section 8.3.

## 6. SITE CONDITIONS

### 6.1 Geology

The Pinjarra sheet of the 1:50,000 scale Urban Geology series map indicates that the site is underlain by “Tamala (Coastal) Limestone: predominantly sand”.

The findings of our investigation show that the site is underlain by sand.

### 6.2 Subsurface Conditions

Based on the materials encountered within the test pits and hand auger boreholes, the soils appear to be relatively consistent across the site and general site conditions can be summarised as comprising:

- ✦ SAND (SP), fine to coarse grained, sub-angular to sub-rounded, grey at surface, becoming white, locally pale brown, localised trace organic fines/rootlets/roots (up to 50 mm) in top 150 mm to 300 mm, generally loose to medium dense, moist to wet, present from surface down to the maximum depth of investigation of 2.3 m.

A variation to the generalised subsurface conditions was noted in a small area towards the northwest corner of the site (which is at a higher elevation than the rest of the site). The soils encountered here comprised:

- ✦ FILL: SAND, fine to coarse grained, yellow/brown, trace organic fines/rootlets near surface, loose, moist, locally present from the surface, extending from the ground surface to a depth of between 0.5 m and 0.7 m; overlying
- ✦ SAND, fine to coarse grained, yellow, loose to medium dense, moist to dry, extending to the maximum depth of investigation of 2.3 m.

An asbestos pipe about 150 mm in outside diameter was encountered within TP02 towards the northeast corner of the site at a depth of 1.2 m. Correspondence with the current occupier of the residence (Roy), indicated that the pipe was used to dispose stormwater from residential developments to the north of the site onto the lot to the east.

We cannot verify the accuracy of the function of the pipe, nor the direction that the pipe is draining. Notwithstanding the function, the extent, alignment and depth of the pipe will need to be established to assess if the pipe needs to be removed / replaced. Additionally, since the pipe is below the current ground water level (observed to be between

0.5 m and 1.1 m below current ground level across the majority of the site), removal of the pipe would require dewatering in the vicinity of the pipe, as well as the implementation of a Dewatering and Acid Sulfate Soils Management Plan. Removal of the pipe and remediation of the trench is therefore likely to be an expensive exercise.

### 6.3 Groundwater

The site is outside the coverage of the Perth Groundwater Atlas (1997). However, the site is relatively low lying and within about 250 m of the Serpentine River. We therefore expect groundwater to be at or close to the level of the river and close to the ground surface in the lower parts of the site. Publicly available mapping shows that the southern half of the site is within the floodplain of the Serpentine River.

Groundwater was encountered in 6 of the 7 test pits and 3 of the 4 hand augers, at depths of between 0.6 m and 1.1 m. This high groundwater level will have an influence on the development.

### 6.4 Acid Sulfate Soils

The southern portion of the site is located in an area mapped by the Department of Environment Regulation (DER) as having a 'high to moderate risk of acid sulfate soil (ASS) occurrence'. The northern portion of the site is mapped as having 'no known risk of ASS'.

## 7. GEOTECHNICAL ASSESSMENT

### 7.1 Preliminary Site Classification

We consider that the site is geotechnically suitable for the proposed residential development, provided that suitable site preparation measures are undertaken.

We have assessed the site in accordance with AS2870 (2011) "Residential Slabs and Footings". We consider that a site classification of "Class A" is appropriate for the site provided that standard site preparation is undertaken prior to construction.

- NOTES:**
1. The majority of the site in its current state, is classified as "Class P" (due to the seasonally high groundwater). The site will need to be raised using inert granular fill to allow the site classification to be amended to "Class A" in those low lying areas impacted by the high groundwater.
  2. The presence of shallow groundwater may cause difficulty during development of the site, depending on the time of the year that earthworks are conducted and the design finished levels.

### 7.2 Site Preparation

The site preparation measures outlined below are aimed at improvement of the site in preparation for construction of buildings including on-ground slabs and shallow footings, retaining walls and pavements. The preparation measures outlined below will be only be necessary where the construction of structures and pavements are proposed

The following site preparation measures must be followed:

- ✦ Demolish and remove all existing structures from the site.
- ✦ Remove existing vegetation and trees, including the grubbing out of tree roots.
- ✦ Strip the topsoil from the site to expose clean underlying sandy soil (we expect that around 100 mm topsoil strip will be adequate, however all roots must be removed).

- ✦ Remove any building debris and buried items left after demolition of structures including footings, soak wells and services.
- ✦ Shape the exposed surface to the required profile.
- ✦ Moisten and proof compact the *in situ* sandy soil to achieve the required degree of compaction to a minimum depth of 0.45 m (refer to Section ~).
- ✦ Where fill is required to build up levels, use approved fill (refer to Section 7.4), placed and compacted in layers of no greater than 300 mm loose thickness.
- ✦ Excavate footing trenches and compact the exposed bases to achieve the level of compaction specified in Section 7.3 to a depth of at least 0.9 m below all footings.

**Note:** As mentioned earlier, it may be necessary to remove the asbestos cement pipe located towards the eastern boundary of the site. The need or otherwise to remove this pipe is dependent on the function, extent, alignment and depth of the pipe. Once this information is obtained it should be possible to establish if the pipe needs to be removed. In light of this we have not provided site preparation procedures for removal and backfilling of the trench remaining after removal of the pipe. We note that damaged drainage pipes can lead to the formation of sinkholes due to the downward erosion of soil into the pipe over time. In addition, any structures built over the pipe will impose loads that may result in damage of the pipe and consequential settlement of the overlying structure.

### 7.3 Compaction

Approved granular fill must be compacted using suitable compaction equipment to achieve a dry density ratio of at least 95% of maximum modified dry density (MMDD) as determined in accordance with AS 1289 5.2.1.

Where sand is used as fill, a Perth sand penetrometer (PSP) may be used for compaction control. The following minimum PSP blow counts must be met:

- ✦ 150 mm-450 mm: 8
- ✦ 450 mm-750 mm: 10
- ✦ 750 mm-1050 mm: 12

If difficulties are experienced in achieving the required blow count, an on-site PSP calibration should be undertaken to determine the site-specific blow count required to achieve the required dry density ratio.

Over-excavation and replacement of loose materials must be carried out where the minimum density cannot be achieved.

Fill must be placed in horizontal layers of not greater than 0.3 m loose thickness. Each layer must be compacted by suitable compaction equipment, and carefully controlled to ensure even compaction over the full area and depth of each layer.

#### TESTING

After compaction, verify that the required level of compaction has been achieved by testing within any fill and to a minimum depth of 0.9 m below foundations:

- ✦ on each lift of fill at the rate of 1 test per 500 m<sup>3</sup>;
- ✦ at each spread footing location;
- ✦ at 7.5 m centres below on-ground slabs;
- ✦ at 10 m centres along gravity retaining wall footings and strip footings (where present); and
- ✦ at 10 m centres on pavement subgrades (on the road centreline or on a grid below car parks/hardstanding).

## 7.4 Approved Fill

Imported granular fill must comply with the material requirements as stated in AS 3798-2007, "Guidelines on Earthworks for Commercial and Residential Developments".

Generally, the *in situ* sand and sand fill present at the site will be suitable for re-use as inert structural fill. Any organic-rich sand or sand containing significant proportions of fines (material less than 0.075 mm in size) must not be used.

Where doubt exists, a geotechnical engineer must be engaged to inspect and approve the use of potential fill materials.

## 7.5 Stormwater Disposal

The results of the infiltration tests carried out at two locations are included in Appendix D. The minimum measured permeabilities are as follows:

- HA01 – 11.7 m/day; and
- HA02 – 4.3 m/day.

The tests show that the sandy soil at the site is relatively permeable. However, we do not recommend on-site disposal of stormwater over the majority of site (in its current state) due to its relatively low elevation and the shallow depth to groundwater. Notwithstanding, if the elevation was raised to 1.2 m above the average annual maximum groundwater level (AAMGL), disposal by on site infiltration would be acceptable. The Western Australia Local Government Association (WALGA) requirements stipulate a minimum of 1.2 m of clean, free-draining sand to be present above AAMGL if soak wells are to be used. Where these requirements are met (and sand fill is compliant with the requirements of Section 7.4), we consider that the sands at the site are suitable for the disposal of stormwater by infiltration by means of soak wells. We recommend a design value of permeability (k) not greater than 3 m/day for the in-situ sand and sand fill.

## 8. ACID SULFATE SOILS ASSESSMENT

### 8.1 ASS Field Testing Results

Results of field tests and confirmatory laboratory analysis are presented in Table A1 and compared against the applicable guidelines presented in DEC (2013) *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes*. This document provides action criteria based on levels of oxidisable sulfur measured for broad categories of soil types.

The results of the field testing are summarised below:

- Field  $pH_F$  test results for all soil samples ranged from 3.7 (TP04/0.0 and TP05/0.00) to 6.2 (TP02/0.00).
- Field  $pH_{FOX}$  test results were lower, ranging from 0.8 (TP04/1.75) to 5.4 (TP01/0.50 and TP03/0.50).
- Differences between  $pH_F$  and  $pH_{FOX}$  levels in individual soil samples ranged from -0.3 (TP05/0.75 and TP06/0.50) to 4.0 (TP04/1.75).
- During oxidation, of the 58 samples field tested, 54 samples displayed a low reaction rate, 1 sample displayed a medium reaction rate, 1 sample displayed a high reaction rate, 1 sample displayed an extreme reaction rate and 1 sample displayed a volcanic reaction rate.

## 8.2 ASS Analysis

The results of the acid sulfate soil analysis using SPOCAS methods are presented in Table A1 and are discussed below. Laboratory certificates of analysis are presented in Appendix E.

- ✦ Titratable actual acidity (TAA) concentrations ranged from <0.02 % at a number of locations to 0.05 %S (TP06/0.00).
- ✦ Titratable peroxide acidity (TPA) concentrations ranged from <0.02 %S at a number of locations to 0.63 %S (TP06/0.00).
- ✦ Titratable sulfidic acidity (TSA) concentrations ranged from <0.02 %S at a number of locations to 0.58 %S (TP06/0.00).
- ✦ Peroxide oxidisable sulfur ( $S_{pos}$ ) ranged from <0.02 %S at a number of locations to 0.47 %S (TP04/1.75).
- ✦ The calculated net acidity ranged from <0.02 %S at a number of locations to 0.47 %S (TP04/1.75), with six samples exceeding the DEC action criterion of 0.03 %S.

## 8.3 Discussion

The investigation has confirmed that potential ASS are present within the site. Soils have been classified as either non-acid sulfate soil (NASS) or potential acid sulfate soil (PASS) based on the following criteria:

- ✦ net acidity;
- ✦ titratable sulfidic acidity;
- ✦ soil type; and
- ✦ location relative to the groundwater table.

Levels of net acidity exceeded the DEC action criterion of 0.03 %S at over half of the sampling locations across the site. The exceedances were identified in soils characterised as:

- ✦ SAND(SP): fine to coarse grained, sub-angular to sub-rounded, grey/white mottled brown with some red iron cemented nodules, extending from depths ranging between 0.0 m and 1.0 m below surface, and extending to depths ranging from 2.0 m to 2.2 m.

Soils classified as ASS or PASS will need to be treated accordingly, while soils identified as non-acid sulfate soil (NASS) will require no management or treatment. This conservative approach is undertaken to make earthworks as efficient as possible while ensuring all ASS is neutralised adequately.

It should be pointed out that the presence of ASS does not necessarily mean that management and treatment is required. The need for this will be determined based on the volume of material required to be excavated in bulk earthworks and civil works. If less than 100 m<sup>3</sup> of ASS material is to be removed, there is no need to treat ASS. Where the need for management and treatment of ASS material could be required would be in deeper excavations commonly required for sewer installation. This will need to be addressed once details of the development have been decided.

## 9. CLOSURE

We draw your attention to Appendix F of this report, Understanding your Report. The information provided within is intended to inform you as to what your realistic expectations of this report should be. Guidance is also provided on how to minimise risks associated with groundworks for this project. This information is provided not to reduce the level of responsibility accepted by Galt, but to ensure that all parties who rely on this report are aware of the responsibilities each assumes in so doing.

### GALT GEOTECHNICS PTY LTD



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Geotechnical Engineer

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# Tables





## Appendix A: Site Photographs



**Photograph 1: Looking north from near TP01**



**Photograph 2: Existing property towards northwest corner of the site**



**Photograph 3: Looking north from TP04**



**Photograph 4: Typical hand auger spoil**



## Appendix B: Test Pit Reports

# METHOD OF SOIL DESCRIPTION BOREHOLE AND TEST PIT REPORTS



## GRAPHIC LOG & UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) SYMBOLS

Graphic	USCS	Soil Name	Graphic	USCS	Soil Name
		FILL (various types)		SM	Silty SAND
		COBBLES		ML	SILT (low liquid limit)
		BOULDERS		MH	SILT (high liquid limit)
	GP	GRAVEL (poorly graded)		CL	CLAY (low plasticity)
	GW	GRAVEL (well graded)		CI	CLAY (medium plasticity)
	GC	Clayey GRAVEL		CH	CLAY (high plasticity)
	SP	SAND (poorly graded)		OL	Organic SILT (low liquid limit)
	SW	SAND (well graded)		OH	Organic SILT (high liquid limit)
	SC	Clayey SAND		Pt	PEAT

## RESISTANCE TO EXCAVATION

Symbol	Term	Description
VE	Very easy	All resistances are relative to the selected method of excavation
E	Easy	
F	Firm	
H	Hard	
VH	Very hard	

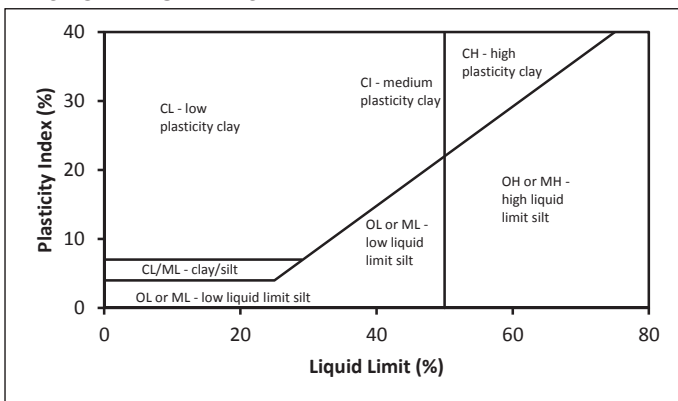
## SOIL CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil descriptions are based on AS1726-1993, Appendix A. Material properties are assessed in the field by visual/tactile methods in combination with field testing techniques (where used).

## PARTICLE SIZE

Soil Name	Particle Size (mm)	
BOULDERS	>200	
COBBLES	63 to 200	
GRAVEL	Coarse	20 to 63
	Medium	6 to 20
	Fine	2 to 6
SAND	Coarse	0.6 to 2.0
	Medium	0.2 to 0.6
	Fine	0.075 to 0.2
FINES	SILT	0.002 to 0.075
	CLAY	<0.002

## PLASTICITY PROPERTIES



## MOISTURE CONDITION

AS1726-1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays and silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition and may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

## CONSISTENCY AND DENSITY

AS1726-1993 and HB160-2006

Symbol	Term	Undrained Shear Strength (kPa)	SPT "N"	DCP blows per 100 mm	Symbol	Term	Density Index (%)	SPT "N"	DCP blows per 100 mm	PSP Blows per 300 mm
VS	Very Soft	0 to 12	0 to 2	<1	VL	Very Loose	<15	0 to 4	<1	0 to 2
S	Soft	12 to 25	2 to 4	<1	L	Loose	15 to 35	4 to 10	1 to 2	2 to 6
F	Firm	25 to 50	4 to 8	1 to 2	MD	Medium Dense	35 to 65	10 to 30	2 to 3	6 to 8
St	Stiff	50 to 100	8 to 15	3 to 4	D	Dense	65 to 85	30 to 50	4 to 8	8 to 15
VSt	Very Stiff	100 to 200	15 to 30	5 to 10	VD	Very Dense	>85	>50	>8	>15
H	Hard	>200	>30	>10						

Note: PSP correlations only valid to 450 mm depth

Consistency and density may also be inferred from excavation performance and material behaviour.

# EXPLANATORY NOTES TO BE READ WITH BOREHOLE AND TEST PIT REPORTS



## METHOD OF DRILLING OR EXCAVATION

AC	Air Core	E	Excavator	PQ3	PQ3 Core Barrel
AD/T	Auger Drilling with TC-Bit	EH	Excavator with Hammer	PT	Push Tube
AD/V	Auger Drilling with V-Bit	HA	Hand Auger	R	Ripper
AT	Air Track	HMLC	HMLC Core Barrel	RR	Rock Roller
B	Bulldozer Blade	HQ3	HQ3 Core Barrel	SON	Sonic Rig
BH	Backhoe Bucket	N	Natural Exposure	SPT	Driven SPT
CT	Cable Tool	NMLC	NMLC Core Barrel	WB	Washbore
DT	Diatube	PP	Push Probe	X	Existing Excavation

## SUPPORT

T Timbering

## PENETRATION EFFORT (RELATIVE TO THE EQUIPMENT USED)

VE	Very Easy	E	Easy	F	Firm
H	Hard	VH	Very Hard		

## WATER

▶	Water Inflow	▼	Water Level
◀	Water Loss (complete)		
◁	Water Loss (partial)		

## SAMPLING AND TESTING

B	Bulk Disturbed Sample	P	Piston Sample
BLK	Block Sample	PBT	Plate Bearing Test
C	Core Sample	U	Undisturbed Push-in Sample
CBR	CBR Mould Sample		U50: 50 mm diameter
D	Small Disturbed Sample	SPT	Standard Penetration Test
ES	Environmental Soil Sample		Example: 3, 4, 5 N=9
EW	Environmental Water Sample		3,4,5: Blows per 150 mm
G	Gas Sample		N=9: Blows per 300 mm after
HP	Hand Penetrometer		150 mm seating interval
LB	Large Bulk Disturbed Sample	VS	Vane Shear; P = Peak
M	Mazier Type Sample		R = Remoulded (kPa)
MC	Moisture Content Sample	W	Water Sample

## ROCK CORE RECOVERY

$$TCR = \text{Total Core Recovery (\%)} = \frac{CRL}{TCL} \times 100$$

$$SCR = \text{Solid Core Recovery (\%)} = \frac{CCR}{TCL} \times 100$$

$$RQD = \text{Rock Quality Designation (\%)} = \frac{ALC > 100}{TCL} \times 100$$

TCL Length of Core Run

CRL Recovered Length of Core

CCR Total Length of Cylindrical Pieces of Core Recovered

ALC>100 Total Length of Axial Lengths of Core Greater than 100 mm Long



















## Appendix C: Summary Hand Auger Borehole Reports



**Job Number:** J1401130  
**Client:** Property Edge WA  
**Project:** Proposed Residential Subdivision  
**Location:** Lot 601 Old Pinjarra Road, Greenfields

**Date Performed:** 22 July 2014  
**Drilled By:** JH  
**Logged By:** JH

## Hand Auger Borehole HA01

Test Depth (m)	Stratigraphy
0.0 – 1.7	SAND (SP), fine to coarse grained, sub-angular to sub-rounded, grey becoming white, trace rootlets and organics in top 200 mm, loose to medium dense, moist to wet
End of Borehole at 1.7 m Terminated due to presence of groundwater Groundwater level could not be determined due to collapse of hole	

## Hand Auger Borehole HA02

Test Depth (m)	Stratigraphy
0.0 – 0.5	FILL: SAND (SP), fine to coarse grained, yellow/brown, trace organics and rootlets, moist, medium dense
0.5 – 2.0	SAND (SP), fine to coarse grained, sub-angular to sub-rounded, yellow, moist, medium dense to dense, (possibly fill)
End of Borehole at 2.0 m Target Depth Groundwater not encountered	

## Hand Auger Borehole HA03

Test Depth (m)	Stratigraphy
0.0 – 1.3	SAND (SP), fine to coarse grained, grey becoming white, trace organic fines, trace rootlets in top 400 mm, moist to wet, loose
End of Borehole at 1.3 m Terminated due to presence of groundwater Groundwater level could not be determined due to collapse of hole	

## Hand Auger Borehole HA04

Test Depth (m)	Stratigraphy
0.0 – 0.3	FILL: SAND (SP), fine to coarse grained, sub-angular to sub-rounded, grey/brown, trace organics and rootlets, moist, medium dense
0.3 – 1.8	SAND (SP), fine to coarse grained, sub-angular to sub-rounded, grey becoming white mottled pale brown, trace organics, moist to wet, dense
End of Borehole at 2.0 m Terminated due to presence of groundwater Groundwater level could not be determined due to collapse of hole	

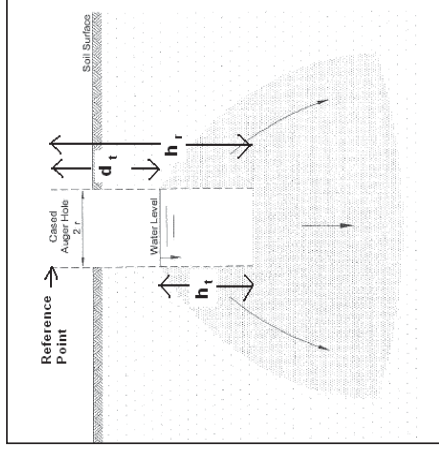


## Appendix D: Permeability Test Results

# Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author:	ORW	17-Oct-09
Job No:	J1401130	REFERENCE: Cocks, G. Disposal of Stormwater Runoff by Soakage in Perth Western Australia, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114		
Client:	Project Edge WA			
Site:	Lot 601 Old Pinjarra Rd			
Location:	Greenfields			
Calc by:	JH 24-Jul-14			
BH Name:	HA01			
Test Depth:	0.56 m			
<b>Spreadsheet Legend</b>				
Required input		Value	Units	
Calculated field		0.045	m/s	
Comment field		0.61	s	
Field not used			m	
Fixed field			m	

$$K = 1.15r \frac{1}{t - t_0} \log_{10} \left( h_0 + \frac{1}{2}r \right) - \log_{10} \left( h_t + \frac{1}{2}r \right)$$



## Test 1

t (s)	d <sub>w</sub> (m)	h <sub>t</sub> (m)	K (m/s)	K (m/day)
0	0.19	0.42		
30	0.37	0.24	3.9E-04	33.8
60	0.425	0.185	2.8E-04	24.5
90	0.465	0.145	2.4E-04	21.0
120	0.5	0.11	2.3E-04	19.5
<b>AVERAGE</b>			2.9E-04	24.7

## Test 2

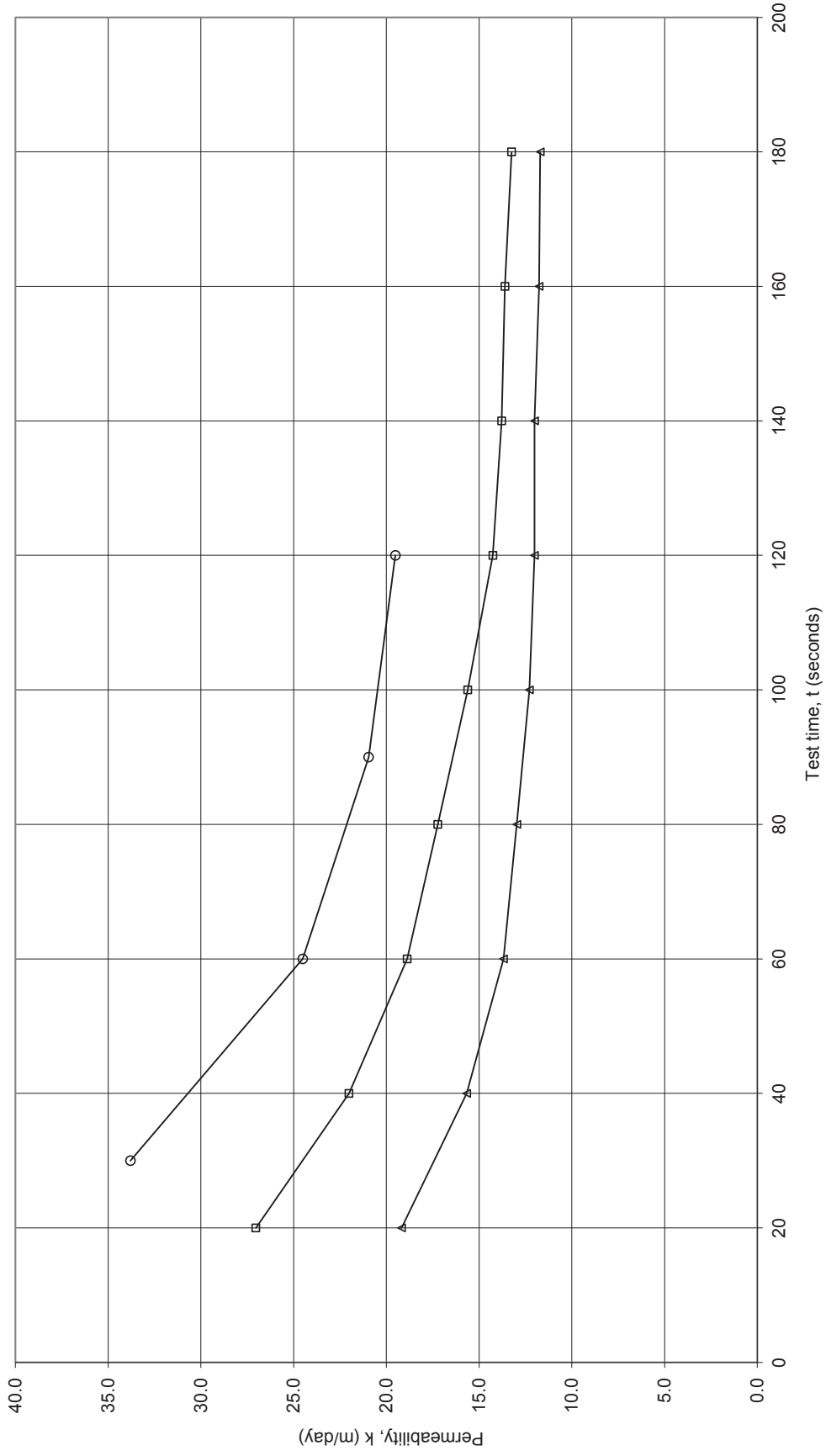
t (s)	d <sub>w</sub> (m)	h <sub>t</sub> (m)	K (m/s)	K (m/day)
0	0.18	0.43		
20	0.29	0.32	3.1E-04	27.0
40	0.345	0.265	2.5E-04	22.0
60	0.38	0.23	2.2E-04	18.9
80	0.41	0.2	2.0E-04	17.2
100	0.43	0.18	1.8E-04	15.6
120	0.445	0.165	1.7E-04	14.3
140	0.465	0.145	1.6E-04	13.8
160	0.485	0.125	1.6E-04	13.6
180	0.5	0.11	1.5E-04	13.2
<b>AVERAGE</b>			2.0E-04	17.3

## Test 3

t (s)	d <sub>w</sub> (m)	h <sub>t</sub> (m)	K (m/s)	K (m/day)
0	0.27	0.34		
20	0.335	0.275	2.2E-04	19.2
40	0.37	0.24	1.8E-04	15.7
60	0.395	0.215	1.6E-04	13.7
80	0.42	0.19	1.5E-04	13.0
100	0.44	0.17	1.4E-04	12.3
120	0.46	0.15	1.4E-04	12.0
140	0.48	0.13	1.4E-04	12.0
160	0.495	0.115	1.4E-04	11.8
180	0.51	0.1	1.4E-04	11.7
<b>AVERAGE</b>			1.6E-04	13.5

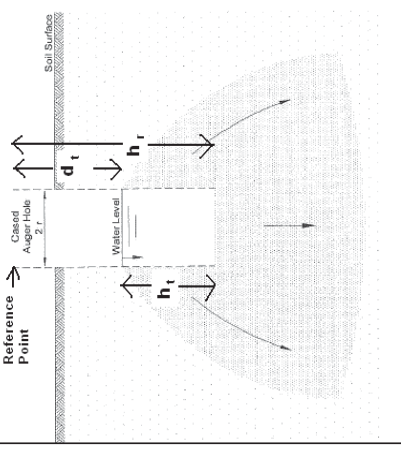
# Permeability by Inverse Auger Hole Method

HA01



# Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics		Spreadsheet author:	ORW	17-Oct-09
Job No:	J1401130			
Client:	Project Edge WA			
Site:	Lot 601 Old Pinjarra Rd			
Location:	Greenfields			
Calc by:	JH	24-Jul-14		
BH Name:	HA02			
Test Depth:	0.54 m			
<b>Spreadsheet Legend</b>				
Requested input				
Calculated field				
Comment field				
Field not used				
Fixed field				



REFERENCE: Cocks, G. Disposal of Stormwater Runoff by Soakage in Perth Western Australia, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

$$K = 1.15r \frac{1}{t - t_0} \log_{10} \left( h_0 + \frac{1}{2}r \right) - \log_{10} \left( h_t + \frac{1}{2}r \right)$$

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h <sub>r</sub>	reference point height above base	0.61	m
d <sub>t</sub>	depth from reference point to water at time t		m
h <sub>t</sub>	Water column height at time t		m
h <sub>0</sub>	h <sub>t</sub> at t=0		m

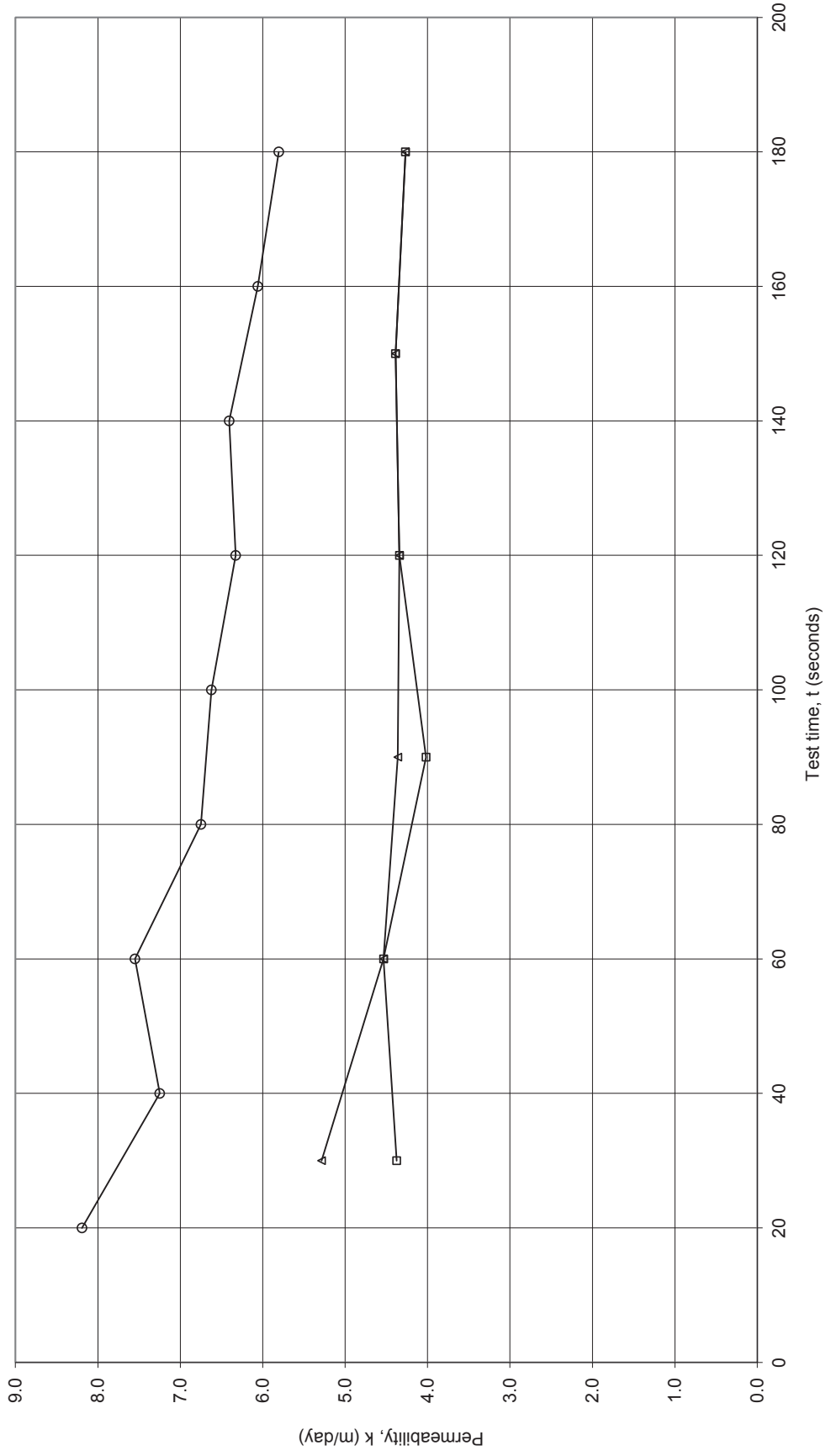
Test 1					
t (s)	d <sub>w</sub> (m)	h <sub>t</sub> (m)	K (m/s)	K (m/day)	
0	0.2	0.41			
20	0.235	0.375	9.5E-05	8.2	
40	0.26	0.35	8.4E-05	7.3	
60	0.29	0.32	8.7E-05	7.6	
80	0.305	0.305	7.8E-05	6.8	
100	0.325	0.285	7.7E-05	6.6	
120	0.34	0.27	7.3E-05	6.3	
140	0.36	0.25	7.4E-05	6.4	
160	0.37	0.24	7.0E-05	6.1	
180	0.38	0.23	6.7E-05	5.8	
AVERAGE				7.8E-05	6.8

Test 2					
t (s)	d <sub>w</sub> (m)	h <sub>t</sub> (m)	K (m/s)	K (m/day)	
0	0.25	0.36			
30	0.275	0.335	5.1E-05	4.4	
60	0.3	0.31	5.2E-05	4.5	
90	0.315	0.295	4.7E-05	4.0	
120	0.34	0.27	5.0E-05	4.3	
150	0.36	0.25	5.1E-05	4.4	
180	0.375	0.235	4.9E-05	4.3	
AVERAGE				5.0E-05	4.3

Test 3					
t (s)	d <sub>w</sub> (m)	h <sub>t</sub> (m)	K (m/s)	K (m/day)	
0	0.25	0.36			
30	0.28	0.33	6.1E-05	5.3	
60	0.3	0.31	5.2E-05	4.5	
90	0.32	0.29	5.0E-05	4.4	
120	0.34	0.27	5.0E-05	4.3	
150	0.36	0.25	5.1E-05	4.4	
180	0.375	0.235	4.9E-05	4.3	
AVERAGE				5.2E-05	4.5

# Permeability by Inverse Auger Hole Method

HA02





## Appendix E: Certificates of Analysis

Galt Environment P/L  
2/39 Flynn St  
Wembley  
WA 6014



NATA Accredited  
Accreditation Number 1261  
Site Number 20794

Accredited for compliance with ISO/IEC 17025.  
The results of the tests, calibrations and/or  
measurements included in this document are traceable  
to Australian/national standards.

Attention: Henry Taylor

Report 426774-S  
Client Reference VAUGHAN DD GREENFIELDS J1401130  
Received Date Jul 30, 2014

Client Sample ID			TP 1 0.5	TP 1 1.0	TP 1 1.75	TP 2 0.25
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins   mgt Sample No.			B14-JI25543	B14-JI25544	B14-JI25545	B14-JI25546
Date Sampled			Jul 22, 2014	Jul 22, 2014	Jul 22, 2014	Jul 22, 2014
Test/Reference	LOR	Unit				
<b>SPOCAS Suite</b>						
pH-KCL	0.1	units	5.8	5.5	5.2	5.7
pH-OX	0.1	units	4.6	4.5	2.9	3.1
Acid trail - Titratable Actual Acidity	2	mol H+/t	3.0	4.0	5.0	4.0
Acid trail - Titratable Peroxide Acidity	2	mol H+/t	8.0	4.0	51	26
Acid trail - Titratable Sulfidic Acidity	2	mol H+/t	5.0	< 2	47	22
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
sulfidic - Titratable Peroxide Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	0.08	0.04
sulfidic - Titratable Sulfidic Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	0.07	0.04
Sulfur - KCl Extractable	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Sulfur - Peroxide	0.02	% S	< 0.02	< 0.02	0.05	< 0.02
Sulfur - Peroxide Oxidisable Sulfur	0.02	% S	< 0.02	< 0.02	0.05	< 0.02
acidity - Peroxide Oxidisable Sulfur	10	mol H+/t	< 10	< 10	29	< 10
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite <sup>S02</sup>	0.02	% S	n/a	n/a	n/a	n/a
Calcium - KCl Extractable	0.02	% Ca	< 0.02	< 0.02	< 0.02	0.02
Calcium - Peroxide	0.02	% Ca	< 0.02	< 0.02	< 0.02	0.02
Acid Reacted Calcium	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Calcium	10	mol H+/t	< 10	< 10	< 10	< 10
sulfidic - Acid Reacted Calcium equivalent S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Magnesium - KCl Extractable	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
Magnesium - Peroxide	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
Acid Reacted Magnesium	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Magnesium	10	mol H+/t	< 10	< 10	< 10	< 10
sulfidic - Acid Reacted Magnesium equivalent S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Acid Neutralising Capacity	0.02	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - Acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity equivalent S% pyrite	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (sulfur units) - SPOCAS	0.02	% S	< 0.02	< 0.02	0.05	< 0.02
Net Acidity (acidity units) - SPOCAS	10	mol H+/t	< 10	< 10	33	< 10
Liming rate - SPOCAS	1	kg CaCO3/t	< 1	< 1	3.0	< 1



Client Sample ID			TP 1 0.5	TP 1 1.0	TP 1 1.75	TP 2 0.25
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins   mgt Sample No.			B14-JI25543	B14-JI25544	B14-JI25545	B14-JI25546
Date Sampled			Jul 22, 2014	Jul 22, 2014	Jul 22, 2014	Jul 22, 2014
Test/Reference	LOR	Unit				
<b>Extraneous Material</b>						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005		n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
<b>% Moisture</b>						
	0.1	%	16	20	19	19

Client Sample ID			TP 2 0.75	TP 2 1.0	TP 3 0.25	TP 3 1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins   mgt Sample No.			B14-JI25547	B14-JI25548	B14-JI25549	B14-JI25550
Date Sampled			Jul 22, 2014	Jul 22, 2014	Jul 22, 2014	Jul 22, 2014
Test/Reference	LOR	Unit				
<b>SPOCAS Suite</b>						
pH-KCL	0.1	units	5.9	5.2	6.4	5.2
pH-OX	0.1	units	3.7	4.0	3.2	4.0
Acid trail - Titratable Actual Acidity	2	mol H+/t	3.0	9.0	< 2	6.0
Acid trail - Titratable Peroxide Acidity	2	mol H+/t	4.0	4.0	68	8.0
Acid trail - Titratable Sulfidic Acidity	2	mol H+/t	< 2	< 2	68	2.0
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
sulfidic - Titratable Peroxide Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	0.11	< 0.02
sulfidic - Titratable Sulfidic Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	0.11	< 0.02
Sulfur - KCl Extractable	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Sulfur - Peroxide	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Sulfur - Peroxide Oxidisable Sulfur	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Peroxide Oxidisable Sulfur	10	mol H+/t	< 10	< 10	< 10	< 10
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite <sup>S02</sup>	0.02	% S	n/a	n/a	n/a	n/a
Calcium - KCl Extractable	0.02	% Ca	< 0.02	< 0.02	0.06	< 0.02
Calcium - Peroxide	0.02	% Ca	< 0.02	< 0.02	0.07	< 0.02
Acid Reacted Calcium	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Calcium	10	mol H+/t	< 10	< 10	< 10	< 10
sulfidic - Acid Reacted Calcium equivalent S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Magnesium - KCl Extractable	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
Magnesium - Peroxide	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
Acid Reacted Magnesium	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Magnesium	10	mol H+/t	< 10	< 10	< 10	< 10
sulfidic - Acid Reacted Magnesium equivalent S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Acid Neutralising Capacity	0.02	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - Acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity equivalent S% pyrite	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (sulfur units) - SPOCAS	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Net Acidity (acidity units) - SPOCAS	10	mol H+/t	< 10	< 10	< 10	< 10
Liming rate - SPOCAS	1	kg CaCO3/t	< 1	1.0	< 1	< 1

Client Sample ID			TP 2 0.75	TP 2 1.0	TP 3 0.25	TP 3 1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins   mgt Sample No.			B14-JI25547	B14-JI25548	B14-JI25549	B14-JI25550
Date Sampled			Jul 22, 2014	Jul 22, 2014	Jul 22, 2014	Jul 22, 2014
Test/Reference	LOR	Unit				
<b>Extraneous Material</b>						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005		n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
<b>% Moisture</b>						
	0.1	%	8.9	12	8.5	4.6

Client Sample ID			TP 3 1.75	TP 4 0.25	TP 4 1.25	TP 4 1.75
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins   mgt Sample No.			B14-JI25551	B14-JI25552	B14-JI25553	B14-JI25554
Date Sampled			Jul 22, 2014	Jul 22, 2014	Jul 22, 2014	Jul 22, 2014
Test/Reference	LOR	Unit				
<b>SPOCAS Suite</b>						
pH-KCL	0.1	units	5.7	4.5	4.5	4.5
pH-OX	0.1	units	4.4	3.4	2.3	2.2
Acid trail - Titratable Actual Acidity	2	mol H+/t	4.0	8.0	8.0	9.0
Acid trail - Titratable Peroxide Acidity	2	mol H+/t	5.0	19	250	320
Acid trail - Titratable Sulfidic Acidity	2	mol H+/t	< 2	11	240	310
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
sulfidic - Titratable Peroxide Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	0.03	0.40	0.50
sulfidic - Titratable Sulfidic Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	0.02	0.38	0.49
Sulfur - KCl Extractable	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Sulfur - Peroxide	0.02	% S	< 0.02	< 0.02	0.33	0.47
Sulfur - Peroxide Oxidisable Sulfur	0.02	% S	< 0.02	< 0.02	0.33	0.47
acidity - Peroxide Oxidisable Sulfur	10	mol H+/t	< 10	< 10	210	290
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite <sup>S02</sup>	0.02	% S	n/a	n/a	n/a	n/a
Calcium - KCl Extractable	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 0.02
Calcium - Peroxide	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 0.02
Acid Reacted Calcium	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Calcium	10	mol H+/t	< 10	< 10	< 10	< 10
sulfidic - Acid Reacted Calcium equivalent S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Magnesium - KCl Extractable	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
Magnesium - Peroxide	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
Acid Reacted Magnesium	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Magnesium	10	mol H+/t	< 10	< 10	< 10	< 10
sulfidic - Acid Reacted Magnesium equivalent S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Acid Neutralising Capacity	0.02	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - Acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity equivalent S% pyrite	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (sulfur units) - SPOCAS	0.02	% S	< 0.02	< 0.02	0.35	0.48
Net Acidity (acidity units) - SPOCAS	10	mol H+/t	< 10	< 10	220	300
Liming rate - SPOCAS	1	kg CaCO3/t	< 1	1.0	16	23

Client Sample ID			TP 3 1.75	TP 4 0.25	TP 4 1.25	TP 4 1.75
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins   mgt Sample No.			B14-JI25551	B14-JI25552	B14-JI25553	B14-JI25554
Date Sampled			Jul 22, 2014	Jul 22, 2014	Jul 22, 2014	Jul 22, 2014
Test/Reference	LOR	Unit				
<b>Extraneous Material</b>						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005		n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
<b>% Moisture</b>						
	0.1	%	4.7	17	18	19

Client Sample ID			TP 5 0.25	TP 5 1.5	TP 5 2.0	TP 6 0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins   mgt Sample No.			B14-JI25555	B14-JI25556	B14-JI25557	B14-JI25558
Date Sampled			Jul 22, 2014	Jul 22, 2014	Jul 22, 2014	Jul 22, 2014
Test/Reference	LOR	Unit				
<b>SPOCAS Suite</b>						
pH-KCL	0.1	units	5.0	5.0	5.0	4.2
pH-OX	0.1	units	3.9	4.1	2.3	2.4
Acid trail - Titratable Actual Acidity	2	mol H+/t	4.0	4.0	6.0	28
Acid trail - Titratable Peroxide Acidity	2	mol H+/t	7.0	5.0	190	390
Acid trail - Titratable Sulfidic Acidity	2	mol H+/t	3.0	< 2	180	360
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	0.05
sulfidic - Titratable Peroxide Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	0.30	0.63
sulfidic - Titratable Sulfidic Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	0.29	0.58
Sulfur - KCl Extractable	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Sulfur - Peroxide	0.02	% S	< 0.02	< 0.02	0.29	< 0.02
Sulfur - Peroxide Oxidisable Sulfur	0.02	% S	< 0.02	< 0.02	0.29	< 0.02
acidity - Peroxide Oxidisable Sulfur	10	mol H+/t	< 10	< 10	180	< 10
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	< 0.02
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	< 0.02
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	< 10
Net Acid soluble sulfur - equivalent S% pyrite <sup>S02</sup>	0.02	% S	n/a	n/a	n/a	< 0.02
Calcium - KCl Extractable	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 0.02
Calcium - Peroxide	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 0.02
Acid Reacted Calcium	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Calcium	10	mol H+/t	< 10	< 10	< 10	< 10
sulfidic - Acid Reacted Calcium equivalent S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Magnesium - KCl Extractable	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
Magnesium - Peroxide	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
Acid Reacted Magnesium	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Magnesium	10	mol H+/t	< 10	< 10	< 10	< 10
sulfidic - Acid Reacted Magnesium equivalent S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Acid Neutralising Capacity	0.02	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - Acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity equivalent S% pyrite	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (sulfur units) - SPOCAS	0.02	% S	< 0.02	< 0.02	0.30	0.05
Net Acidity (acidity units) - SPOCAS	10	mol H+/t	< 10	< 10	180	28
Liming rate - SPOCAS	1	kg CaCO3/t	< 1	< 1	14	2.0

Client Sample ID			TP 5 0.25	TP 5 1.5	TP 5 2.0	TP 6 0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins   mgt Sample No.			B14-JI25555	B14-JI25556	B14-JI25557	B14-JI25558
Date Sampled			Jul 22, 2014	Jul 22, 2014	Jul 22, 2014	Jul 22, 2014
Test/Reference	LOR	Unit				
<b>Extraneous Material</b>						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005		n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
<b>% Moisture</b>						
	0.1	%	11	17	20	20

Client Sample ID			TP 6 1.25	TP 6 1.75	TP 7 0.25	TP 7 0.75
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins   mgt Sample No.			B14-JI25559	B14-JI25560	B14-JI25561	B14-JI25562
Date Sampled			Jul 22, 2014	Jul 22, 2014	Jul 22, 2014	Jul 22, 2014
Test/Reference	LOR	Unit				
<b>SPOCAS Suite</b>						
pH-KCL	0.1	units	5.5	5.3	5.8	5.9
pH-OX	0.1	units	3.9	2.3	3.8	4.2
Acid trail - Titratable Actual Acidity	2	mol H+/t	5.0	5.0	4.0	3.0
Acid trail - Titratable Peroxide Acidity	2	mol H+/t	6.0	160	5.0	3.0
Acid trail - Titratable Sulfidic Acidity	2	mol H+/t	< 2	150	< 2	< 2
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
sulfidic - Titratable Peroxide Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	0.25	< 0.02	< 0.02
sulfidic - Titratable Sulfidic Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	0.24	< 0.02	< 0.02
Sulfur - KCl Extractable	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Sulfur - Peroxide	0.02	% S	< 0.02	0.24	< 0.02	< 0.02
Sulfur - Peroxide Oxidisable Sulfur	0.02	% S	< 0.02	0.24	< 0.02	< 0.02
acidity - Peroxide Oxidisable Sulfur	10	mol H+/t	< 10	150	< 10	< 10
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite <sup>S02</sup>	0.02	% S	n/a	n/a	n/a	n/a
Calcium - KCl Extractable	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 0.02
Calcium - Peroxide	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 0.02
Acid Reacted Calcium	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Calcium	10	mol H+/t	< 10	< 10	< 10	< 10
sulfidic - Acid Reacted Calcium equivalent S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Magnesium - KCl Extractable	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
Magnesium - Peroxide	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
Acid Reacted Magnesium	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Magnesium	10	mol H+/t	< 10	< 10	< 10	< 10
sulfidic - Acid Reacted Magnesium equivalent S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Acid Neutralising Capacity	0.02	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - Acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity equivalent S% pyrite	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (sulfur units) - SPOCAS	0.02	% S	< 0.02	0.25	< 0.02	< 0.02
Net Acidity (acidity units) - SPOCAS	10	mol H+/t	< 10	150	< 10	< 10
Liming rate - SPOCAS	1	kg CaCO3/t	< 1	12	< 1	< 1

Client Sample ID			TP 6 1.25	TP 6 1.75	TP 7 0.25	TP 7 0.75
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins   mgt Sample No.			B14-JI25559	B14-JI25560	B14-JI25561	B14-JI25562
Date Sampled			Jul 22, 2014	Jul 22, 2014	Jul 22, 2014	Jul 22, 2014
Test/Reference	LOR	Unit				
<b>Extraneous Material</b>						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005		n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
<b>% Moisture</b>						
	0.1	%	19	8.5	4.3	15

Client Sample ID			TP 7 1.5	QC1
Sample Matrix			Soil	Soil
Eurofins   mgt Sample No.			B14-JI25563	B14-JI25564
Date Sampled			Jul 22, 2014	Jul 22, 2014
Test/Reference	LOR	Unit		
<b>SPOCAS Suite</b>				
pH-KCL	0.1	units	5.7	5.4
pH-OX	0.1	units	3.4	2.4
Acid trail - Titratable Actual Acidity	2	mol H+/t	5.0	7.0
Acid trail - Titratable Peroxide Acidity	2	mol H+/t	2.0	170
Acid trail - Titratable Sulfidic Acidity	2	mol H+/t	< 2	160
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02
sulfidic - Titratable Peroxide Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	0.27
sulfidic - Titratable Sulfidic Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	0.25
Sulfur - KCl Extractable	0.02	% S	< 0.02	< 0.02
Sulfur - Peroxide	0.02	% S	< 0.02	0.33
Sulfur - Peroxide Oxidisable Sulfur	0.02	% S	< 0.02	0.33
acidity - Peroxide Oxidisable Sulfur	10	mol H+/t	< 10	210
HCl Extractable Sulfur	0.02	% S	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite <sup>S02</sup>	0.02	% S	n/a	n/a
Calcium - KCl Extractable	0.02	% Ca	< 0.02	< 0.02
Calcium - Peroxide	0.02	% Ca	< 0.02	< 0.02
Acid Reacted Calcium	0.02	% Ca	< 0.02	< 0.02
acidity - Acid Reacted Calcium	10	mol H+/t	< 10	< 10
sulfidic - Acid Reacted Calcium equivalent S% pyrite	0.02	% S	< 0.02	< 0.02
Magnesium - KCl Extractable	0.02	% Mg	< 0.02	< 0.02
Magnesium - Peroxide	0.02	% Mg	< 0.02	< 0.02
Acid Reacted Magnesium	0.02	% Mg	< 0.02	< 0.02
acidity - Acid Reacted Magnesium	10	mol H+/t	< 10	< 10
sulfidic - Acid Reacted Magnesium equivalent S% pyrite	0.02	% S	< 0.02	< 0.02
Acid Neutralising Capacity	0.02	%CaCO3	n/a	n/a
Acid Neutralising Capacity - Acidity units	10	mol H+/t	n/a	n/a
Acid Neutralising Capacity equivalent S% pyrite	0.02	% S	n/a	n/a
ANC Fineness Factor			1.5	1.5
Net Acidity (sulfur units) - SPOCAS	0.02	% S	< 0.02	0.34
Net Acidity (acidity units) - SPOCAS	10	mol H+/t	< 10	210
Liming rate - SPOCAS	1	kg CaCO3/t	< 1	16

<b>Client Sample ID</b>			<b>TP 7 1.5</b>	<b>QC1</b>
<b>Sample Matrix</b>			<b>Soil</b>	<b>Soil</b>
<b>Eurofins   mgt Sample No.</b>			<b>B14-JI25563</b>	<b>B14-JI25564</b>
<b>Date Sampled</b>			<b>Jul 22, 2014</b>	<b>Jul 22, 2014</b>
Test/Reference	LOR	Unit		
<b>Extraneous Material</b>				
<2mm Fraction	0.005	g	n/a	n/a
>2mm Fraction	0.005		n/a	n/a
Analysed Material	0.1	%	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1
<b>% Moisture</b>				
	0.1	%	17	19

### Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported. A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
SPOCAS Suite			
SPOCAS Suite	Brisbane	Jul 31, 2014	6 Week
- Method: LTM-GEN-7050			
Extraneous Material	Brisbane	Jul 31, 2014	0 Day
% Moisture	Brisbane	Jul 31, 2014	14 Day
- Method: Method 102 - ANZECC - % Moisture			

**Melbourne**  
 3/5 Kingston Town Close  
 Oakleigh VIC 3166  
 Phone: +61 3 9584 5000  
 MATA # 1261  
 Site # 1254 & 14271

**Sydney**  
 Unit 16, Building F  
 16 Mac's Road  
 Lane Cove West NSW 2066  
 Phone: +61 2 9909 8400  
 NATA # 1261 Site # 18217

**Brisbane**  
 1/21 Smallwood Place  
 Murarie QLD 4172  
 Phone: +61 7 3902 4600  
 NATA # 1261 Site # 20794

ABN - 50 005 085 521 e.mail - EnviroSales@eurofins.com.au web - www.eurofins.com.au

**Company Name:** Galt Environment P/L  
**Address:** 2/39 Flynn St  
 Wembley  
 WA 6014

**Client Job No.:** VAUGHAN DD GREENFIELDS J1401130

**Order No.:**  
**Report #:** 426774  
**Phone:** 08 6272 0200  
**Fax:** 08 9285 8444

**Received:** Jul 30, 2014 9:00 AM  
**Due:** Aug 6, 2014  
**Priority:** 5 Day  
**Contact Name:** Brad Palmer

**Eurofins | mgt Client Manager: Natalie Krasselt**

Sample Detail					
Sample ID	Sample Date	Sampling Time	Matrix	LAB ID	
TP 1 0.5	Jul 22, 2014		Soil	B14-JJ25543	X
TP 1 1.0	Jul 22, 2014		Soil	B14-JJ25544	X
TP 1 1.75	Jul 22, 2014		Soil	B14-JJ25545	X
TP 2 0.25	Jul 22, 2014		Soil	B14-JJ25546	X
TP 2 0.75	Jul 22, 2014		Soil	B14-JJ25547	X
TP 2 1.0	Jul 22, 2014		Soil	B14-JJ25548	X
TP 3 0.25	Jul 22, 2014		Soil	B14-JJ25549	X
TP 3 1.0	Jul 22, 2014		Soil	B14-JJ25550	X
TP 3 1.75	Jul 22, 2014		Soil	B14-JJ25551	X
TP 4 0.25	Jul 22, 2014		Soil	B14-JJ25552	X
SPOCAS Suite					
% Moisture					
Laboratory where analysis is conducted					
Melbourne Laboratory - NATA Site # 1254 & 14271					
Sydney Laboratory - NATA Site # 18217					
Brisbane Laboratory - NATA Site # 20794					
External Laboratory					



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Sample Detail		% Moisture	SPOCAS Suite
<b>Laboratory where analysis is conducted</b>			
Melbourne Laboratory - NATA Site # 1254 & 14271			
Sydney Laboratory - NATA Site # 18217			
Brisbane Laboratory - NATA Site # 20794			
<b>External Laboratory</b>			
TP 4 1.25	Jul 22, 2014	Soil	B14-JJ25553 X X
TP 4 1.75	Jul 22, 2014	Soil	B14-JJ25554 X X
TP 5 0.25	Jul 22, 2014	Soil	B14-JJ25555 X X
TP 5 1.5	Jul 22, 2014	Soil	B14-JJ25556 X X
TP 5 2.0	Jul 22, 2014	Soil	B14-JJ25557 X X
TP 6 0	Jul 22, 2014	Soil	B14-JJ25558 X X
TP 6 1.25	Jul 22, 2014	Soil	B14-JJ25559 X X
TP 6 1.75	Jul 22, 2014	Soil	B14-JJ25560 X X
TP 7 0.25	Jul 22, 2014	Soil	B14-JJ25561 X X
TP 7 0.75	Jul 22, 2014	Soil	B14-JJ25562 X X
TP 7 1.5	Jul 22, 2014	Soil	B14-JJ25563 X X

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 Phone : +61 7 3902 4600  
 NATA # 1261 Site # 20794

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 WA 6014

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**Eurofins | mgt Client Manager: Natalie Krasselt**

Sample Detail	
SPOCAS Suite	
% Moisture	
Laboratory where analysis is conducted	
Melbourne Laboratory - NATA Site # 1254 & 14271	
Sydney Laboratory - NATA Site # 18217	
Brisbane Laboratory - NATA Site # 20794	
External Laboratory	
QC1	Soil
Jul 22, 2014	B14-JJ25564
	X
	X

## Eurofins | mgt Internal Quality Control Review and Glossary

### General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Actual PQLs are matrix dependant. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
4. Results are uncorrected for matrix spikes or surrogate recoveries.
5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis. 7. This report replaces any interim results previously issued.

### Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Acknowledgment.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

**\*\*NOTE:** pH duplicates are reported as a range NOT as RPD

### UNITS

**mg/kg:** milligrams per Kilogram

**mg/l:** milligrams per litre

**ug/l:** micrograms per litre

**ppm:** Parts per million

**ppb:** Parts per billion

**%:** Percentage

**org/100ml:** Organisms per 100 millilitres

**NTU:** Units

**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

### TERMS

<b>Dry</b>	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
<b>LOR</b>	Limit of Reporting.
<b>SPIKE</b>	Addition of the analyte to the sample and reported as percentage recovery.
<b>RPD</b>	Relative Percent Difference between two Duplicate pieces of analysis.
<b>LCS</b>	Laboratory Control Sample - reported as percent recovery
<b>CRM</b>	Certified Reference Material - reported as percent recovery
<b>Method Blank</b>	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
<b>Surr - Surrogate</b>	The addition of a like compound to the analyte target and reported as percentage recovery.
<b>Duplicate</b>	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
<b>Batch Duplicate</b>	A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.
<b>Batch SPIKE</b>	Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.
<b>USEPA</b>	United States Environmental Protection Agency
<b>APHA</b>	American Public Health Association
<b>ASLP</b>	Australian Standard Leaching Procedure (AS4439.3)
<b>TCLP</b>	Toxicity Characteristic Leaching Procedure
<b>COC</b>	Chain of Custody
<b>SRA</b>	Sample Receipt Advice
<b>CP</b>	Client Parent - QC was performed on samples pertaining to this report
<b>NCP</b>	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within
<b>TEQ</b>	Toxic Equivalency Quotient

### QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

### QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxophene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
9. For Matrix Spikes and LCS results a dash " - " in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

**Quality Control Results**

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
<b>Duplicate</b>									
<b>SPOCAS Suite</b>				Result 1	Result 2	RPD			
pH-KCL	B14-JI25543	CP	units	5.8	5.6	4.0	30%	Pass	
pH-OX	B14-JI25543	CP	units	4.6	4.7	2.0	30%	Pass	
Acid trail - Titratable Actual Acidity	B14-JI25543	CP	mol H+/t	3.0	3.0	11	30%	Pass	
Acid trail - Titratable Peroxide Acidity	B14-JI25543	CP	mol H+/t	8.0	9.0	9.0	30%	Pass	
Acid trail - Titratable Sulfidic Acidity	B14-JI25543	CP	mol H+/t	5.0	5.0	8.0	30%	Pass	
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	B14-JI25543	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
sulfidic - Titratable Peroxide Acidity - equivalent S% pyrite	B14-JI25543	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
sulfidic - Titratable Sulfidic Acidity - equivalent S% pyrite	B14-JI25543	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Sulfur - KCl Extractable	B14-JI25543	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Sulfur - Peroxide	B14-JI25543	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Sulfur - Peroxide Oxidisable Sulfur	B14-JI25543	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
acidity - Peroxide Oxidisable Sulfur	B14-JI25543	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Calcium - KCl Extractable	B14-JI25543	CP	% Ca	< 0.02	< 0.02	<1	30%	Pass	
Calcium - Peroxide	B14-JI25543	CP	% Ca	< 0.02	< 0.02	<1	30%	Pass	
Acid Reacted Calcium	B14-JI25543	CP	% Ca	< 0.02	< 0.02	<1	30%	Pass	
acidity - Acid Reacted Calcium	B14-JI25543	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
sulfidic - Acid Reacted Calcium equivalent S% pyrite	B14-JI25543	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Magnesium - KCl Extractable	B14-JI25543	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass	
Magnesium - Peroxide	B14-JI25543	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass	
Acid Reacted Magnesium	B14-JI25543	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass	
acidity - Acid Reacted Magnesium	B14-JI25543	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
sulfidic - Acid Reacted Magnesium equivalent S% pyrite	B14-JI25543	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
ANC Fineness Factor	B14-JI25543	CP		1.5	1.5	<1	30%	Pass	
Net Acidity (sulfur units) - SPOCAS	B14-JI25543	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Net Acidity (acidity units) - SPOCAS	B14-JI25543	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Liming rate - SPOCAS	B14-JI25543	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
<b>Duplicate</b>									
<b>SPOCAS Suite</b>				Result 1	Result 2	RPD			
pH-KCL	B14-JI25553	CP	units	4.5	4.5	<1	30%	Pass	
pH-OX	B14-JI25553	CP	units	2.3	2.3	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B14-JI25553	CP	mol H+/t	8.0	8.0	1.0	30%	Pass	
Acid trail - Titratable Peroxide Acidity	B14-JI25553	CP	mol H+/t	250	230	8.0	30%	Pass	
Acid trail - Titratable Sulfidic Acidity	B14-JI25553	CP	mol H+/t	240	220	8.0	30%	Pass	
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	B14-JI25553	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
sulfidic - Titratable Peroxide Acidity - equivalent S% pyrite	B14-JI25553	CP	% pyrite S	0.40	0.37	8.0	30%	Pass	
sulfidic - Titratable Sulfidic Acidity - equivalent S% pyrite	B14-JI25553	CP	% pyrite S	0.38	0.35	8.0	30%	Pass	
Sulfur - KCl Extractable	B14-JI25553	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Sulfur - Peroxide	B14-JI25553	CP	% S	0.33	0.33	1.0	30%	Pass	
Sulfur - Peroxide Oxidisable Sulfur	B14-JI25553	CP	% S	0.33	0.33	1.0	30%	Pass	
acidity - Peroxide Oxidisable Sulfur	B14-JI25553	CP	mol H+/t	210	210	1.0	30%	Pass	
Calcium - KCl Extractable	B14-JI25553	CP	% Ca	< 0.02	< 0.02	<1	30%	Pass	
Calcium - Peroxide	B14-JI25553	CP	% Ca	< 0.02	< 0.02	<1	30%	Pass	
Acid Reacted Calcium	B14-JI25553	CP	% Ca	< 0.02	< 0.02	<1	30%	Pass	

Duplicate								
SPOCAS Suite				Result 1	Result 2	RPD		
acidity - Acid Reacted Calcium	B14-JI25553	CP	mol H+/t	< 10	< 10	<1	30%	Pass
sulfidic - Acid Reacted Calcium equivalent S% pyrite	B14-JI25553	CP	% S	< 0.02	< 0.02	<1	30%	Pass
Magnesium - KCl Extractable	B14-JI25553	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass
Magnesium - Peroxide	B14-JI25553	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass
Acid Reacted Magnesium	B14-JI25553	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass
acidity - Acid Reacted Magnesium	B14-JI25553	CP	mol H+/t	< 10	< 10	<1	30%	Pass
sulfidic - Acid Reacted Magnesium equivalent S% pyrite	B14-JI25553	CP	% S	< 0.02	< 0.02	<1	30%	Pass
ANC Fineness Factor	B14-JI25553	CP		1.5	1.5	<1	30%	Pass
Net Acidity (sulfur units) - SPOCAS	B14-JI25553	CP	% S	0.35	0.34	1.0	30%	Pass
Net Acidity (acidity units) - SPOCAS	B14-JI25553	CP	mol H+/t	220	210	1.0	30%	Pass
Liming rate - SPOCAS	B14-JI25553	CP	kg CaCO3/t	16	16	1.0	30%	Pass
Duplicate								
SPOCAS Suite				Result 1	Result 2	RPD		
pH-KCL	B14-JI25563	CP	units	5.7	5.8	2.0	30%	Pass
pH-OX	B14-JI25563	CP	units	3.4	3.4	1.0	30%	Pass
Acid trail - Titratable Actual Acidity	B14-JI25563	CP	mol H+/t	5.0	5.0	12	30%	Pass
Acid trail - Titratable Peroxide Acidity	B14-JI25563	CP	mol H+/t	2.0	2.0	<1	30%	Pass
Acid trail - Titratable Sulfidic Acidity	B14-JI25563	CP	mol H+/t	< 2	< 2	<1	30%	Pass
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	B14-JI25563	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass
sulfidic - Titratable Peroxide Acidity - equivalent S% pyrite	B14-JI25563	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass
sulfidic - Titratable Sulfidic Acidity - equivalent S% pyrite	B14-JI25563	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass
Sulfur - KCl Extractable	B14-JI25563	CP	% S	< 0.02	< 0.02	<1	30%	Pass
Sulfur - Peroxide	B14-JI25563	CP	% S	< 0.02	< 0.02	<1	30%	Pass
Sulfur - Peroxide Oxidisable Sulfur	B14-JI25563	CP	% S	< 0.02	< 0.02	<1	30%	Pass
acidity - Peroxide Oxidisable Sulfur	B14-JI25563	CP	mol H+/t	< 10	< 10	<1	30%	Pass
Calcium - KCl Extractable	B14-JI25563	CP	% Ca	< 0.02	< 0.02	<1	30%	Pass
Calcium - Peroxide	B14-JI25563	CP	% Ca	< 0.02	< 0.02	<1	30%	Pass
Acid Reacted Calcium	B14-JI25563	CP	% Ca	< 0.02	< 0.02	<1	30%	Pass
acidity - Acid Reacted Calcium	B14-JI25563	CP	mol H+/t	< 10	< 10	<1	30%	Pass
sulfidic - Acid Reacted Calcium equivalent S% pyrite	B14-JI25563	CP	% S	< 0.02	< 0.02	<1	30%	Pass
Magnesium - KCl Extractable	B14-JI25563	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass
Magnesium - Peroxide	B14-JI25563	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass
Acid Reacted Magnesium	B14-JI25563	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass
acidity - Acid Reacted Magnesium	B14-JI25563	CP	mol H+/t	< 10	< 10	<1	30%	Pass
sulfidic - Acid Reacted Magnesium equivalent S% pyrite	B14-JI25563	CP	% S	< 0.02	< 0.02	<1	30%	Pass
ANC Fineness Factor	B14-JI25563	CP		1.5	1.5	<1	30%	Pass
Net Acidity (sulfur units) - SPOCAS	B14-JI25563	CP	% S	< 0.02	< 0.02	<1	30%	Pass
Net Acidity (acidity units) - SPOCAS	B14-JI25563	CP	mol H+/t	< 10	< 10	<1	30%	Pass
Liming rate - SPOCAS	B14-JI25563	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass

**Comments**

**Sample Integrity**

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

**Qualifier Codes/Comments**

<b>Code</b>	<b>Description</b>
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5

**Authorised By**

Natalie Krasselt                      Client Services



**Glenn Jackson**  
**Laboratory Manager**

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

\* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

Eurofins | mgt shall not be liable for loss, cost, damages or expenses incurred by the client, or any other person or company, resulting from the use of any information or interpretation given in this report. In no case shall Eurofins | mgt be liable for consequential damages including, but not limited to, lost profits, damages for failure to meet deadlines and lost production arising from this report. This document shall not be reproduced except in full and relates only to the items tested. Unless indicated otherwise, the tests were performed on the samples as received.



## Appendix F: Understanding Your Geotechnical Engineering

# UNDERSTANDING YOUR GEOTECHNICAL ENGINEERING REPORT

GALT FORM PMP11 Rev1

## 1. EXPECTATIONS OF A GEOTECHNICAL ENGINEERING REPORT

This document has been prepared to clarify what is and is not provided in your geotechnical report. It is intended to inform you of what your realistic expectations of this report should be and how to manage your risks associated with geotechnical conditions.

Geotechnical engineering is a less exact science than other engineering disciplines. We include this information to help you understand where our responsibilities as geotechnical engineers begin and end, to help the client recognise his responsibilities and risks. You should read and understand this information. Please contact us if you do not understand the report or this explanation. We have extensive experience in a wide variety of geotechnical problems and we can help you to manage your risk.

## 2. THIS REPORT RELATES TO PROJECT-SPECIFIC CONDITIONS

This report was developed for a unique set of project-specific conditions to meet the needs of the nominated client. It took into account the following :

- ✦ The project objectives as we understood them and as described in this report;
- ✦ the specific site mentioned in this report; and
- ✦ the current and proposed development at the site.

It should not be used for any purpose other than that indicated in the report. You should not rely on this geotechnical report if any of the following conditions apply:

- ✦ the report was not written for you;
- ✦ the report was not written for the site specific to your development;
- ✦ the report was not written for your project (including a development at the correct site but other than that listed in the report); or
- ✦ the report was written before significant changes occurred at the site (such as a development or a change in ground conditions).

You should always inform us of changes in the proposed project (including minor changes) and request an assessment of their impact.

Where we are not informed of developments relevant to your geotechnical engineering report, we cannot be held responsible or liable for problems that may arise as a consequence.

Where design is to be carried out by others using information provided by us, we recommend that we be involved in the design process by being engaged for consultation with other members of the design team and by being able to review work produced by other members of the design team which relies on geotechnical information provided in our report.



### 3. GEOTECHNICAL ENGINEERING LOGS

Our reports often include logs of intrusive and non-intrusive geotechnical investigation techniques. These logs are based on our interpretation of field data and laboratory results. The logs should only be read in conjunction with the report they were issued with and should not be re-drawn for inclusion in other documents not prepared by us.

### 4. THIRD PARTY RELIANCE

We have prepared this report for use by the client. This report must be regarded as confidential to the client and the client's professional advisors. We do not accept any responsibility for contents of this document from any party other than the nominated client. We take no responsibility for any damages suffered by a third party as a consequence of any decisions or actions they may make based on this report. Any reliance or decisions made by a third party based on this report are the responsibility of the third party and not of us.

### 5. CHANGE IN SUBSURFACE CONDITIONS

The geotechnical recommendations in this report are based on the ground conditions that existed at the time when the study was undertaken. Changes in ground conditions can occur in numerous ways including as a result of anthropogenic events (such as construction on or adjacent to the site) or natural events (such as floods, groundwater fluctuations or earthquakes). We should be consulted prior to use of this report so that we can comment on its reliability. It is important to note that where ground conditions have changed, additional sampling, testing or analysis may be required to fully assess the changed conditions.

### 6. SUBSURFACE CONDITIONS DURING CONSTRUCTION

Practical constraints mean that we cannot know every minute detail about the subsurface conditions at a particular site. We use engineering judgement to form an opinion about the subsurface conditions at the site. Some variation to our evaluated conditions is likely and significant variation is possible. Accordingly, our report should not be considered as final as it is developed from engineering judgement and opinion.

The most effective means of dealing with unanticipated ground conditions is to engage us for construction support. We can only finalise our recommendations by observing actual subsurface conditions encountered during construction. We cannot accept liability for a report's recommendations if we cannot observe construction.

### 7. ENVIRONMENTAL ISSUES

Unless specifically mentioned otherwise in our report, environmental considerations are not included. The investigation techniques used by us in developing our report differ from those for an environmental investigation. Our report was not prepared with environmental considerations in mind and it is the client's responsibility to satisfy himself that environmental considerations have been taken into account for the site. If you require guidance on how to proceed on evaluating environmental risk at the site, we can provide further information and contacts.

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**APPENDIX 4**

Estimate of Construction Costs

Prepared by McDowall Affleck

October 2014



Rivergreen Pty Ltd  
10 Boronia Trail,  
CANNING VALE WA 6155

Attention: Mike Kelly

Dear Mike,

**PROPOSED DEVELOPMENT – LOT 601 OLD PINJARRA ROAD, GREENFIELDS**

As requested, we submit an estimate of construction costs for the above mentioned development.

The development consists of 1 lot being developed into a 114 unit site fronting Old Pinjarra Road. The civil works will be completed over 2 stages.

As no development approval conditions are available, we have based our estimate on our experience from similar projects, being earthworks to achieve sufficient finished floor levels, internal roads, drainage, sewer, water, gas, underground power and telecommunications. Construction costs are based on rates provided on similar projects we have completed recently.

Please find attached our estimate of development costs together with the allowances made in preparing the estimate.

**Degree of accuracy**

Please note that as the final designs have not been approved, there is a degree of uncertainty associated with the estimate. Therefore we advise that the actual development costs could be within  $\pm 20\%$  of our estimated costs.

**Closure**

If you have any questions please call on 9274 6444.

Regards

**Grant Speldewinde | LPM Minor Subdivision (Civil) | McDowall Affleck Pty Ltd | ABN: 23 009 033 345 |**

**T: +61 8 9274 6444 | F: +61 8 9250 3433 | E: gspeldewinde@mapl.net.au | www.mcdowallaffleck.com.au |**

**7 October 2014**

Enclosures: Allowances  
Estimate of costs



## **ALLOWANCES**

### **Earthworks**

We have allowed to clear, strip topsoil and import fill to provide a minimum 0.5m clearance to the 100 year flood level of 2.1 AHD. The rear of the block will be 1m below the natural ground level to reduce the amount of fill required. In turn, it requires a 1m retaining wall that reduces the useable space by 1m along the rear boundary.

We have also allowed to construct limestone retaining walls as required to achieve the design levels.

Stage 1 allows for the majority of the import fill to be placed on the site. The eastern half of the site will be retained as part of the stage 1 works, the remainder of the fill will be retained as part of stage 2.

### **Roads and Footpaths**

We have allowed for:

1. Upgrading Old Pinjarra Road to a kerbed standard with an asphalt overlay while maintaining its current width. The City of Mandurah will rely on a Traffic Report to determine if an upgrade is required and it's standard.
2. Footpath along Old Pinjarra Road.
3. Internal roads.

We have allowed upgrading Old Coast Road to match the existing levels. Drainage to be provided within shallow swales via kerb breaks. We have not allowed to upgrade the basecourse thickness or re-grade the road.

Stage 1 allows for the road upgrade, footpath and 50% of the internal roads. The remainder of the works will be completed in stage 2.

### **Drainage**

We based our estimate on the Geotechnical Report provided by GALT.

We have allowed for all the internal roads and buildings to be drained by way of soakwells with an overland flow path onto Old Pinjarra Road.

Stage 1 allows for the drainage associated with the road upgrade and 50% of the internal drainage. The remainder of the works will be completed in stage 2.

### **Sewer Reticulation**

We have allowed to service the development with sewer reticulation by the way of running a Water Corporation gravity main from the intersection of Teranca Road.

We have allowed for internal sewer reticulation to provide connection points to the unit sites. The internal building services will be done as part of the building works.

We have allowed for Water Corporation sewer headwork's as required by the Water Corporation.

Stage 1 allows for the Water Corporation sewer main within Old Coast Road and 50% of the internal sewer. The remainder of the works will be completed in stage 2.

### **Water Reticulation**

We have allowed providing reticulated scheme water to your development by way of a 150 diameter water main along Old Pinjarra Road and a main upgrade by Water Corporation.



We have allowed for internal water reticulation to provide connection points to the unit sites. The internal building services will be done as part of the building works.

We have allowed for Water Corporation water headwork's as required by the Water Corporation.

Stage 1 allows for the Water Corporation water main within Old Coast Road, water main upgrade and 50% of the internal water. The remainder of the works will be completed in stage 2.

### **Underground Power**

We have allowed for the supply, trenching, installation of cables and transformers to service the proposed development as advised by Western Power based on the estimated demand.

Stage 1 allows for the cables and transformer to service the development and 50% of the internal power. The remainder of the works will be completed in stage 2.

### **Gas Reticulation**

We have allowed for gas to be provided to the development by way of a main extension from Cambridge Drive. We have allowed for the gas to be laid in a common trench with the water main where possible.

We have allowed for internal gas reticulation to provide connection points to the unit sites. The internal building services will be done as part of the building works.

Stage 1 allows for the gas extension within Old Coast Road and 50% of the internal gas. The remainder of the works will be completed in stage 2.

### **Telstra**

We have allowed for Telstra to install a new line within Old Coast Road to allow the removal of Telstra assets from private property.

Stage 1 allows for the extension of the Telstra line within Old Coast Road, removal of existing Telstra assets and 50% of the internal communications. The remainder of the works will be completed in stage 2.

### **Contingency**

Please note that we have included a contingency of 10% of the construction costs for unknowns.

### **Other Fees**

We have made an allowance for fees payable for:

1. Design fees;
2. Tendering;
3. Superintendence;
4. Underground power and telecommunications design;
5. City of Mandurah inspection fees;
6. Water Corporation planning fees.

We have made no allowance for:

1. Landscaping/Street Trees;
2. Rock excavation. You should make an allowance of \$175/m<sup>3</sup> should rock excavation be required;
3. Upgrading other existing infrastructure or extending it to the site;
4. City of Mandurah contribution costs;
5. Cash-in-Lieu of POS contribution;
6. Council Maintenance fees as these fees are refundable;



7. Fencing;
8. Fire Management Plans and implementation;
9. Acid Sulphate Soils;
10. Geotechnical Report;
11. Application fees;
12. Planning fees;
13. Contribution to Education or similar;
14. Internal asconstructed drawings;
15. GST.

## **APPENDIX 5**

Bushfire Management Plan  
Prepared by Ecosystem Solutions  
April 2016

# Bushfire Management Plan



Lot 601 (No. 22) Old Pinjarra Rd

Greenfields

Prepared for  
Property Edge WA Pty Ltd  
&  
RPS Australia Asia Pacific

26<sup>th</sup> April 2016

PO Box 685

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Email: [info@ecosystemsolutions.com.au](mailto:info@ecosystemsolutions.com.au)

Web: [www.ecosystemsolutions.com.au](http://www.ecosystemsolutions.com.au)



## **Limitations Statement**

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In undertaking this work the authors have made every effort to ensure the accuracy of the information used. Any conclusions drawn or recommendations made in the report are done in good faith and the consultants take no responsibility for how this information and the report are used subsequently by others.

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## **1. Introduction**

This Bushfire Management Plan (BMP) has been prepared by Ecosystem Solutions Pty Ltd, as part of the process of the owners of Lot 601 Old Pinjarra Road, Greenfields (hereafter called the "Site") to subdivide the 1.5 ha lot into a multi-dwelling development (Figure 1). This report has been prepared by Gary McMahon (B.Sc. M. Env Mgmt), and Kelly Paterson (B.Sc. Hons. Nat Rs Mgmt).

The purpose of this BMP is to detail the fire management methods and requirements that will be implemented within the proposed development. The aim of the BMP is to reduce the threat to residents and fire fighters in the event of a fire within or near the Site.

## **2. Site Description.**

### **2.1. Location**

The site is located approximately 5 km to the east of Mandurah. It covers an area of approximately 1.54 ha and is a small rural lot with a single dwelling and approximately 0.6ha of degraded vegetation (Ecosystem Solutions, 2014).

The surrounding landscape contains urban development on the eastern edge of the town of Mandurah. The lots to the south and east are still small rural residential lots, while the lots to the north are urban. The land directly to the east of the site is zoned Urban Development and will be residential development in the future.

The State's Bushfire Hazard Mapping shows that the southern portion of the site is classed as Bushfire Prone (Figure 2).

The proposed development has included parking and access areas to the south, with a landscaped area and then the residential areas as shown in Map 1.

### **2.2. Landscape Elements**

The site and surrounding landscape is flat, approximately 3 metres above sea level Australian Height Datum (AHD) and slopes gently to the north up to approximately 5m.

The site includes some areas of vegetation which will mostly be removed during the development process. Some small areas will be landscaped, these will be excluded

from assessment under AS 3959 under Section 2.2.3.2 (f). The main fire hazard vegetation is to the south of the site, located in Lot 10 (Map 2, Figures 3 & 4).

No Development within this zone fill the land to the east is developed or it is demonstrated that the setback from the unmanaged grassland is no longer required – refer to text.



Figure 1: Development Guide Plan for Lot 601 Old Pinjarra Road, Greenfields Refer to Notes on Staging



Figure 2: State Bushfire Risk Map over site and surrounding landscape.



Figure 3: Woodland vegetation in Lot 10 to the south.



Figure 4: Woodland vegetation to the south of the site.

### 3. Statutory Conditions

The Western Australian Planning Commission (WAPC) and the Fire and Emergency Services Authority of Western Australia (FESA) jointly developed *Planning for Bushfire Protection Guidelines* (Edition 2) in May 2010, in accordance with clause 6 of *State Planning Policy 3.4 Natural Hazards and Disasters* (SPP 3.4).

This Policy and Guidelines were superseded on 7<sup>th</sup> December 2015 by *State Planning Policy 3.7: Planning in Bushfire Prone Areas and Guidelines for Planning in Bushfire Prone Areas* (WAPC, 2015).

The objectives of this new policy are to:

- Avoid any increase in the threat of bushfire to people, property and infrastructure;
- Reduce the vulnerability to bushfire through the identification and consideration of bushfire risks in decision making at all stages of the planning and development process;
- Ensure higher order strategic planning documents, strategic planning proposals, subdivision and development applications take bushfire protection requirements into account; and
- Achieve an appropriate balance between bushfire risk management measures, biodiversity conservation values, environmental protection and landscape amenity.

The policy determines those areas that are most vulnerable to bushfire and where development is appropriate and not appropriate. The provisions and requirements contained in the new *Guidelines for Planning in Bushfire Prone Areas* (WAPC, 2015) are used in for this determination.

These guidelines form the foundation for fire risk management planning in WA at a community and land development level.

The Bushfires Act (1954) sets out provisions to reduce the dangers resulting from bushfires, prevent, control and extinguish bushfires and for other purposes. The Act addresses various matters such as prohibited burning times, and enables Local Government to require landowners/occupiers to maintain fire breaks, to control and extinguish bushfires and to establish and maintain Bushfire Brigades.



This Bushfire Management Plan (BMP) demonstrates that all fire protection requirements for issues including fire suppression response, development design, access, water supply, building locations and other relevant performance criteria contained in *Guidelines for Planning in Bushfire Prone Areas* (WAPC, 2015) can be achieved to the satisfaction of the WAPC.

## **4. Fire Risk**

Numerous elements affect building survival in a bushfire event. Some of these factors relate to the bushfire behaviour experienced at the Site, others relate to the design and the construction materials used in the building and the development's surrounding landscape. Infrastructure, utilities, climate and human behaviour also contribute to the overall risk.

Within this plan, the assessment of fire risk takes into account the layout of the development and the conditions that exist at the Site. These include:

- Vegetation Type and cover;
- Topography, with particular reference to ground slopes and accessibility;
- Climate; and
- Relationship to surrounding development.

### **4.1. Vegetation and Topography**

An assessment of the composition of the vegetation and the slope of the land under that vegetation was conducted on site in March 2016.

The site has some areas of vegetation which will be mostly removed as part of the development process. A small section (~2,000m<sup>2</sup>) of landscaped feature will be incorporated into the access areas of the design, which will retain some of the trees in the area. This area will be cultivated gardens and is excluded from assessment under AS 3959 under Section 2.2.3.2 (f). The main fire hazard vegetation is to the south of the site, located in Lot 10 (Map 2). The land to the east and is currently paddock areas. Figure 2 of the States Bushfire Risk Map shows that this area is not considered a bushfire risk in its entirety, as the northern half of the adjoining paddock is not highlighted.

The vegetation to the south is *Eucalyptus rudis* (Flooded gum) woodland with scattered shrubland understorey, mainly *Acacia* spp and *Lepidosperma* weed species (Figures

3 & 4). The ground layer is dominated with perennial grass weeds. The slope under the vegetation is flat, being at approximately 3m AHD. This vegetation is classified as Group B Woodland, upslope and flat land (0 degrees) under AS 3959-2009.

The land to the east is paddock with a few small patches of trees. The trees are under 0.25 ha and more than 20 from other assessable vegetation and are therefore excluded from assessment under AS 3959-2009 2.2.3.2 (c). The paddock area will be categorised as Class G Grassland, unless an agreement can be obtained from the landowner stating that they will maintain the grass in a low fuel state (i.e. under 100mm) during the bushfire season.

The vegetation assessment is shown in Map 2.

A Bushfire Hazard Level Assessment Map has been prepared which considers vegetation type and structure, and the topography of the Site (Map 3). The vegetation to the south of the site would be considered a Moderate Bushfire Hazard and the grassland/paddocks to the east would be classified as Low.

#### **4.2. Fire Climate**

Bushfire behaviour is significantly affected by weather conditions. They will burn more aggressively when high temperatures combine with low humidity and strong winds. Generally, the greatest fire risk occurs from summer through to autumn, when the moisture levels in the soil and vegetation are low.

The Site is located within south-west of Western Australia which experiences hot dry summers and cool wet winters (commonly called a Mediterranean climate).

Data from the Bureau of Meteorology at Mandurah (approximately 5 kms to the west of the Site) confirms that the Site experiences hot dry summers with an average December to February temperature of 29°C and 14 mm of rain per month over summer. Winters are cooler with a mean maximum temperature through June, July and August of 18°C and an average June rainfall of 120mm (BOM, accessed February 2016).

The 3pm December wind rose for Mandurah shows that the afternoon sea breeze from the south-west dominates at nearly 60 % of the time. This is similar for January and February.

The combination of hot dry summers, prevailing winds and dry vegetation poses a bushfire risk. Bushfire prevention is considered essential for the protection of life and

property and to ensure that frequent and uncontrolled burning does not degrade the vegetation and conservation values of the property.

### **4.3. Surrounding Landscape & History**

The surrounding landscape contains urban development on the eastern edge of the town of Mandurah. The lots to the south and east are still small rural residential lots containing some remnant vegetation, while the lots to the north are urban.

The surrounding urban areas pose a low bushfire risk due to the lack of remaining vegetation. The paddock areas to the east (until they are developed into residential lots) will be required to be managed in a low fuel state during the fire season and are therefore considered a low risk.

The areas of remnant vegetation to the south pose a moderate bushfire risk.

The fire risk to people and property within the Site is considered moderate due to the areas of remnant vegetation south of the site. By complying with the requirements of this BMP, this risk can be appropriately managed.

### **4.4. Bushfire Hazard Level Assessment**

Bushfire Hazard Level Assessment (BHL) is determined by rating the vegetation type against Table 3: Hazard levels and characteristics of *Guidelines for Planning in Bushfire Prone Areas* (WAPC, 2015).

A Bushfire Hazard Level Assessment map has been prepared which considers vegetation type and structure, and the topography of the Site (Map 3). The *Eucalyptus rudis* woodland areas to the south of the development are classified as a Moderate bushfire hazard.

Provided the requirements of this BMP are maintained, the fire risk to people and property within the proposed Site is considered moderate.

## 5. Bushfire Management Plan

The aim of the Bushfire Management Plan is to reduce the impacts to residents and fire fighters in the event of bushfire within or near the Site.

The Site will need to be developed to incorporate fire management measures outlined within this plan. This includes the following bushfire protection elements as outlined in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015):

- Location;
- Siting and Design of Development;
- Vehicular Access;
- Water sources and storage; and
- Dwelling Construction Standards.

Map 4 shows the elements of the Bushfire Management Plan as mentioned below.

### 5.1. Element 1: Location

#### **Performance Principle**

The intent of this element may be achieved where the development is located in an area where the bushfire hazard assessment is or will on completion, be moderate or low, or a BAL-29 or below and the risk can be managed.

#### **Acceptable Solutions**

To achieve compliance with this element using an acceptable solution approach, acceptable solutions A 1.1 must be met:

#### **A1.1 – Development Location**

#### **Background**

Australian Standard (AS) 3959-2009 requires that properties exposed to a potential bushfire risk, be assessed to determine a “Bushfire Attack Level” (BAL). The standard defines BAL as:

*A means of measuring the severity of a building's potential exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kilowatts per metre squared, and the basis for establishing the requirements for construction to improve protection of building elements from attack by bushfire. (Standards Australia, AS 3959-2009).*

Once assigned, a BAL will determine the appropriate construction requirements for a block or property.

AS 3959-2009 specifies 6 Bushfire Attack Levels (BAL), ranging from Low to Extreme. There are increasing construction requirements ranging from ember protection to direct flame contact protection as the BAL level increases. A BAL assessment determines the appropriate construction requirements for the property. The determination of a property's BAL in accordance with AS 3959 for bushfire prone areas, is a site specific assessment that considers a number of factors including the slope of the land, the types of surrounding vegetation and its proximity to other building or structures on the Site. A BAL-LOW rating is considered to be a low bushfire hazard land classification. BAL-12.5, BAL-19 and BAL-29 ratings are considered to be areas with a moderate bushfire hazard and BAL-40 and BAL-FZ are rated as areas with extreme bushfire hazard levels and these are not normally approved as suitable building sites by the decision making authorities.

### **Acceptable Solutions**

***The development is located in an area that is, or will be on completion, be subject to either a moderate bushfire hazard level or BAL-29 or lower.***

A BAL contour for the proposed lots has been produced using the slope and proximity of each of the lots to the existing *Eucalyptus rudis* Woodland vegetation (Map 4), which is the primary fire hazard. The grassland within the paddock to the east is categorised as unmanaged grassland until it is developed or until there is an agreement with the landowner that they will maintain the paddock grasses along that boundary as a low fuel zone (i.e. under 100 mm) for the fire season. The setback from unmanaged grassland to provide BAL-29 maximum is 8m on flat land. This line is shown in Map 4.

If an agreement with the landowner to the east of the site cannot be obtained, the development will be staged, where the area to the east of the site (i.e. Stage 4 on Figure 1) will not be developed until the land to the east is developed or a signed agreement with the landowner is obtained. This will allow the development to progress in the interim. The separation distance from the eastern edge of proposed stage 3 to the boundary and the unmanaged grassland vegetation is 25 m, which will result in the dwellings in Stage 3 and 6 being categorised as BAL-12.5.

With the above condition, Within the proposed development, the maximum Bushfire Attack Level of the residential elements of the site will be BAL-12.5. No dwelling within the proposed development will be required to be built above a BAL-29 construction standard, as preferred by Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015). Accordingly as per AS 3959-2009, Construction Standards Section 2 and 5 will apply.

## **5.2. Element 2: Siting & Design of Development**

### ***Performance Principle***

The intent of this element may be achieved where the siting and design of the development, including roads, paths and landscaping, is appropriate to the level of bushfire threat that applies to the site. That it minimizes the bushfire risk to people, property and infrastructure, including compliance with AS 3959 if appropriate.

### ***Acceptable Solutions***

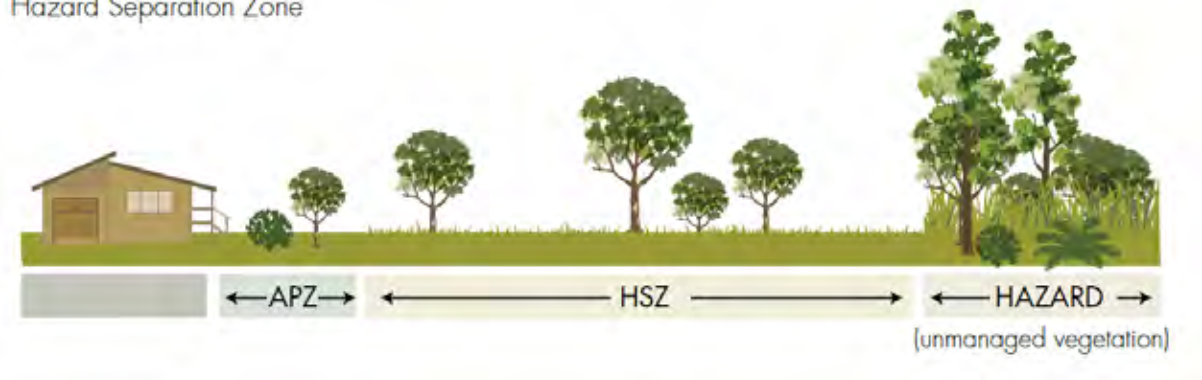
To achieve compliance with this element using an acceptable solution approach, either or both acceptable solutions (A2.1 and A2.2) must be met to the extent that it satisfies Element 1 - Location.

#### **A2.1 – Asset Protection Zone**

##### ***Background***

The WAPC (2015) states that the Asset Protection Zone (APZ) is a low fuel area immediately surrounding a habitable or specified building, and is designed to minimise the likelihood of flame contact with buildings. A Hazard Separation Zone (A2.2) is required in addition to the APZ. All of the requirements prescribed in A2.1 are essential and must be achieved to ensure compliance. A cross section of the Asset Protection Zone and Hazard Separation Zone (Figure 12 from Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015)) is shown in Figure 5 below:

**Figure 12:** Cross section of Asset Protection Zone and Hazard Separation Zone



**Figure 5: Cross section of the Asset Protection Zone and Hazard Separation Zone (WAPC, 2015)**

Non-flammable features such as driveways, lawns, landscaped gardens and vegetable patches can form part of the APZs. Isolated trees and shrubs may be retained within APZs.

Ideally APZs should be accommodated within the boundaries of the subject lot. However, with small size lots, this is not achievable. Within Section E 2.1 of the Appendices of Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015 b), it states where a full 20 m APZ is not possible, the APZ needs to be sufficient to ensure the potential radiant heat impact of a fire does not exceed 29 kW/m<sup>2</sup> (i.e. a BAL-29). This will be the case in this development as no residential construction element will be exposed to a radiant heat impact exceeding 12.5 kW/m<sup>2</sup>.

### **Acceptable Solutions**

Every building will be surround be an APZ, which meets the following requirements:

- a) Width: A full 20 metre APZ is not possible within the lots in this development, however with design, layout and maintaining each lots APZ to their boundary, will be sufficient enough to ensure the potential radiant heat impact of a fire does not exceed 29 kW/m<sup>2</sup>.
- b) Location: the APZ will be maintained to the boundaries of the lot on which the building is situated;
- c) Fine Fuel load: will be reduced to and maintained at two tonnes per hectare within the APZ;
- d) Trees (crowns) are a minimum distance of ten metres apart. A small group of trees within close proximity to one another may be treated as one crown

- provided the combined crowns do not exceed the area of a large or mature crown size for that species;
- e) No tall shrubs or trees will be located within two metres of a building;
  - f) No tree crowns will overhang the building;
  - g) Fences within the APZ are to be constructed using non-combustible materials (eg. iron, brick, limestone, metal post and wire); and
  - h) Sheds within the APZ should not contain flammable materials.

## **A2.2 Hazard Separation Zone**

### **Background**

The Hazard Separation Zone (HSZ) is a physical separation from bushfire prone vegetation (WAPC, 2015).

#### *Hazard separation around subdivisions*

The HSZ provides a physical separation between any extreme bushfire hazard areas and the development front which is situated within low and moderate hazard areas. The aim of this area of low fuel is to reduce bush fire intensity close to dwellings, and to minimise the likelihood of flame contact with buildings

It should be noted that the use of a HSZ will only minimise bush fire vulnerability. It is only one of the tools to be applied to reduce the likely bush fire intensity near buildings. Under adverse fire conditions, high intensity bush fires can still occur in, and fire fronts can burn through, even well maintained HSZs.

Within this subdivision, the roading and lack of vegetation provide an adequate HSZ for the dwellings within it.

#### *Hazard separation within subdivisions*

Separation may be necessary on the perimeter of a subdivision but may also be needed where bushfire hazards exist within a subdivision. This separation reduces the overall vulnerability of a subdivision and related development and assists with fire control operations. Examples of bushfire hazards within a subdivision may include wetlands and their buffers, gullies, waterways and their foreshore areas, or public open space with remnant vegetation. Other hazard areas may include undeveloped stages or lots within, or adjacent to, a subdivision and related development and are



required to be taken into account, even if the hazard will eventually be removed at a subsequent stage.

Hazard separation should be provided between extreme bushfire hazards and buildings within a subdivision to create a combined minimum separation distance of 100 metres between the buildings and the hazard in order to protect them from burning embers, radiant heat and direct flame contact. The minimum hazard separation distance may be reduced if the development is compliant with AS 3959 or by using a performance principle assessment. Under AS 3959, as the distance from the vegetation is reduced, the construction standard must be increased.

### **Acceptable Solutions**

A HSZ is not required for this development as any proposed construction will meet the standard appropriate to the BAL for that location, and does not exceed BAL-29.

## **5.3. Element 3: Vehicular Access**

### **Performance Principle**

The intent of this element may be achieved where the internal layout, design and construction of public and private vehicular access and egress in the subdivision/development allow emergency and other vehicles to move through it easily and safely at all times

### **Acceptable Solutions**

To achieve the intent, all applicable 'acceptable solutions' must be addressed.

#### **A3.1 – Two Access Routes**

The main entrance to the Site is via Old Pinjarra Road, Greenfields. Old Pinjarra Road is a designated public road and conforms to the public road standards as outlined below.

Access/egress for the proposed lots is achievable by taking Old Pinjarra Road to either the south or the west, to access Pinjarra Road. Pinjarra Road can then be taken to the south-east towards Barragup or to the west to Mandurah.

#### **A3.2 – Public Roads**

Public Roads to be constructed to allow access into the development will meet the following requirements as outlined in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015) Table 4, Column 1:

- Minimum trafficable surface: 6 metres
- Horizontal clearance: 6 metres
- Vertical clearance: 4.5 metres
- Maximum grade over <50 metres: 1 in 10
- Minimum weight capacity: 15 tonnes
- Maximum crossfall: 1 in 33
- Curves minimum inner radius: 8.5 metres

#### **5.4. Element 4: Water Sources and Storage.**

##### ***Performance Principle***

The intent of this element may be achieved where the subdivision, development or land use is provided with a permanent and secure water supply that is sufficient for firefighting purposes.

##### ***Acceptable Solutions***

###### **A4.1: Reticulated Areas**

Fire services require quick and ready access to and adequate water supplies during fire emergencies. The area will be provided with reticulated water (including hydrants) to Water Corporation and Department of Fire and Emergency Services Standards.

The Water Corporation of WA's Water Reticulation Standard No. 63 is considered to be the baseline criteria for developments and will be applied to this subdivision.

Hydrants will be installed within the development at regular intervals and in easily located areas. Fire hydrants' locations will be marked and identified by pole indicators, road markings and retro road pavement markings as appropriate and required by the City of Mandurah and the Department of Fire and Emergency Services.

#### **5.5. Dwelling Construction**

Any dwelling that is to be constructed shall be designed and built to conform with:

- The City of Mandurah's specifications and requirements;
- Australian Standards AS3959-2009 (Recommendations)- with a BAL-12.5 AS 3959-2009 Sections 3 & 5 apply (Australian Standards 2009);
- and

- The *Homeowners Bushfire Survival Manual* (FESA, 2007) & *Prepare, Act, Survive* (FESA, 2011) guidelines.

## **6. Conclusion.**

This plan provides acceptable solutions and responses to the performance criteria outlined in *Guidelines for Planning in Bushfire Prone Areas* (WAPC, 2015).

To the south and east of the site are rural residential lots which contain areas of remnant vegetation, posing a moderate bushfire risk. Other surrounding areas have been cleared for urban development and pose only a low bushfire hazard due to lack of remaining vegetation.

Bushfire safety is a shared responsibility between governments, fire agencies, communities and landowners. The planning and building controls outlined in this plan will reduce the risk of bushfire to people and property. It will not remove all risk however. People interpret risk differently. The way they prepare and maintain their properties, buildings and assets and the actions they take (e.g. evacuate early or stay and defend) greatly influence their personal safety. Should any residents eventuate within the proposed Site, they need to maintain self-reliance and not wait or expect warnings or assistance from emergency services.

## **7. Summary**

### **7.1. Overall Fire Threat**

The design of the proposed expansion and the facilities to be established at the time of development are such that, with the implementation of this Bushfire Management Plan, fire threat to people and property within this development is significantly reduced.

### **7.2. Landowners' Responsibilities**

The landowners' in succession will be responsible for:

- Being aware of the bushfire risk potentially affecting their property, with an understanding that bushfire threat can never be fully removed;
- Reading, understanding and complying with this Bushfire Management Plan;
- Ensuring the ongoing implementation of this Bushfire Management Plan, including providing successive landowners with a copy of this Bushfire Management Plan, and making them aware of the responsibilities outlined in this Bushfire Management Plan;
- Preparing and implementing contingency measures in the event a bushfire should occur onsite;
- Responding to and complying with fire protection or hazard management notices issued by the local government;
- Ensuring that all dwellings are designed and constructed in full compliance with Australian Standards AS3959-2009 (Recommendations) and the requirements of the City of Mandurah.

### **7.3. Developer's Responsibilities**

The developer shall be required to carry out works that include the points listed below.

- Install all access ways as described.
- Install Asset Protection Zones as described.
- Proposed Stage 4 will not be developed until either an agreement is obtained with the landowner to the east that the grassland will be maintained in a low fuel state during the fire season, OR the land to the east is developed and no longer considered a fire hazard.

- Lodging a section 70A Notification on each Certificate of Title proposed by the subdivision. The notification shall alert purchasers of land and successors in Title of the responsibilities of this Bushfire Management Plan.
- Maintaining the existing fire breaks to the required standard until individual lots are sold (when they become the individual lot owner's responsibilities).
- Supply a copy of this Bushfire Management Plan and the Bushfire Survival Manual to each property owner on sale of the allotment. A copy of the approved Bushfire Management Plan must be attached to all Contracts of Sale for the Lot.

#### **7.4. City of Mandurah's Responsibilities**

The responsibility for compliance with the law rests with individual property owner and occupiers and the following conditions are not intended to necessarily transfer some to the responsibilities to the City of Mandurah.

The City of Mandurah shall be responsible for:

- Monitoring bush fuel loads in road reserve, public reserves, public open space areas and other areas of bushfire risk and maintaining fuel loads at safe levels;
- Maintaining public roads to appropriate standards ensuring compliance with standards.
- Developing and maintaining District Fire-Fighting Facilities.
- Maintaining, in good order, the condition of the district water tanks and fire hydrants and the apparatus for firefighting purposes.
- Enforcement of the Annual Firebreak Notice;
- Seeking comments and advice from the WAPC and DFES in relation to local bushfire planning policies, and;
- Provision of fire prevention and preparedness advice to landowners upon request.

## 8. Compliance Checklist

The following comprises the completed checklist for performance criteria and acceptable solutions as stipulated in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015).

Element			
<b>1: Location</b>	<b>Yes</b>	<b>No</b>	<b>Comment</b>
Does the proposal comply with the performance criteria by applying acceptable solution A1.1?	✓		
<b>2: Siting and design of development</b>	<b>Yes</b>	<b>No</b>	<b>Comment</b>
Does the proposal comply with the performance criteria by applying acceptable solution A2.1	✓		
Does the proposal comply with the performance criteria by applying acceptable solution A2.2	✓		
<b>3: Vehicular access</b>	<b>Yes</b>	<b>No</b>	<b>Comment</b>
Does the proposal comply with the performance criteria by applying acceptable solution A3.1	✓		
Does the proposal comply with the performance criteria by applying acceptable solution A3.2	✓		
Does the proposal comply with the performance criteria by applying acceptable solution A3.3			N/A
Does the proposal comply with the performance criteria by applying acceptable solution A3.4			N/A
Does the proposal comply with the performance criteria by applying acceptable solution A3.5			N/A
Does the proposal comply with the performance criteria by applying acceptable solution A3.6			N/A
Does the proposal comply with the performance criteria by applying acceptable solution A3.7			N/A
Does the proposal comply with the performance criteria by applying acceptable solution A3.8			N/A
<b>4: Water sources and storage</b>	<b>Yes</b>	<b>No</b>	<b>Comment</b>
Does the proposal comply with the performance criteria by applying acceptable solution A4.1	✓		
Does the proposal comply with the performance criteria by applying acceptable solution A4.2			N/A

Does the proposal comply with the performance criteria by applying acceptable solution A4.3			N/A

**Applicant Declaration**

This Bushfire Management Plan meets the requirements of SPP 3.7 and the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015).

I declare that the information proposed within this plan is true and correct to the best of my knowledge.

**Gary McMahon (B.Sc. M. EnvMgmt) for Ecosystem Solutions Pty Ltd.**

**26<sup>th</sup> April 2016**



## 9. References

- Barnesby, B.A. and Proulx-Nixon, M.E. (2000). *Land resources from Harvey to Capel on the Swan Coastal Plain, Western Australia - Sheets 1 and 2. Land Resources Maps No. 23/1 and 23/2.* Agriculture Western Australia.
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- FESA, WAPC & Dept of Planning (2010). *Planning for Bushfire Protection.* Edition 2. May, Government of Western Australia, Perth. WA.
- FESA (2012). *Visual Fuel Load Guide for Scrub Vegetation of the Swan Coastal Plain and Darling Scarp, including Geraldton Sandplains & Leeuwin Ridge Regions of Western Australia.* Bushfire and Environmental Protection Branch, Fire and Emergency Services Authority of Western Australia.
- WAPC (2015). *Guidelines for Planning in Bushfire Prone Areas.* Western Australian Planning Commission, Perth. WA.
- WAPC (2015a). *State Planning Policy 3.7: Planning in Bushfire Prone Areas (SPP 3.7).* Western Australian Planning Commission, Perth. WA.







**Map 2** Vegetation Assessment

Site	Lot 601 Old Pinjarra Rd Greenfields
Project	Bushfire Management Plan
Client	Property Edge WA Pty Ltd
Scale	1: 1,100

**Legend**

- Study Area
- Contours (m AHD)
- Access and Landscaping
- Vegetation to be removed
- Hazard
- Excluded 2.2.3.2(c)
- Group B Woodland
- Unmanaged Grassland



Prepared by Gary McMahon  
 Ecosystem Solutions  
 April 2016  
 Projection - MGA50  
 Datum - GDA94  
 NOTE: This drawing is not to scale and  
 has not been derived from survey.










**Map 3**

**Bushfire Hazard**

Site	Lot 601 Old Pinjarra Rd Greenfields
Project	Bushfire Management Plan
Client	Property Edge WA Pty Ltd
Scale	1:1,000

**Legend**

-  Study Area
-  Contours (m AHD)
-  Access and Landscaping
- Bushfire Hazard Assessment**
-  Moderate
-  Low



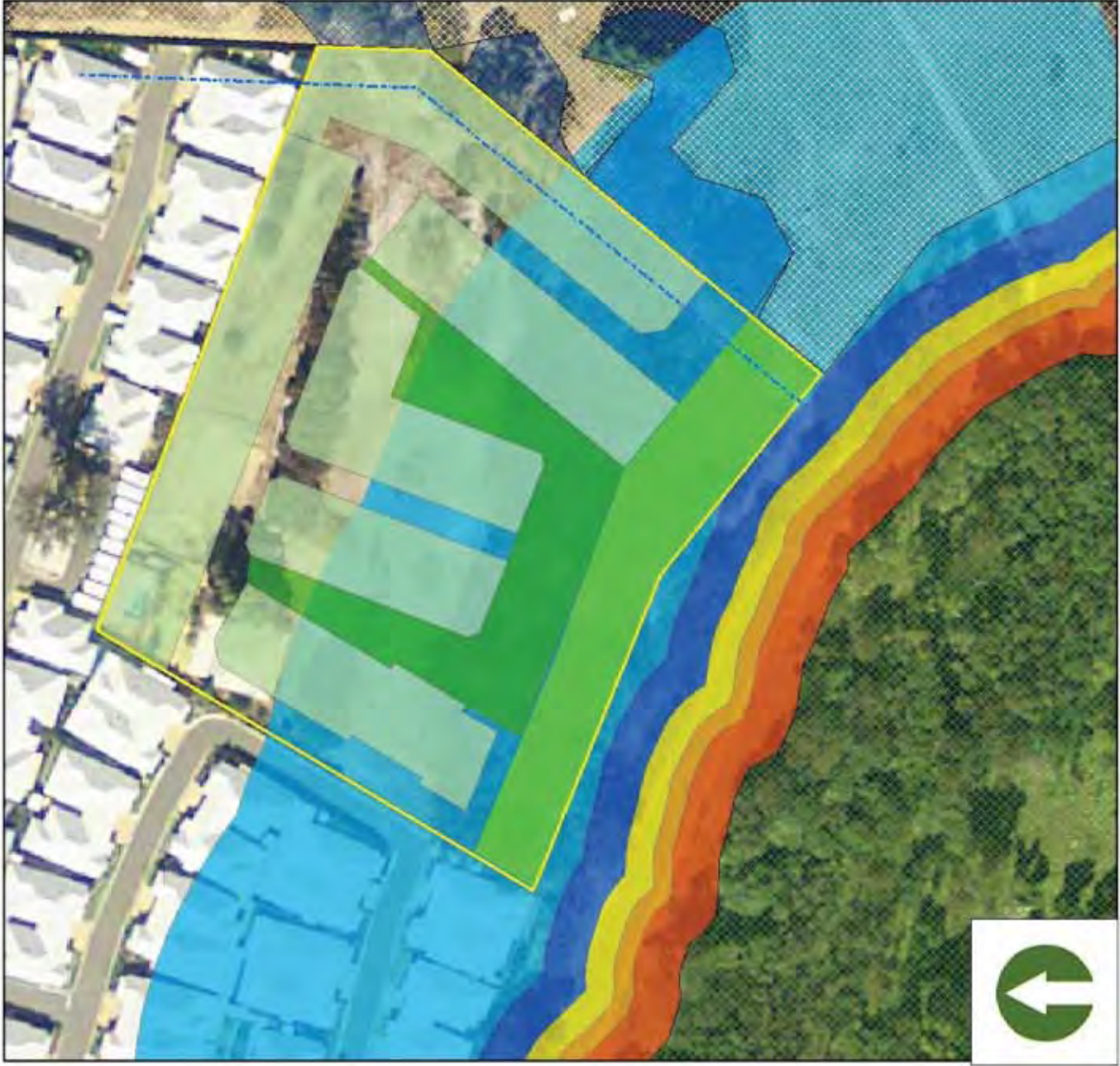
Prepared by Gary McMahon  
 Ecosystem Solutions  
 April 2016  
 Projection - MGA 50  
 Datum - GDA 94  
 NOTE: This drawing is not to scale and  
 has not been derived from survey.



### Map 4 Bushfire Management Plan

Site	Lot 601 Old Pinjarra Rd Greenfields
Project	Bushfire Attack Level
Client	Property Edge WA Pty Ltd
Scale	1: 800

- Legend**
- Study Area
  - Residential R60
  - Commercial Open Space
  - Access and Landscaping
  - Grassland BAL-29 limit
  - Hazard
  - Excluded 2.2.3.2(c)
  - Group B Woodland
  - Unmanaged Grassland
- Woodland-FireUpslope BAL Contour**
- <10m: BAL-FZ
  - 10-14m: BAL-40
  - 14-20m: BAL-29
  - 20-29m: BAL-19
  - 29-100m: BAL-12.5



Prepared by Gary McMahon  
 Ecosystem Solutions  
 April 2016  
 Projection - MGA50  
 Datum - GDA94  
 NOTE: This drawing is not to scale and has not been derived from survey.



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