

# WOODLAND VISTA LOCAL STRUCTURE PLAN NO. 92

‘WOODLAND VISTA’ ESTATE  
LOT 51 FLYNN DRIVE  
CARRAMAR

CITY OF WANNEROO

Revision 5: March 2017



*PREPARED BY:*

**burgess** design group  
TOWN PLANNING + URBAN DESIGN



**‘Woodland Vista’ Estate  
Lot 51 (No. 575) Flynn Drive, Carramar**

City of Wanneroo

**LOCAL STRUCTURE PLAN No.92**

Revision 5: March 2017

Prepared for: **Woodland Consortium Pty Ltd**

Prepared by: Burgess Design Group  
101 Edward Street, Perth, 6000  
PO Box 8779, Perth Business Centre, W.A., 6849  
Telephone: (08) 9328 6411  
Facsimile: (08) 9328 4062  
Website: [www.burgessdesigngroup.com.au](http://www.burgessdesigngroup.com.au)  
Email: [reception@burgessdesigngroup.com.au](mailto:reception@burgessdesigngroup.com.au)

Project Planner: Mark Szabo  
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Revision No: 5

Quality Assurance

Issue/Version:	Date:	Author:	Reviewer:
1	18 May 2012	J. Pirone	M. Szabo
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3	12 November 2015	M.Bisby	M.Szabo
4	21 October 2016	M.Bisby	M.Szabo
5	31 March 2017	M.Bisby	M.Szabo

This structure plan is prepared under the provisions of the City of Wanneroo District Planning Scheme No.2

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY  
RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION  
ON: 1 May 2017

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

1 May 2017.

Date

Date of Expiry: 1 May 2027

TABLE 1: AMENDMENTS

AMENDMENT NO.	SUMMARY OF THE AMENDMENT	AMENDMENT TYPE	DATE APPROVED BY WAPC

TABLE 2: DENSITY PLANS

DENSITY PLAN NO.	AREA OF DENSITY PLAN APPLICATION	DATE ENDORSED BY WAPC

## EXECUTIVE SUMMARY

This Local Structure Plan (LSP) applies to Lot 51 Flynn Drive, Carramar, being the land contained within the inner edge of the line denoting the 'Structure Plan Boundary' as shown on the Structure Plan Map.

A summary of all key statistics and planning outcomes of the LSP is provided in Table 3 below:

**TABLE 3: SUMMARY TABLE**

ITEM	DATA	STRUCTURE PLAN REF (SECTION NO.)
Total area covered by the Structure Plan:	3.0290 hectares	1.2.2
Area of each land use proposed: <ul style="list-style-type: none"><li>- Residential</li><li>- Public Use (Drainage)</li><li>- Public Open Space</li></ul>	1.7507 hectares 0.0621 hectares 0.3479 hectares	3.0
Estimated Lot Yield:	39 lots	3.2
Estimated number of dwellings:	39 dwellings	3.2
Estimated residential site density	22 dwellings per site hectare	3.2
Estimated population:	101 people	3.2
Estimated number and % of public open space: <ul style="list-style-type: none"><li>- Local open space</li></ul>	0.3479 hectares = 10%	3.3

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## 1. STRUCTURE PLAN AREA

This Structure Plan shall apply to Lot 51 Flynn Drive, Carramar; being the land contained within the inner edge of the line denoting the Structure Plan Boundary as shown on the Structure Plan Map (refer to **Plan 1 – Structure Plan Map**).

## 2. OPERATION

The date the structure plan comes into effect is the date the structure plan is approved by the WAPC.

## 3. STAGING

Development is not dependent upon a staged approach.

## 4. SUBDIVISION AND DEVELOPMENT REQUIREMENTS

The Structure Plan Map outlines land use, zones and reserves applicable within the Structure Plan area.

### 4.1 Land Use Permissibility

Land use permissibility within the Structure Plan area shall be in accordance with the corresponding zone or reserve under the Scheme.

### 4.2 Residential Zoned Land

#### 4.2.1 Dwelling Target

- a) An estimated 39 dwellings within the Structure Plan area.

#### 4.2.2 Density

- a) The **Structure Plan Map** defines the residential densities that apply to the Structure Plan area.

### 4.3 Public Open Space

Public open space is to be provided generally as shown on the Structure Plan Map and in accordance with the Public Open Space Schedule contained at **Appendix 1**.

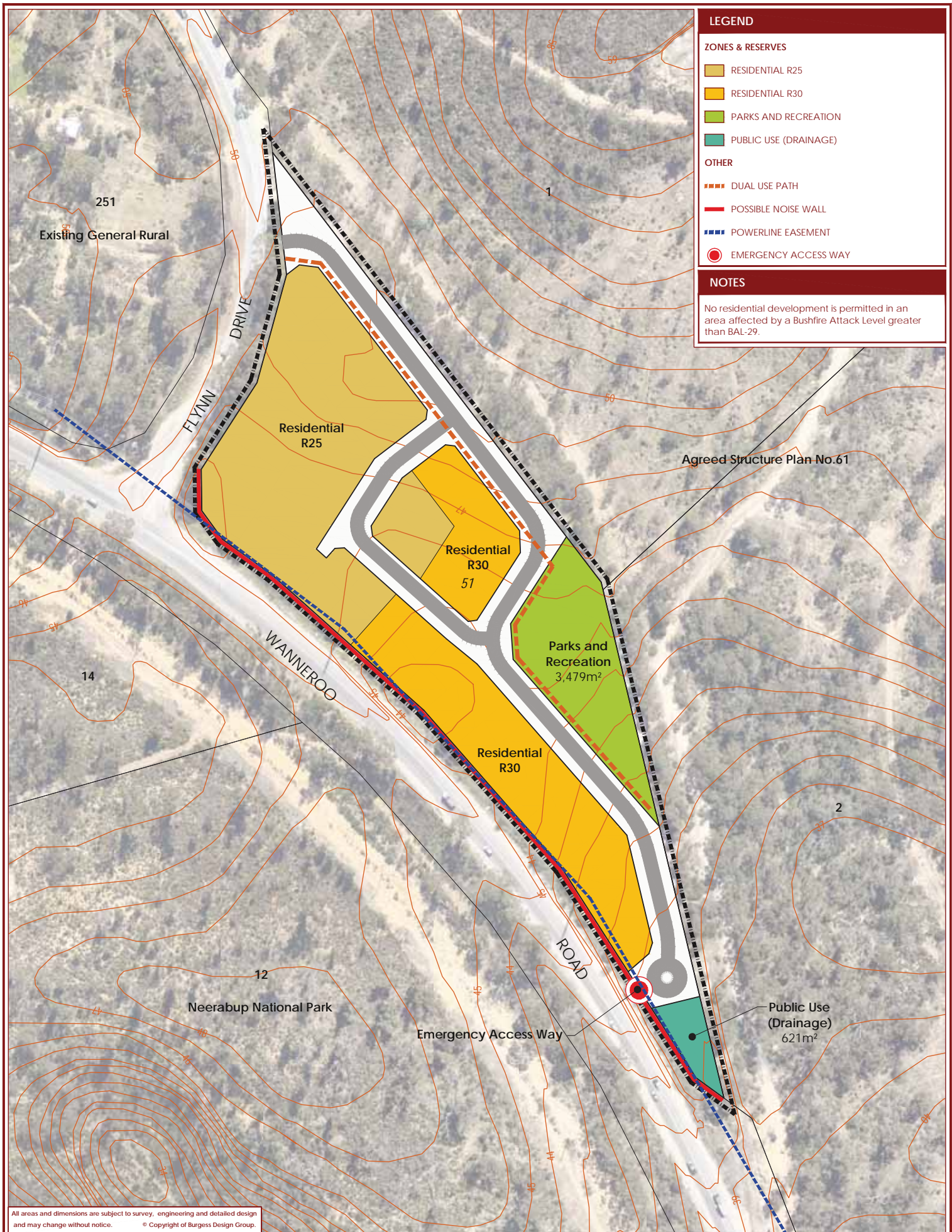
## 5. BUSHFIRE PRONE AREAS

The site is in a bushfire prone area and is subject to the requirements of a Bushfire Management Plan. Implementation of the Bushfire Management Plan is to be addressed at both the subdivision and development stage in accordance with State Planning Policy 3.7: *Planning in Bushfire Prone Areas*.

## 6. ADDITIONAL INFORMATION

Where additional information is required to be submitted by the Structure Plan, the details of the additional information and the stage at which it is to be submitted may be incorporated into the structure plan in a table.

ADDITIONAL INFORMATION	APPROVAL STAGE	CONSULTATION REQUIRED
Updated Noise Assessment and Management Plan	Prior to Subdivision	WAPC/City of Wanneroo
Tree Assessment	Prior to Subdivision	WAPC/City of Wanneroo
Landscape Plan	Prior to Subdivision	WAPC/City of Wanneroo
Urban Water Management Plan	Prior to Subdivision	WAPC/City of Wanneroo
Geotechnical Report including Karst Assessment	Prior to Subdivision	WAPC/City of Wanneroo



**BUROESS DESIGN GROUP**  
TOWN PLANNING • URBAN DESIGN

PO Box 8779, Perth Business Centre 6849  
www.burgessdesigngroup.com.au

P (08) 9328 6411  
F (08) 9328 4062

Plan No: LAK CAR 02-036-01 Client: Woodland Consortium  
Date: 09.03.17 Planner: MS/MB



NORTH

0 10 20 30 40 50m  
SCALE 1:1,500 (A3)

**PLAN 1: WOODLAND VISTA LOCAL STRUCTURE PLAN**

**LOT 51 FLYNN DRIVE**

**CARRAMAR**

**CITY OF WANNEROO**

## PART TWO | EXPLANATORY SECTION

# 1. PLANNING BACKGROUND

## 1.1 INTRODUCTION AND PURPOSE

This LSP report has been prepared in accordance with the Western Australian Planning Commission (WAPC) *Structure Plan Framework* (August 2015). This LSP represents the logical extension of an existing Urban area to the north, and to that extent, the LSP abuts Agreed Structure Plan No.61 (ASP61) on its eastern boundary.

The LSP has been prepared in collaboration with a team of specialist consultants, who have provided technical input in relation to the following matters

- |                                 |                                      |
|---------------------------------|--------------------------------------|
| ▪ Bayley Environmental Services | Environmental Assessment             |
| ▪ VDM Group                     | Civil Engineering Services Report    |
| ▪ Transcore                     | Traffic Impact Statement             |
| ▪ Lloyd George Acoustics        | Acoustic Report                      |
| ▪ Shawmac                       | Local Water Management Strategy      |
| ▪ Coffey                        | Geotechnical and Drainage Assessment |
| ▪ Lex Bastian                   | Karst Assessment                     |

It should also be noted that this LSP has been prepared in consultation with the Department of Planning, City of Wanneroo's Planning and Engineering Departments, Main Roads WA and the Department of Water.

## 1.2 LAND DESCRIPTION

### 1.2.1 Location

Lot 51 is located in the suburb of Carramar, immediately south east of the intersection of Flynn Drive and Wanneroo Road, approximately 35 kilometres north of the Perth CBD and 9 kilometres north-east of the Joondalup town centre. Refer to **Figure 1 – Location Plan**.

Carramar is characterised by large undeveloped landholdings, small rural residential landholdings to the east and south, and a golf course and existing urban development further to the south.

### 1.2.2 Area and Land Use

Lot 51 Flynn Drive, Carramar, comprises a total legal land area of 3.0290 hectares.

Lot 51 has previously been cleared to facilitate agricultural activities, though some mature vegetation remains. The subject land currently accommodates a single storey brick and tile dwelling and associated outbuildings (refer to **Figure 2 – Aerial Site Plan**).

### 1.2.3 Legal Description and Ownership

The subject land is registered in the ownership of Woodland Consortium Pty Ltd and is legally described as:

- Lot 51 on Diagram 63970, Volume 2192 Folio 899.

There are no restrictions or encumbrances registered on the Certificate of Title. A copy of the Certificate of Title can be found at **Appendix 2 – Certificates of Title and Survey Plans**.

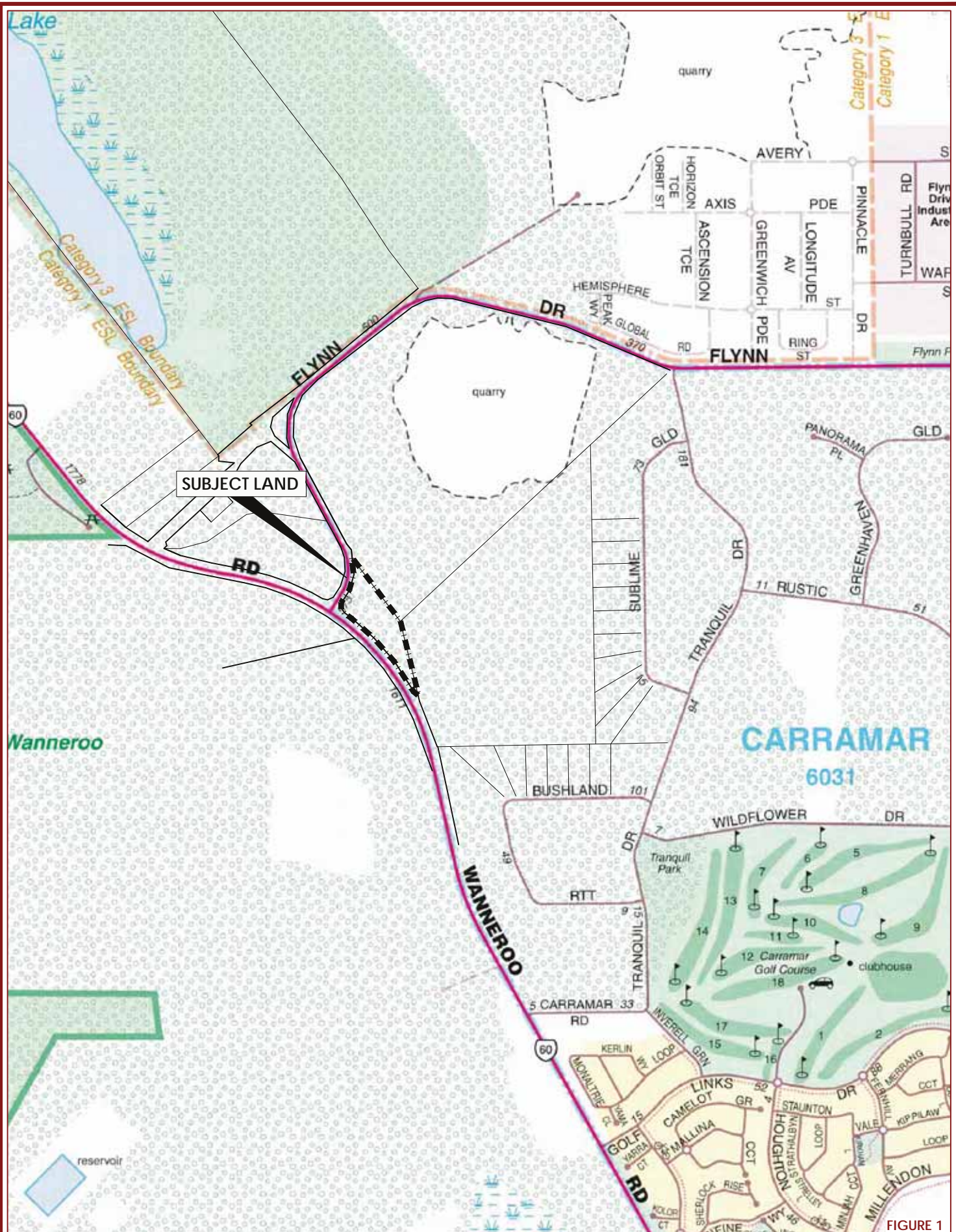



FIGURE 1



LEGEND

 Subject Site

0 25 50 75 100  
SCALE 1:2,500 (A4)



NORTH

Planner: KM  
Client: LAKESHORE BUILDERS

Date: 07.04.14  
Plan No: LAK CAR 2-01f

**burgess design group**  
TOWN PLANNING + URBAN DESIGN

PO Box 8779, Perth Business Centre 6849  
www.burgessdesigngroup.com.au

P (08) 9328 6411  
F (08) 9328 4062

**LOCAL LOCATION**  
**LOT 51 FLYNN DRIVE**  
**CARRAMAR**  
**CITY OF WANNEROO**



FIGURE 2



LEGEND



Subject Site



NORTH

Planner: KM

Client: LAKESHORE BUILDERS

**AERIAL PHOTOGRAPH**  
**LOT 51 FLYNN DRIVE**  
**CARRAMAR**

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TOWN PLANNING + URBAN DESIGN

PO Box 8779, Perth Business Centre 6849  
[www.burgessdesigngroup.com.au](http://www.burgessdesigngroup.com.au)

P (08) 9328 6411  
F (08) 9328 4062

Plan No: LAK CAR 01-01a

## 1.3 PLANNING FRAMEWORK

### 1.3.1 Zoning and Reservations

#### Metropolitan Region Scheme

The subject land is zoned 'Urban' under the Metropolitan Region Scheme (MRS), and abuts a 'Primary Regional Road' Reserve on its southern boundary (being Wanneroo Road).

#### City of Wanneroo District Planning Scheme No. 2

The subject site is zoned 'Urban Development' under DPS2.

This LSP has been prepared in accordance with both the generic Scheme provisions relating to the preparation of structure plans and also those pertaining to the 'Urban Development' zone. The objectives of the Urban Development Zone are detailed in **Table 4** below.

Table 4: DPS2 'Urban Development' Zone Objectives		
	Objectives of 'Urban Development' zone	LSP Achieves Objectives By
1.	Designate land for future urban development;	Site forms part of a growing urban development area;
2.	Provide for the orderly planning of large areas of land for residential and associated purposes through a comprehensive structure planning process;	The LSP designates suitable uses throughout the LSP area based upon a comprehensive range of technical inputs;
3.	Enable planning to be flexible and responsive to changing circumstances throughout the developmental stages of the area.	The LSP provides a comprehensive framework for future development without limiting the generality of evolving policies or practices.

### 1.3.2 Planning Strategies

#### Directions 2031

Directions 2031 recognises the benefits of a more consolidated city and sets realistic goals to promote housing affordability and sustainable urban growth. This LSP is considered compliant with the key objectives and themes of Directions 2031 and responds in the following manner:-

- The LSP forms part of a wider urban area experiencing significant growth and development that is serviced by a range of local and district level facilities. The area has been fully planned to comply with State policies, and represents an efficient use of urban zoned land;
- The proposed development seeks to improve the viability of district and regional centres whilst enhancing community and environmental health; and
- The LSP achieves a minimum 14 dwellings per gross urban zoned hectare. Though this is below the Directions 2031 minimum target of 15 dwellings per gross hectare of urban zoned land, it is considered sufficient given the site's design constraints (such as the tapering cadastral boundary, noise impacts, and bushfire risk considerations).

### 1.3.3 Planning Policies

#### *Urban Growth and Settlement*

This policy sets out the principles and considerations which apply to planning for urban growth and settlements throughout Western Australia. The objectives of this policy are:

- 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 build on existing communities with established local and regional economies, concentrate investment in the improvement of services and infrastructure and enhance the quality of life in those communities;
- 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;
- To promote the development of a sustainable and liveable neighbourhood form which reduces energy, water and travel demand while 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; and,
- To coordinate new development with the efficient, economic and timely provision of infrastructure and services.

The proposed Development will aid in achieving the above through the provision of additional land for urban growth in a location where access to normal urban facilities and services is readily available and where there is little or no negative impacts on the local environment, heritage and community values. The growth will be well planned and managed, with the result being a neighbourhood with a sense of place and variety of lot types.

#### *Liveable Neighbourhoods:*

Liveable Neighbourhoods is a state-wide development control policy that aims to facilitate the development of sustainable communities. It provides an integrated planning and assessment framework for the preparation of Structure Plans and subdivision designs and represents an alternative performance-based approach to conventional subdivision policies.

The LSP presented within this report adopts the principles of Liveable Neighbourhoods and has been developed to meet the objectives and requirements of each of the Liveable Neighbourhoods design elements.

## 2. SITE CONDITIONS AND CONSTRAINTS

A Context and Constraints Plan (refer Figure 3) has been prepared to illustrate the main issues discussed in this section of the LSP.

### 2.1 BIODIVERSITY AND NATURAL AREA ASSETS

The subject site contains scattered mature trees with limited understorey vegetation. It is noted that revegetation occurred during the 1980's, as is evidenced by the size and type of vegetation on the site.

The Department of Planning's Bush Forever mapping, sourced from Landgate's SLIP WA Atlas, does not show a Bush Forever site on the subject land.

The Environmental Assessment Reports, prepared by Bayley Environmental Services (March 2006 and December 2011) (refer **Appendix 3**), outline that:

- the vegetation of the property is considered 'degraded' to 'completely degraded' as a result of prolonged grazing by horses;
- there are some native species present (mostly trees and some shrubs) and many weed species;
- there are some reasonable to large-sized tuart and jarrah trees present, although these showed signs of degradation;
- one area near the centre of the property appears to have suffered less damage from horses, although it has been recently burnt in a fire. This area is largely contained within the Public Open Space shown on the LSP; and,

No native fauna were observed. The only animals seen were two horses, although the owner advised that a large number had been present on the site prior to the fire when most were evacuated. Due to the degraded state of the vegetation, the site provides no significant habitat for native animals, although a few disturbance-tolerant bird species may make use of some of the larger trees. The property does not contain viable habitat for any of the listed species in the CALM Threatened and Priority Fauna Database, although Carnaby's Black Cockatoo may be an occasional visitor to the few large trees.

### 2.2 LANDFORM AND SOILS

The landform features a gentle slope, falling from a high point of 49m AHD in the north west to a low point of 40m AHD in the southern corner. Refer to **Figure 2 – Aerial Site Plan**.

#### Acid Sulfate Soils

The Local Water Management Strategy (LWMS) prepared by Shawmac (refer **Appendix 4**) states that preliminary research shows the subject land is of low risk for Acid Sulfate Soils (ASS) and it is unlikely that further assessment will be required prior to construction. However, ASS will be assessed for the preparation of the Urban Water Management Plan (UWMP). In the event that the assessment indicates ASS being present, then an ASS Management Plan will be developed that addresses the specific constraints and issues.



### **Site Contamination**

The Department of Environment and Conservation's (DEC) Contaminated Sites Database does not identify the subject land as a "Known Contaminated Site".

A review of historical aerial photography and discussions with Planning Officers at the City of Wanneroo did not indicate any uses or activities that are of concern. It is considered that the risk of contamination from past and/or present land use activities is low.

### **Karst Assessment**

In 2006 an investigation into subsurface limestone formations was undertaken, revealing no evidence of any karst formations under the site at shallow depths (refer **Appendix 5**). However, it did recommend that further penetrating investigations be undertaken to reveal any formations at greater depths. Should this be required, it is recommended that this occur at the subdivision stage.

In addition, the investigation provided commentary on the treatment of drainage management as part of any future residential development. This shall be considered at the more detailed engineering stage, and as part of the stormwater management plans for the site.

## **2.3 GROUNDWATER AND SURFACE WATER**

The site is not located within a 1-in-100 year ARI event floodplain of a river or major watercourse; and, owing to sandy soils, is generally devoid of surface water flow.

Groundwater at the site is expected to be in the vicinity of 30 metres below the surface. As such, groundwater monitoring has not been undertaken. Groundwater at the site is expected to be marginally fresh, unsuitable for garden bores, and low risk of iron staining.

## **2.4 BUSHFIRE HAZARD**

The site falls within a designated bushfire prone area. In accordance with the policy measures of State Planning Policy 3.7, a Bushfire Management Plan (BMP) has been prepared to assess the risk and set out appropriate management measures (refer **Appendix 6**).

### **2.4.1 Bushfire Hazard Level**

The Bushfire Hazard Level applicable to the site and its surrounds has been assessed as 'moderate' to 'extreme'. The risk will be appropriately managed through the implementation of suitable Asset Protection Zones (APZ) and Hazard Separation Zones (HSZ) or the application of Bushfire Attack Level (BAL) construction standards in accordance with Australian Standard AS3959-2009. To that end, the design of the LSP responds directly to bushfire risk insofar that that roads, public open space and drainage is sited to maximise separation to potential bushfire hazards.

#### 2.4.2 Bushfire Attack Level

A BAL Contour Map contained within the BMP shows the site is capable of accommodating development without requiring construction to BAL-40 or BAL-FZ construction standards. In order to prevent inappropriate siting of development within future lots, it may be necessary for Local Development Plans to prescribe minimum setbacks on lots that fall partially within areas subject to BAL-40 or BAL-FZ. This shall be determined following the preparation of a BAL Contour Map at subdivision stage once lot boundaries are known.

#### 2.4.3 Bushfire Management Measures

The BMP sets out management measures to maintain an acceptable level of risk in accordance with the acceptable solutions of the Bushfire Protection Criteria listed at Appendix 5 of the *Guidelines for Planning in Bushfire Prone Areas* (Guidelines). This includes responses to the location, siting and design, vehicular access, and water elements of the Guidelines.

### 2.5 HERITAGE

The Department of Aboriginal Affairs Aboriginal Heritage Inquiry System indicates that there are no known heritage sites located on the subject land.

The Environmental Assessment Reports, prepared by Bayley Environmental Services (March 2006 and December 2011), outline that:

- there are no Aboriginal heritage sites within 1km of the property. The nearest recorded site is associated with Lake Neerabup, which is 1.3km north-west of the property; and,
- the property does not contain any significant physical features (hills, rocky outcrops, caves, creeks, wetlands) that would suggest a likelihood of any ethnographic significance).

Refer to **Appendix 3** for the Environmental Assessment Reports by Bayley Environmental Services.

#### 2.5.1 CONTEXT AND CONSTRAINTS ANALYSIS

A Context and Constraints Plan (refer **Figure 3**) has been prepared to illustrate the main issues discussed in this section of the LSP.

##### **OPPORTUNITIES**

###### Industrial Area

There is a recently approved industrial park north east to the subject land developed by LandCorp named 'Meridian Park'. The area was developed to meet the industrial land demand in the north-west district corridor of Perth for the next 20 years. The development comprises 400 hectares of general industrial, service industrial and business zoned land. The development is expected to create approximately 20,000 new employment opportunities, thereby encouraging significant development and growth in the surrounding areas.

### Future Residential

Adjacent Lots 1 and 2 Flynn Drive, Carramar, are the subject of Agreed Structure Plan 61, which proposes low density residential uses, open space, and an equine recreation park.

The proposed development on Lots 1 and 2 complements the proposed LSP, and represents the logical expansion of an existing urban area further to the south.

## 2.5.2 CONSTRAINTS

### Powerline Easement

High voltage powerlines are located adjacent to the southern boundary of the subject site, along the eastern side of Wanneroo Road.

Initial consultation with Western Power has indicated that an approximate 12 metre easement will be required from the powerlines to all dwellings/buildings. The proposed LSP limits the impact that the powerline easement will have on future development by locating road reserves and open space within the easement area to the extent that it is reasonable. However, those areas that are affected by the easement will require consideration at subdivision and engineering stage, at which point, the exact width of the easement will be determined.

### Flynn Drive Realignment

Flynn Drive is proposed to be realigned to access Wanneroo Road approximately 660m north west of the current intersection, which will subsequently be closed and converted to a cul-de-sac. The proposed realignment aims to better service the increased traffic demands of the future 400 hectare Meridian Park industrial estate to the north east of the subject site.

Whilst the proposed realignment will likely reduce the impacts of heavy vehicle movements to and from the abovementioned industrial estate, it will add approximately 2km to the trips of future residents who wish to access the subject site from Wanneroo Road.

### Noise

A Noise Impact Assessment undertaken by Lloyd George Acoustics concluded that *the majority of lots fronting Wanneroo Road are predicted to exceed the SPP 5.4 Limit criteria*, and recommended that both *façade treatments* and *an acoustic barrier, 2.5m above road height*, be considered (refer **Appendix 7**).

As per these recommendations, the LSP incorporates these treatments, with quiet house design principles to be outlined through a Local Development Plan, and notifications to be placed on the Certificates of Title for all future affected lots (refer section 3.7.1 for further detail).

An updated Noise Impact Assessment will be required at subdivision stage to address any management measures required to mitigate noise impacts on the final design.

### 3. LAND USE AND SUBDIVISION REQUIREMENTS

#### 3.1 LAND USE

The proposed landuses comprise low and medium density residential uses, public open space, and drainage. Refer to **Plan 1 – Local Structure Plan**.

#### 3.2 RESIDENTIAL

The LSP proposes low and medium residential densities, comprising R25 and R30. This mix of densities generally serves to provide a transition between the low density (R5) uses proposed in the adjoining Agreed Structure Plan No.61, whilst still accommodating conventional housing product.

The total area available for residential development is approximately 1.7507ha, which will accommodate approximately 39 lots, each comprising a single dwelling with a total population of 101 people, representing a density of 22 dwellings per site hectare.

The proposed lot layout has been orientated such that it can provide effective surveillance of the public domain such as the streets and public open spaces, whilst minimising the impact of the powerline easement and potential bushfire hazards.

#### 3.3 PUBLIC OPEN SPACE

The proposed Public Open Space (POS) comprises one site 3,479m<sup>2</sup> in area, comprising 10.09% of the gross subdivisible area.

The location and shape of the proposed POS responds to the context of the site by incorporating a drainage swale, retaining some significant trees, providing additional separation to potential bushfire hazards, and allowing for relatively conventional and developable lots. Additionally, all future lots will be within 200m of the POS, providing all future residents with easy access to recreational space.

#### 3.4 MOVEMENT NETWORKS

##### 3.4.1 Road Network

The proposed road network comprises two roads with a reserve width of 15m (reduced to 13.5m where abutting POS).

The site is to gain access from Flynn Drive through a priority-controlled T-intersection, approximately 35m north east of where it intersects Wanneroo Road. Flynn Drive is proposed to be realigned to access Wanneroo Road approximately 660m to the north of where it currently intersects, at which time the current intersection will be closed.

A Traffic Impact Assessment has been prepared by Transcore (refer **Appendix 8**). This Assessment states that the development would generate approximately 360 daily vehicle trips during a typical week day. The Assessment concluded that *the impact of the traffic from this development on the operation of the surrounding road network is marginal to moderate and therefore does not necessitate any upgrades to these roads.*

### 3.4.2 Public Transport and Cyclist Network

The Clarkson Train Station is located 6 kilometres west of the subject land. Additionally, a number of bus routes are available approximately 1 kilometre south of the subject land along Wanneroo Road. Given the growth and development of the area, it is likely that the Public Transport Authority will investigate additional future bus routes in the Carramar area.

In accordance with the Department of Transport Perth Bike Maps, the portion of Wanneroo Road that abuts the subject land is considered a 'Poor Road Riding Environment' due to the large volume of fast traffic without cycle paths. However, Flynn Drive is considered to be a 'Medium Road Riding Environment'. It is recommended that the Department of Transport consider cycle paths in their upgrades of Wanneroo Road and Flynn Drive.

## 3.5 WATER MANAGEMENT

A Local Water Management Strategy (LWMS) has been prepared by Shawmac (July 2016) to support the implementation of the LSP (refer **Appendix 4**). The LWMS has been prepared to achieve best practice water management outcomes through strategies that manage the total water cycle in a sustainable manner, in accordance with the objectives of State Planning Policy 2.9: *Water Resources*. The LWMS is summarised briefly below.

### 3.5.1 Groundwater Management

Groundwater at the site is expected to be in the vicinity of 30 metres below the surface. Given this depth, the use of controlled groundwater levels and fill is not required.

### 3.5.2 Stormwater Management

The stormwater management strategies for the site include:

- Implementing a drainage design that limits the peak outflow from the development to pre-development levels through on-site storage and infiltration;
- Utilising lot connections to the public stormwater network (see details below);
- Providing rain-gardens to reduce nutrient loads; and,
- Providing two stormwater retention basins to control the outflow for the 1, 5, and 100 year ARI events and ensure that the 1-in-100-year ARI event flood levels are below residential floor levels.

Geotechnical investigations have concluded that karstic features may underlie the site. This precludes the use of on-site soakwells; as concentrated water run-off may affect foundation conditions by mobilising loose sands in the limestone discontinuities. As such, lot-connections to the public stormwater network will be used instead.

## 3.6 EDUCATION FACILITIES

There are no schools or educational facilities provided within the proposed Local Structure Plan.

Additionally, it is not expected that the additional population to be accommodated in the proposed development will create the need for additional educational facilities nor will it create a burden on those existing.

## 3.7 INFRASTRUCTURE COORDINATION, SERVICING AND STAGING

### 3.7.1 Transport Noise Impacts

A Noise Impact Assessment undertaken by Lloyd George Acoustics concluded that *"the majority of lots fronting Wanneroo Road are predicted to exceed the SPP 5.4 Limit criteria,"* and recommended that both façade treatments and an acoustic barrier, 2.5m above road height, be implemented (refer **Appendix 7**). However, as the design of development has changed since the preparation of the Noise Impact Assessment, further assessment may be required at subdivision stage to determine appropriate management measures.

### 3.7.2 Power

An Engineering Services Report prepared by VDM Group confirms that an existing underground power supply on the eastern side of Wanneroo Road has sufficient capacity to service the proposed development with underground power (refer **Appendix 9**).

### 3.7.3 Water

There is no existing water main in the subject area. Mains water can be supplied through the extension of an existing 300mm diameter water main in Wanneroo Road, northwards from Golf Link Drive to Carramar Road for a distance of 500 metres, and then a 250mm water main to the site for a distance of 1.4km (refer **Appendix 9**).

### 3.7.4 Wastewater

There is no existing sewer infrastructure in the area. A new gravity fed sewer can connect to the existing sewer line near Golf Links Drive and Wanneroo Road (refer **Appendix 9**). This sewer infrastructure has sufficient capacity to service the proposed development.

### 3.7.5 Telecommunications

There is an existing Telstra network in the immediate vicinity of the subject site with sufficient capacity to service the development with telecommunications services (refer **Appendix 9**). Telstra will install any new telecommunication network facilities to the proposed lots, subject to the developer providing, at their cost, trenching for cable laying.

### 3.7.6 Gas

There is an existing 150mm diameter high pressure gas main within the Wanneroo Road reserve; with sufficient capacity to service the development with reticulated gas services (refer **Appendix 9**). A pressure reducing station will need to be installed to reticulate the gas throughout the subdivision.

## 4. CONCLUSION

This LSP report, accompanying plans, and appendices, satisfy the Council's Scheme requirements with respect to the objectives of the 'Urban Development' zone, and the preparation of Structure Plans.

The Local Structure Plan as described in this report satisfies the planning frameworks adopted by the City of Wanneroo and the Western Australian Planning Commission and the advice received during consultation with other agencies. The Plan should ultimately assist in achieving a contemporary and well integrated subdivision that provides the foundation for a strong and cohesive community.

In light of the above, the Local Structure Plan as submitted represents a logical, well planned and timely addition to the ongoing development of the Carramar locality.

## **APPENDIX 1: Public Open Space Schedule**

# POS SCHEDULE - TABLE 1 (of 2)

LAK CAR/ 161021 POS SCHEDULE.xlsx

ha

ha

A	<b>Gross area</b>		
	Lot 51 Flynn Drive	3.0290	
	<b>GROSS AREA</b>		<b>3.0290</b>
B	<b>Deductions</b>		
	Non Creditable open area's (1:1 drainage) (J)	0.0540	
	Public Use Reserve (Drainage)	0.0621	
C		<b>Sub-total</b>	<b>0.1161</b>
D	Excess Restricted POS ((M-(0.02(A-B)))/0.98=C)	0.0000	
	<b>TOTAL DEDUCTIONS (B+C=D)</b>		<b>0.1161</b>
E		<b>Net Subdivisible Area (A-D=E)</b>	<b>2.9129</b>
F		<b>10% Requirement (10% of E = F)</b>	<b>0.2913</b>
G	<b>POS requirement</b>		
	Minimum 80% unrestricted open space (80% of F=G)	0.2330	
	Maximum 20% restricted open space (20% of F=H)	0.0583	
O	<b>POS provided</b>		
	Total unrestricted open space (N)		0.2839
	Net restricted open space (M-C=P)		0.0100
Q	Creditable restricted open space (to a max H)		0.0100
R	<b>Total creditable POS provided (O+Q)</b>		<b>0.2939</b>
S	<b>Percentage of POS provided (R/E)</b>		<b>10.09%</b>
T	<b>POS Balance area (R-F)</b>		<b>0.0026</b>
U	Gross POS (I)		0.3479
V	Gross POS /gross area (I/A)		11.49%

## POS SCHEDULE - TABLE 2 (of 2)

**APPENDIX 2:**  
**Certificate(s) of Title**  
**and Survey Plan(s)**

WESTERN



AUSTRALIA

REGISTER NUMBER  
**51/D63970**DUPLICATE  
EDITION  
**5**DATE DUPLICATE ISSUED  
**6/5/2010**

# RECORD OF CERTIFICATE OF TITLE

## UNDER THE TRANSFER OF LAND ACT 1893

VOLUME  
**2192**FOLIO  
**899**

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 51 ON DIAGRAM 63970

**REGISTERED PROPRIETOR:**  
 (FIRST SCHEDULE)

WOODLAND CONSORTIUM PTY LTD OF UNIT 2, 44 BUCKINGHAM DRIVE, WANGARA  
 (T L298828 ) REGISTERED 28 APRIL 2010

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

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: 2192-899 (51/D63970).  
 PREVIOUS TITLE: 1671-197.  
 PROPERTY STREET ADDRESS: 575 FLYNN DR, CARRAMAR.  
 LOCAL GOVERNMENT AREA: CITY OF WANNEROO.

ORIGINAL: Not to be removed from the Department of Land Administration.

Transfer H462954

Volume 1671 Folio 197

WESTERN



AUSTRALIA

VOLUME FOLIO

2192 899

IN THE REGISTER



# CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

The person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements, encumbrances and notices shown in the Second Schedule hereto.

Dated 2<sup>nd</sup> June, 2000

*J. H. H. H.*  
REGISTRAR OF TITLES



## ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of Swan Location 998 and being Lot 51 on Diagram 63970, delineated on the map in the Third Schedule hereto.

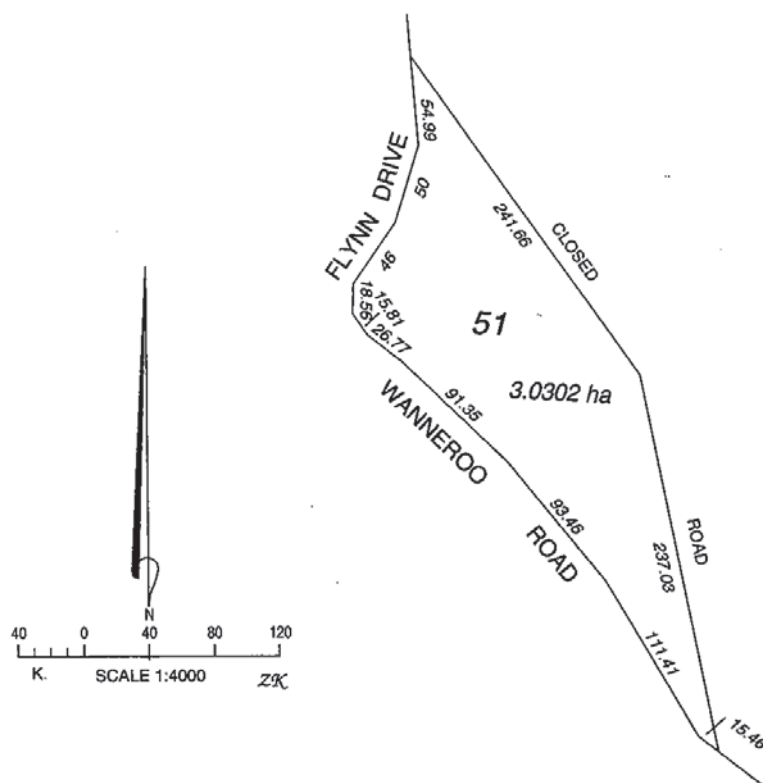
## FIRST SCHEDULE (continued overleaf)

Dawn Frances La Puma of 575 Flynn Drive, Neerabup.

## SECOND SCHEDULE (continued overleaf)

MORTGAGE H462955 to Energy Credit Union Ltd. Registered 2.6.2000 at 15.10 hrs.

## THIRD SCHEDULE



NOTE: Entries may be affected by subsequent endorsements.



**APPENDIX 3:  
Environmental  
Assessment Report +  
Addendum**

Our Ref: J06008

23 March 2006

Mr Peter Fitzgerald  
Allerding Burgess Pty Ltd  
PO Box 307  
NORTHBRIDGE WA 6865

Dear Peter

**Flora, Fauna and Aboriginal Heritage Survey  
Lot 51 Flynn Drive, Carramar**

At your instructions we have carried out flora, fauna and Aboriginal heritage surveys of the above property in support of a subdivision application to the City of Wanneroo. An aerial view of the site and proposed subdivision is attached in Figure 1.

The surveys consisted of the following:

- A site inspection of the property on 22 March 2006 in company with botanist Dr Arthur Weston to identify the main species present, note vegetation types and condition, photograph the vegetation and identify fauna habitat types and value.
- Searches of the CALM Declared Rare and Priority Flora and Threatened Fauna databases for records of significant flora or fauna on the property or in surrounding areas.
- A search of the Department of Indigenous Affairs' online database for records of Aboriginal heritage sites on or near the property.

The results of these surveys are described below.

### **Vegetation and Flora**

#### *Site Inspection*

The site survey found that the vegetation of the property is Degraded to Completely Degraded as a result of prolonged grazing by horses and, in part, by a recent fire.

There were few native species present (restricted mostly to trees and a few more resistant shrubs) and many weed species. There was almost no understorey and large areas of bare ground.

There were a few reasonable to large-sized tuart and jarrah trees present, although these showed signs of damage from horses and jarrah dieback. The proposed subdivision plan locates building envelopes away from these larger trees.

One area near the centre of the property appears to have suffered less damage from horses, although it has been recently burnt. This area is excluded from building envelopes under the subdivision plan.

Most or all of the vegetation on the appears to have little potential for unassisted recovery to anything approaching good condition.

The full report by Dr Weston is attached in Appendix A. Photographs of the vegetation are attached in Appendix B.

#### *Flora Database Search*

A search of the CALM Threatened Flora Database produced records of one Declared Rare Flora (DRF) species, one Priority 1 species, three Priority 3 and one Priority 4 species within a 10km radius of the property and a further one Priority 1 species in the general area of Pinjar/Wanneroo. The WA Herbarium Specimen Database lists three DRF species and twenty Priority species, including all but one of those listed in the CALM database, as occurring in the greater Wanneroo district. The results of the database searches are attached in Appendix C.

None of the species listed in the CALM or WAHERB databases was observed during the site inspection, even though most should have been identifiable if they were present.

#### **Fauna and Habitats**

##### *Site Inspection*

No native fauna were observed during the site inspection. The only animals seen were two horses, although the owner advised that a larger number had been present until the recent fire, when most were evacuated.

The degraded state of the vegetation would provide no significant habitat for native animals, although a few disturbance-tolerant bird species would probably use the larger trees for roosting, nesting and seasonal feeding.

### *Fauna Database Search*

The CALM Threatened and Priority Fauna Database records sightings of five Schedule 1 fauna species (fauna that is rare or likely to become extinct) and eleven Schedule 4 species (other specially protected fauna) within a 10km radius of the property. The results of the database search are attached in Appendix D.

The property does not contain viable habitat for any of the listed species, although Carnaby's Black-cockatoo (*Calyptorhynchus latirostris*) may be an occasional visitor to the few large trees, and other species could be present in the bushland to the east.

### **Aboriginal Heritage Sites**

A search of the DIA online Aboriginal Sites Database found no registered Aboriginal heritage sites within 1km of the property. The nearest recorded site is associated with Lake Neerabup, located about 1.3km north-west of the property. The results of the DIA database search are attached in Appendix E.

No field search for Aboriginal heritage sites was conducted as part of this investigation. However, the severe vegetation and ground disturbance caused by prolonged horse grazing makes it unlikely that any archaeological material that previously existed would still be identifiable. The property does not contain any significant physical features (hills, rock outcrops, caves, creeks, wetlands etc.) that would suggest a likelihood of any ethnographic significance.

### **Summary of Findings**

The property does not appear to possess any vegetation, fauna or cultural features of any conservation significance. The few good-sized trees are excluded from building envelopes under the current plan of subdivision. Depending upon the land uses within the subdivided lots, there is potential for the overall condition of the property to be significantly improved.

As a result of this investigation it is concluded that there is no impediment in terms of flora, fauna or Aboriginal heritage to subdivision of the site as proposed.

We trust the above and attached provides the information you require. Please do not hesitate to contact the undersigned if you have any queries.

Yours sincerely

**BAYLEY ENVIRONMENTAL SERVICES**



**PHIL BAYLEY**

## Figures

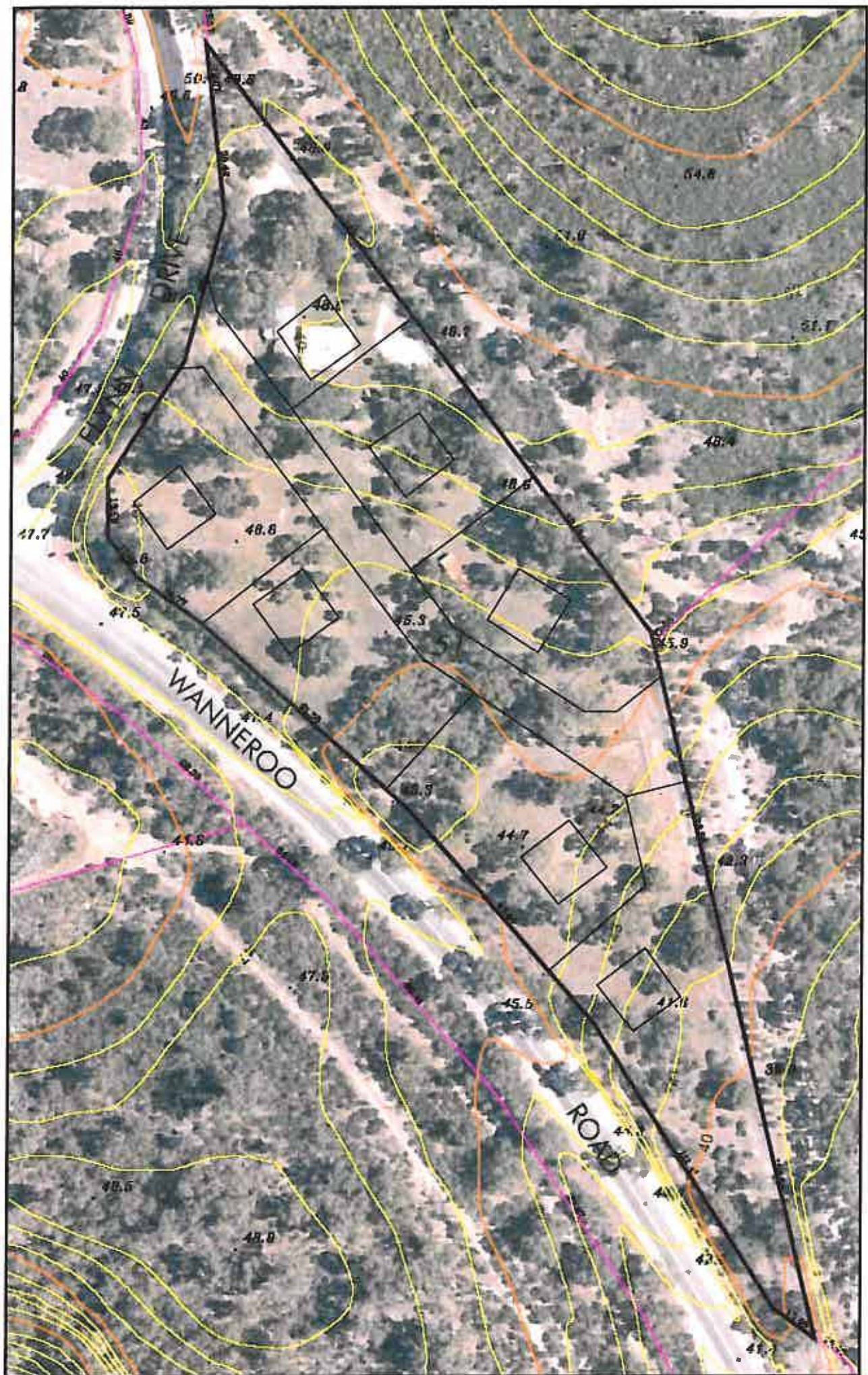


Figure 1

Site Plan

# **Appendix A**

## **Botanist's Report**

Arthur S. Weston, PhD (Botany)  
Consulting Botanist  
Phone (08) 9458 9738  
[naomiseg@iinet.net.au](mailto:naomiseg@iinet.net.au)

ABN/GST No  
54 924 460 919

8 Pitt Street  
ST JAMES  
WA 6102  
AUSTRALIA

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Flora and Vegetation Survey  
Lot 51 Flynn Drive  
Carramar  
City of Wanneroo

REPORT

**Introduction**

The survey area, Lot 51 Flynn Drive, is approximately 2ha in the south-eastern corner of the intersection of Flynn Drive with Wanneroo Road.

This report on the vegetation complexes, vegetation units, vegetation condition, floristic community types, flora and significant flora of Lot 51 is based upon field work on Tuesday morning, 21 March 2006, when we drove just inside the eastern boundary of the property and walked into the centre of the property and through it at several points. We also drove on the roads outside the northern and western boundaries and looked into the property from there.

**Soils**

The Perth 1:250,000 scale sheet of landforms and soils mapping of the Darling System, by Churchward and McArthur, shows the survey area as being in the Cottesloe (Ct) unit, with shallow brown sands over limestone. The Herdsman (Hd) peaty swamp unit is a short distance north-west of the survey area, and the Karrakatta (K) unit, with deep yellow sands over limestone, is further east and south.

**Vegetation Complex**

The Perth 1:250,000 scale sheet of the vegetation complexes of the Darling System, by Heddlé *et al.*, shows the survey area as being in the Cottesloe Complex – Central and South (52), with woodlands and open forest being dominated by tuart (*Eucalyptus gomphocephala*). The Herdsman Complex (53: sedgelands and fringing woodlands) is a short distance north-west of the survey area, and the Karrakatta Complex – Central and South (49: predominantly open forest dominated by tuart) is further east and south.

**Vegetation Units**

The vegetation of Lot 51 Flynn Drive is, for the most part, tuart (*Eucalyptus gomphocephala*) woodland to open woodland over jarrah (*Eucalyptus marginata*) low woodland to open woodland over heavily grazed pasture grasses and bare ground. *Banksia grandis* trees are sparsely dispersed through the lot and there are scattered, heavily browsed balga (blackboy: *Xanthorrhoea preissii*) shrubs there that vary from low open shrubland to shrubland through the property.

The densest remaining native vegetation is a fenced stand of tuart woodland over jarrah – *Banksia grandis* low open woodland to low woodland over balga low heath to open shrubland next to the central part of the south-west boundary of the lot. It is shown in Phil Bayley's Photo 6. Because all of it was burnt within the previous two weeks and has been trampled, though apparently not so heavily as the rest of the property, the ground layer of herbaceous plants and small to medium sized shrubs was almost totally absent at the time of the survey (a few plants of *Dryandra lindleyana* were the exceptions). There are also small trees of *Banksia prionotes* and *Jacksonia sternbergiana* in the stand.

Small trees of peppermint (*Agonis flexuosa*), both planted and spread from plantings, are in the northern part of the property. According to *Leaf and Branch*, by CALM's Robert Powell, peppermint occurs naturally only as far north as Swanbourne and City Beach, not Wanneroo.

*Banksia attenuata* and a few trees of red gum (*Corymbia calophylla*) and *Banksia menziesii* are in the central and southern parts of the lot. One or a few *Eucalyptus todtiana* trees are on the east side.

### **Vegetation Condition**

All of the vegetated parts of the property have been heavily grazed, and most grass, other herbaceous plants and small shrubs are absent; they have been trampled or eaten by horses. Furthermore, part of the property, including the fenced most densely vegetated part, in the southern half of the lot, was burnt earlier in March.

Consequently, the condition of most of the vegetation, over 90% of the lot, is assessed as Completely Degraded. The condition of the fenced, burnt stand of tuart woodland referred to above, covering under 5% of the lot, is assessed as Degraded.

### **Floristic Community Types and Threatened Ecological Communities**

It probably would be impossible to determine which FCT(s) is (are) represented in Lot 51, either by sampling or inferring, even in spring. However, *Bush Forever* lists two upland, sand-based floristic community types (FCT, SCP) as sampled in the Bush Forever Site nearest the Lot 51 survey area – Site 383, which includes Neerabup National Park. These floristic community types are 24 and 28.

Neither FCT 24 nor FCT 28 is the December 2005 list of communities on CALM's Threatened Ecological Community database, nor is either listed in *Bush Forever* Volume 2, Table 10.

### **Flora and Significant Flora**

Due largely to heavy grazing by horses, the flora of Lot 51 is depauperate.

Native shrubs recorded in Lot 51 are *Xanthorrhoea preissii*, *Hakea lissocarpha*, *Jacksonia sternbergiana*, *Acacia saligna* and *Macrozamia riedlei*. Established alien shrubs and small trees recorded in Lot 51, but not native to the area, include *Agonis flexuosa*, *Chamaelaucium uncinatum*, *Acacia decurrens*, *Acacia longifolia* and *Acacia iteaphylla*. Established alien herbaceous plants include *Asphodelus fistulosus*, *Dittrichia graveolens*, *Euphorbia peplus*, *Euphorbia terracina*, *Foeniculum vulgare*, *Pelargonium capitatum* and *Conyza* spp.

No species of Declared Rare or Priority Flora was identified in the survey area, nor was any other species listed in Table 13 of Volume 2 of *Bush Forever* as a significant species.

It is unlikely that there is any habitat in Lot 51 suitable for any significant species, except possibly in the fenced, burnt stand of vegetation referred to above.

# **Appendix B**

## **Site Photographs**



1



2



3



4



5



5



7



8



9



10



11



12

## **Appendix C**

### **CALM Flora Database Search**



Your reference:  
Our reference: 2006F000108V01  
Enquiries: Kelly Poultney

Phone: 9334 0123  
Fax: 9334 0278  
Email: [kellyp@calm.wa.gov.au](mailto:kellyp@calm.wa.gov.au)

Arthur S. Weston  
8 Pitt Street  
ST JAMES WA 6102

Dear Dr Weston

#### REQUEST FOR RARE FLORA INFORMATION

I refer to your request of 22 March 2006 for information on rare flora in the Carramar area. The search co-ordinates used were 31° 36' 00" - 31° 47' 30" S and 115° 40' 00" - 115° 52' 30" E.

A search was undertaken for this area of (1) the Department's *Threatened (Declared Rare) Flora* database (for results, *if any*, see "Threatened Flora Data" – coordinates are GDA94), (2) the *Western Australian Herbarium Specimen* database for priority species opportunistically collected in the area of interest (for results, *if any*, see "WAHERB" – coordinates are GDA94 – see condition number 9 in the attached 'Conditions in Respect of Supply') and (3), the Department's *Declared Rare and Priority Flora List* [this list, which may also be used a species target list, contains species that are declared rare (Conservation Code R or X for those presumed to be extinct), poorly known (Conservation Codes 1, 2 or 3), or require monitoring (Conservation Code 4) – for results, *if any*, see "Declared Rare and Priority Flora List"]. The results are attached electronically to this email.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the seventh point, which refers to the requirement to undertake field investigations for the accurate determination of rare flora occurrence at a site. *The information supplied should be regarded as an indication only of the rare flora that may be present and may be used as a target list in any surveys undertaken.*

An invoice for \$200 (plus GST) to supply this information will be forwarded.

It would be appreciated if any populations of rare flora encountered by you in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss rare flora management, please contact my Principal Botanist, Dr Ken Atkins, on (08) 9334 0425.

Yours faithfully

*KPoultney*

.....  
for Keiran McNamara  
EXECUTIVE DIRECTOR  
23 March, 2006

Please note: Co-ordinates supplied for all data search requests must be provided in latitude/longitude format, 'eastings and northings' are no longer suitable. Thank you.

# DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

## RARE FLORA INFORMATION

### CONDITIONS IN RESPECT OF SUPPLY OF INFORMATION

1. All requests for data to be made in writing to the Executive Director, Department of Conservation and Land Management, Attention: Threatened Flora Database Officer, Species and Communities Branch.
2. The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided, without the prior written consent of the Executive Director, Department of Conservation and Land Management.
3. Specific locality information for Declared Rare Flora is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for DRF may not be used in public reports without the written permission of the Executive Director, Department of Conservation and Land Management. Publicly available reports may only show generalised locations or, where necessary, show specific locations without identifying species. The Department is to be contacted for guidance on the presentation of rare flora information.
4. Note that the Department of Conservation and Land Management respects the privacy of private landowners who may have rare flora on their property. Rare flora locations identified in the data as being on private property should be treated in confidence, and contact with property owners made through the Department of Conservation and Land Management.
5. Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data provided, they may be present. The Department of Conservation and Land Management accepts no responsibility for this.
6. Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
7. **It should be noted that the supplied data do not necessarily represent a comprehensive listing of the rare flora of the area in question. Its comprehensiveness is dependant on the amount of survey carried out within the specified area. The receiving organisation should employ a botanist, if required, to undertake a survey of the area under consideration.**
8. Acknowledgment of the Department of Conservation and Land Management as source of the data is to be made in any published material. Copies of all such publications are to be forwarded to the Department of Conservation and Land Management, Attention: Principal Botanist, Species and Communities Branch.
9. The development of the PERTH Herbarium database was not originally intended for electronic mapping (eg. GIS ArcView). The latitude and longitude coordinates for each entry are not verified prior to being databased. It is only in recent times that collections have been submitted to PERTH with GPS recorded in latitude and longitude coordinates. Therefore, be aware when using this data in ArcView that some records may not plot to the locality description given with each collection.

## THE DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

### DECLARED RARE AND PRIORITY FLORA LIST

for Western Australia

#### CONSERVATION CODES

R: Declared Rare Flora - Extant Taxa

**Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.**

X: Declared Rare Flora - Presumed Extinct Taxa

**Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.**

1: Priority One - Poorly known Taxa

**Taxa which are known from one or a few (generally <5) populations which are under threat**, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two - Poorly Known Taxa

**Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat** (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three - Poorly Known Taxa

**Taxa which are known from several populations, and the taxa are not believed to be under immediate threat** (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.

4: Priority Four - Rare Taxa

**Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors.** These taxa require monitoring every 5-10 years.

**ABBREVIATIONS USED IN THREATENED FLORA DATABASE PRINTOUTS**

**VESTING**

AGR	Chief Exec Dept of Agriculture
ALT	Aboriginal Land Trust
BAP	Baptist Union of WA Inc
BSA	Boy Scouts Association
CC	Conservation Commission – NPNCA - LFC
CGT	Crown Grant in Trust
COM	Commonwealth of Australia
CRO	Crown Freehold-Govt Ownership
DOL	Dept of Land Administration
DPU	Ministry for Planning
EXD	Exec Direc CALM
FRE	Freehold
HOW	Homeswest
ILD	Industrial Lands Develop. Auth
JOI	Joint Vesting-NPNCA & Shire
LAC	LandCorp
LFC	Lands and Forests Commission
MAG	Minister for Agriculture
MED	Ministry of Education
MHE	Minister for Health
MIN	Minister for Mines
MPL	Ministry for Planning
MPR	Minister for Prisons
MRD	Main Roads WA
MTR	Minister for Transport
MWA	Minister for Water Resources
MWO	Minister for Works
NAT	Natural Trust of Australia WA
NON	Not Vested
NPN	NPNCA
OTH	Other
PRI	Private
RAI	Westrail
SEC	Western Power
SHI	Shire
SPC	State Planning Commission
TEL	Telstra
TGR	Timber Govt Requirement
TOW	TOWN
UNK	Unknown
WAT	Water Corporation
WEL	Minister Community Welfare
WRC	Water & Rivers Commission
XPL	Ex-Pastoral Lease

**PURPOSES**

ABR	Aboriginal Reserve
AER	Aerodrome
CAM	Camping
CAR	Caravan park
CEM	Cemetery
CFA	Conservation of Fauna
CFF	Conservation Of Flora & Fauna
CFL	Conservation of Flora
CHU	Church
CPK	Car Park
COM	Common
CON	Conservation Park
DEF	Defence
DRA	Drain
EDE	Educational Endowment
EDU	Educational purposes UWA
ENE	Enjoyment of Natural Environ.
EXC	Excepted from sale

EXL	Exploration Lease
EXP	Experimental Farm
FIR	Firing Range
FOR	State Forest
GHA	Grain Handling
GOL	Golf
GRA	Gravel Pit
GRE	Green Belt
GVT	Government Requirements
HAR	Harbour Purposes
HEP	Heritage Purposes
HER	Heritage trail
HOS	Hospital
KEN	Kennels
MIN	Mining lease
MUN	Municipal Purposes
NPK	National Park
NRE	Nature Reserve
OTH	Other
PAC	Public access
PAR	Parkland (& Recreation)
PAS	Pastoral lease
PFL	Protection of Flora
PIC	Picnic ground
PLA	Plantation
POS	Public Open Space
PPA	Public parkland
PRS	Prison site
PUT	Public Utility
QUA	Quarry
RAD	Radio Station
RAC	Racecourse
REC	Recreation
REH	Rehabilitation
RNP	Re-establish Native Plants
RRE	Railway Reserve
RUB	Rubbish
SAN	Sand
SCH	School-site
SET	Settlers requirements
SHI	Shire Requirements
SHO	Showgrounds
SNN	Sanitary
STO	Stopping place
TIM	Timber
TOU	Tourism
TOW	Town-site
TRA	Training Ground
TRI	Trig station
TVT	Television transmitting
UNK	Unknown
UTI	Utilities
VCL	Vacant Crown Land
VER	Road Verge
VPF	Vermin Proof Fence
WAT	Water
WCO	Water & Conservation of F & F
WOO	Firewood

\* Please note that LFC now comes under the Conservation Commission.

Total No. of Records = 27

Species Name	Cons.	Pop ID	No. Plants	Latitude	Longitude	Purpose	Vest
Acacia benthamii	2	2		31^42'55.6"	115^48'25.3"		PRI
	3	3		31^46'45.6"	115^52'11.3"	Recreation	SHI
	R	7A	4	31^37'50.6"	115^45'41.3"	Slate Forest	LFC
Cylalhochaeta leretifolia	R	7B	44	31^38'02.6"	115^45'43.3"	Slate Forest	LFC
	R	10	34	31^38'31.6"	115^45'59.3"	Quarry	NON
	R	13	8	31^41'50.6"	115^42'32.3"		PRI
Eucalyptus argutifolia	R	14A	35	31^39'04.6"	115^46'35.3"	Mining lease	NON
	R	14B	4	31^38'55.6"	115^46'24.3"	Mining lease	NON
	R	15	20	31^40'55.6"	115^42'40.3"		PRI
Hibbertia spicata subsp. leptolheca	R	17A	1	31^38'45.6"	115^45'36.3"		PRI
	R	17B	1	31^38'43.6"	115^45'33.3"		PRI
	3	4A		31^43'48.0"	115^43'12.0"	Recreation	SHI
Jacksonia sericea	3	4B		31^44'22.6"	115^43'25.3"		PRI
	4	1		31^45'45.6"	115^47'35.3"	Parkland (& Recreation)	SHI
	4	4A		31^45'20.6"	115^46'05.3"		PRI
Sarcozona bicarinata	4	4B		31^45'25.6"	115^46'05.3"		NON
	4	4C		31^45'25.6"	115^45'55.3"		PRI
	4	5A		31^43'55.6"	115^45'05.3"		NON
MRD	4	5B		31^43'55.6"	115^45'05.3"		MRD
	4	5C		31^43'55.6"	115^45'05.3"		RAI
	4	5D		31^43'55.6"	115^45'05.3"	Road Verge	MRD
RAI	4	5E		31^43'55.6"	115^45'05.3"		RAI
	4	5F		31^43'55.6"	115^45'05.3"		PRI
	4	9A	280	31^46'25.6"	115^46'58.3"	Road Verge	SHI
PRI	4	9B	7200	31^46'25.6"	115^46'58.3"		PRI
	3	1A		31^43'44.0"	115^43'12.0"	Recreation	SHI
	3	1B	25	31^44'39.6"	115^43'52.3"		PRI

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT  
DECLARED RARE AND PRIORITY FLORA LIST  
22 February 2005

SPECIES / TAXON	CONS CODE	CALM REGION	DISTRIBUTION	FLOWER PERIOD
Calectasia sp. Pinjar (C Tauss 557)	1	SW	Pinjar (Wanneroo)	Jul-Oct

WAHERB SPECIMEN DATABASE  
GENERAL ENQUIRY

*Acacia benthamii*  
Meisn. (Mimosaceae)  
CONSERVATION STATUS:P2  
Coll.: C. Andrews s.n. Date: 09 1901 ( PERTH 169579 )  
LOCALITY Woodville [Almost surely Woodvale in W.A.: R.S. Cowan]. WA  
LAT 31 Deg 45 Min 55.600 Sec S LONG 115 Deg 49 Min 5.300 Sec E  
Sand.  
Previous det.: *Acacia cochlearis* (Labill.) H.L. Wendl.

*Acacia benthamii*  
Meisn. (Mimosaceae)  
CONSERVATION STATUS:P2  
Coll.: H. Butler s.n. Date: 09 1975 ( PERTH 703656 )  
LOCALITY Wanneroo WA  
LAT 31 Deg 45 Min Sec S LONG 115 Deg 48 Min Sec E  
Previous det.: *Acacia benthamii* Meissner

*Acacia benthamii*  
Meisn. (Mimosaceae)  
CONSERVATION STATUS:P2  
Coll.: J. Havel 120 Date: 23 09 1965 ( PERTH 00718297 )  
LOCALITY East Wanneroo WA  
LAT 31 Deg 44 Min 54.000 Sec S LONG 115 Deg 47 Min 59.000 Sec E  
Previous det.: *Acacia benthamii* Meisn.

*Acacia benthamii*  
Meisn. (Mimosaceae)  
CONSERVATION STATUS:P2  
Coll.: J.J. Havel H 120 Date: 23 09 1965 ( PERTH 00920320 )  
LOCALITY E [of] Wanneroo WA  
LAT 31 Deg 44 Min 54.000 Sec S LONG 115 Deg 47 Min 59.000 Sec E  
Previous det.: *Acacia ? sessilis* Benth.

*Anthotium junciforme*  
(de Vriese) D.A.Morrison (Goodeniaceae)  
CONSERVATION STATUS:P4  
Coll.: B.J. Keighery 2070 Date: 10 11 1994 ( PERTH 06514049 )  
LOCALITY SE end off Perry Road, Lake Pinjar Bushland (System 6 Area M8, Bush Forever 382). Lake Pinjar, in System 6 Update quadrat pinj 03 WA  
LAT 31 Deg 38 Min 21.100 Sec S LONG 115 Deg 49 Min 2.200 Sec E  
Flowers purple and buds. Seasonal Wetland. Flat ground; dark brown clay loam, over ?clay. Poor drainage,

wet during winter and spring. Dwarf Scrub  
C. Associated species: *Calothamnus lateralis*, *Pericalymma elipticum*.

*Astroloma microcalyx*  
Sond. (Epacridaceae)  
CONSERVATION STATUS:P3  
Coll.: R.J. Cranfield s.n. Date: 08 1978 ( PERTH 02966646 )  
LOCALITY Ocean Reef WA  
LAT 31 Deg 45 Min 59.000 Sec S LONG 115 Deg 44 Min 0.000 Sec E  
Previous det.: *Astroloma drummondii* Sonder

*Astroloma microcalyx*  
Sond. (Epacridaceae)  
CONSERVATION STATUS:P3  
Coll.: A.M. Baird s.n. Date: 08 1965 ( PERTH 02966654 )  
LOCALITY Yanchep Road - 8 miles before park WA  
LAT 31 Deg 36 Min Sec S LONG 115 Deg 42 Min Sec E  
Shallow limestone soil. Heath.  
Previous det.: *Astroloma* sp.

*Caladenia huegelii*  
Rchb.f. (Orchidaceae)  
CONSERVATION STATUS:R  
Coll.: C.A. Gardner 7670 Date: 19 09 1945 ( PERTH 255947 )  
LOCALITY Gngangara, WA  
LAT 31 Deg 47 Min Sec S LONG 115 Deg 52 Min Sec E  
Previous det.: *Caladenia huegelii* Rchb.f.

*Comesperma acerosum*  
Steetz (Polygalaceae)  
CONSERVATION STATUS:P3  
Coll.: Ecologia ECOL.81 Date: 12 11 1996 ( PERTH 05643244 )  
LOCALITY Alkimos, 1-2 km W of Dizzy Lamb Park, Wanneroo WA  
LAT 31 Deg 36 Min 35.000 Sec S LONG 115 Deg 42 Min 20.000 Sec E  
Slender upright shrub ca 70 cm tall. On limestone ridge slope. Dry white sand over concretionary gravel.  
Dense coastal heath. Associated species: *Eucalyptus foecunda*, *Dryandra sessilis*, *D. lindleyana*, *Acacia pulchella*, *Hibbertia hypericoides*.

*Comesperma acerosum*  
Steetz (Polygalaceae)  
CONSERVATION STATUS:P3  
Coll.: Ecologia ECOL.79 Date: 12 11 1996 ( PERTH 05642787 )  
LOCALITY Alkimos, 1 km W of Dizzy Lamb Rock, along track, WA

LAT 31 Deg 36 Min 35.000 Sec S LONG  
115 Deg 42 Min 20.000 Sec E  
Slender upright shrub ca 70 cm tall. On  
limestone ridge slope. White sand. Moderately  
old burn, some weeds.  
Dense coastal heath. Associated species:  
*Acacia pulchella* (2-10%), *Cassytha*  
*micrantha* (2-10%), *Desmocladius flexuosa* (2-  
10%), *Dryandra lindleyana* (2-10%),  
*D. sessilis* (2-10%), *Hardenbergia comptoniana*  
(2-10%), *Scaevola thesoides*  
(10-30%), *Melaleuca acerosa*/M. *huegelii* (2-  
10%).

*Conostylis bracteata*  
Lindl. (Haemodoraceae)  
CONSERVATION STATUS:P3  
Coll.: Y. Chadwick 515 Date: 19 11 1962 (   
PERTH 05931436 )  
LOCALITY Mullaloo WA  
LAT 31 Deg 47 Min Sec S LONG  
115 Deg 44 Min Sec E  
Top of sand dune.  
Previous det.: *Conostylis* sp.

*Conostylis bracteata*  
Lindl. (Haemodoraceae)  
CONSERVATION STATUS:P3  
Coll.: S.D. Hopper 5188 Date: 16 08 1986 (   
PERTH 1744321 )  
LOCALITY Kallaroo, 25 km NNW of Perth;  
50 m SSW of Juno Crescent on the verge of  
Dampier Avenue WA  
LAT 31 Deg 47 Min Sec S LONG  
115 Deg 44 Min 30.000 Sec E  
Loosely tufted herb to 80 cm diameter; leaf  
margins with white plumose appressed  
hairs <1 mm long; perianth 10-12 mm long,  
pale yellowish green outside, golden  
yellow inside tube, lobes cream inside,  
becoming golden yellow at base and near apex,  
conspicuously channelled.  
E slopes of a consolidated sand dune. Low  
heath of *Acanthocarpus preissii*, *Acacia*  
*lasiocarpa*.  
Rendered extinct by housing development on  
August 17.

*Conostylis bracteata*  
Lindl. (Haemodoraceae)  
CONSERVATION STATUS:P3  
Coll.: S.D. Hopper 5192 Date: 16 08 1986 (   
PERTH 02052121 )  
LOCALITY Mullaloo, c. 1 km inland,  
recreation reserve W of intersection of  
Waltham and Gunida Streets WA  
LAT 31 Deg 46 Min 48.000 Sec S LONG  
115 Deg 43 Min 54.000 Sec E

Loosely tufted herb, leaves in flattened  
fascicles, margins with white appressed to  
spreading plumose hairs.  
Swale in undulating consolidated dunes, some  
outcropping limestone.  
In coastal scrub of *Dryandra sessilis*, *Acacia*  
*saligna*, *A. xanthina*,  
*Xanthorrhoea preissii*, *Banksia attenuata*,  
*Melaleuca acerosa*.

*Conostylis bracteata*  
Lindl. (Haemodoraceae)  
CONSERVATION STATUS:P3  
Coll.: L.W. Sage s.n. Date: 06 11 1997 (   
PERTH 05305691 )  
LOCALITY Remnant Banksia woodland  
(Block 9471), ca 2 km S of Burns Beach Road,  
E side of Lake Joondalup, Yellagonga  
Regional Park, WA  
LAT 31 Deg 45 Min Sec S LONG  
115 Deg 47 Min Sec E  
Perennial herb, flowers yellow. Plain  
near lake. Grey sand.  
Jarrah with *Banksia attenuata*, *B. menziesii*,  
*Burchardia congesta*, *Hibbertia hypericoides*,  
*Acacia* spp., *Ehrharta calycina*.  
Previous det.: *Conostylis* sp.  
Frequency:occasional.

*Conostylis pauciflora*  
subsp. *euryrhipis* Hopper (Haemodoraceae)  
CONSERVATION STATUS:P3  
Coll.: P.G. Armstrong s.n. Date: 25 10 1996 (   
PERTH 05982138 )  
LOCALITY Site 18, NW corner of the  
Alkimos Estate, 100 m from the coast, WA  
LAT 31 Deg 36 Min Sec S LONG  
115 Deg 40 Min Sec E  
S slope, on sand dunes; dry white sand;  
long unburnt. Low heath 0.3 m tall, 30-70%  
cover.  
Frequency:c. 20 mature plants in a 5 x 20 m  
area.

*Conostylis pauciflora*  
subsp. *euryrhipis* Hopper (Haemodoraceae)  
CONSERVATION STATUS:P3  
Coll.: B.J. Keighery 789 B Date: 23 10 1989 (   
PERTH 04059034 )  
LOCALITY Alkimos Block, W Carabooda  
Lake, Site 4 WA  
LAT 31 Deg 36 Min Sec S LONG  
115 Deg 40 Min Sec E  
Tufted perennial herb, flowers yellow.  
On grey calcareous sand.

*Cyathochaeta teretifolia*  
W.Fitzg. (Cyperaceae)  
CONSERVATION STATUS:P3

Coll.: V. Yeomans 222-01 Date: 02 12 2002 ( PERTH 06808077 )

LOCALITY Gngangara Mound WA

LAT 31 Deg 41 Min 16.800 Sec S LONG 115 Deg 49 Min 33.600 Sec E

Grass like or sedge. Low forest, Melaleuca preissiana, Astartea fascicularis, Hypocalymma angustifolium, Banksia littoralis.

*Cyathochaeta teretifolia*

W.Fitzg. (Cyperaceae)

CONSERVATION STATUS:P3

Coll.: R.J. Cranfield 1184 a Date: 07 02 1980 ( PERTH 2076802 )

LOCALITY 8.38 km N along Galacher Road off Neeves Road WA

LAT 31 Deg 45 Min Sec S LONG 115 Deg 51 Min Sec E

Tall grass like plant 1 m high. In peat swamp.

Previous det.: *Cyathochaeta avenacea* Benth.

*Cyathochaeta teretifolia*

W.Fitzg. (Cyperaceae)

CONSERVATION STATUS:P3

Coll.: B.J. Keighery 2000 Date: ( PERTH 04098374 )

LOCALITY Site 02, Gngangara WA

LAT 31 Deg 47 Min Sec S LONG 115 Deg 52 Min Sec E

Perennial herb up to 2 m tall, clumped.

On grey sandy clay on seasonally wet slope beside permanent lake.

In Melaleuca preissiana and Eucalyptus rudis Open Low Woodland A

over Aotus gracillima and Astartea aff.

fascicularis Heath A over Herbs, Very Open

Tall Sedges and Open Low Sedges.

Previous det.: *Cyathochaeta*

sp.Gngangara(B.J.Keighery 2000)

*Cyathochaeta teretifolia*

W.Fitzg. (Cyperaceae)

CONSERVATION STATUS:P3

Coll.: B.J. Keighery 2000 Date: ( PERTH 04097394 )

LOCALITY Site 02, Gngangara WA

LAT 31 Deg 47 Min Sec S LONG 115 Deg 52 Min Sec E

Perennial herb up to 2 m tall, clumped.

On grey sandy clay on seasonally wet slope beside permanent lake.

In Melaleuca preissiana and Eucalyptus rudis Open Low Woodland A

over Aotus gracillima and Astartea aff.

fascicularis Heath A over Herbs, Very Open

Tall Sedges and Open Low Sedges.

Previous det.: *Cyathochaeta* sp. Gngangara (B.J. Keighery 2000)

*Cyathochaeta teretifolia*

W.Fitzg. (Cyperaceae)

CONSERVATION STATUS:P3

Coll.: B.J. Keighery 2488 Date: 27 10 1994 ( PERTH 06427774 )

LOCALITY E of Lake Gngangara in System 6

Update quadrat gnan02 (System 6 Area M8, Bush Forever Site 193) WA

LAT 31 Deg 46 Min 49.400 Sec S LONG 115 Deg 52 Min 15.600 Sec E

Tufted perennial herb, flowers straw colour.

Damp margin of lake, flat ground, grey sand with clay, poor drainage, wet during winter/spring.

Open Low Woodland A. Associated species:

Melaleuca preissiana, Eucalyptus rudis.

Previous det.: *Cyathochaeta teretifolia*

W.Fitzg.

*Cyathochaeta teretifolia*

W.Fitzg. (Cyperaceae)

CONSERVATION STATUS:P3

Coll.: B.J. Keighery 2000 Date: ( PERTH 04654773 )

LOCALITY Site 02, Gngangara WA

LAT 31 Deg 47 Min Sec S LONG 115 Deg 52 Min Sec E

Perennial herb up to 2 m tall, clumped.

On grey sandy clay on seasonally wet slope beside permanent lake.

In Melaleuca preissiana and Eucalyptus rudis

Open Low Woodland A

over Aotus gracillima and Astartea aff.

fascicularis Heath A over Herbs, Very Open

Tall Sedges and Open Low Sedges.

Previous det.: *Cyathochaeta*

sp.Gngangara(B.J.Keighery 2000)

*Eucalyptus argutifolia*

P.M.Grayling & Brooker (Myrtaceae)

CONSERVATION STATUS:R

Coll.: G.J. Keighery 13177 Date: 22 04 1991 ( PERTH 04110544 )

LOCALITY Mindarie South, 30 km N of Perth WA

LAT 31 Deg 41 Min 59.000 Sec S LONG 115 Deg 44 Min 0.000 Sec E

Mallee to 3 m. Dune slope, grey sand

over limestone. Mallee, Eucalyptus petrensis over heath.

Frequency:rare in area.

*Eucalyptus argutifolia*

P.M.Grayling & Brooker (Myrtaceae)

CONSERVATION STATUS:R

Coll.: Robson J.L. s.n. Date: 06 08 1990 ( PERTH 1123661 )

LOCALITY Ridge State Forest, 260 metres along Hopkins Road, from junction of Wesco Road [Near Lake Pinjar]. WA

LAT 31 Deg 38 Min 10.200 Sec S LONG 115 Deg 45 Min 42.000 Sec E

ESE aspect. Lower ridgetop slope. Sheet sand/brown boulder. Completely open to treeless site.

Melaleuca huegelii, Xanthorrhoea preissii, Dryandra sessilis/nivea, Hakea trifurcata, Hibbertia hypericoides, Native wisteria.

Previous det.: Eucalyptus argutifolia

Eucalyptus argutifolia  
P.M.Grayling & Brooker (Myrtaceae)  
CONSERVATION STATUS:R  
Coll.: J.L. Robson s.n. Date: 15 11 1991 ( PERTH 2117223 )

LOCALITY Quarry Reserve 5204, 250 m from the junction of Myrtle road and 380 m at 195 deg. to rare mallees WA

LAT 31 Deg 39 Min 10.000 Sec S LONG 115 Deg 46 Min 25.000 Sec E

Slight gully situation nestled between two limestone ridges. Limestone/boulder/sand/brown/yellow/dry.

Completely open & treeless with dense scrubland. Dryandra's nivea/ sessilis, Hakea trifurcata, Melaleuca huegelii, Blackboys (Xanthorrhoea preissii), Templetonia retusa.

Abundance: 32 clumps, undisturbed

Eucalyptus argutifolia  
P.M.Grayling & Brooker (Myrtaceae)  
CONSERVATION STATUS:R  
Coll.: J.L. Robson s.n. Date: 15 11 1991 ( PERTH 2160765 )  
LOCALITY Quarry Reserve 5204, 250 m from junction of Myrtle road and 380 m at 195 deg. WA

LAT 31 Deg 39 Min 10.000 Sec S LONG 115 Deg 46 Min 25.000 Sec E

Slight gully situation nestles between two limestone ridges. Sand/boulder/brown/yellow/dry/limestone.

Completely open and treeless with dense scrubland. Dryandra's nivea/ sessilis, Hakea trifurcata, Melaleuca huegelii, Blackboys (Xanthorrhoea preissii), Templetonia retusa.

Abundance: 32 clumps

Previous det.: Eucalyptus argutifolia Grayling & Brooker

Fabronia hampeana  
Sond. (Fabroniaceae)  
CONSERVATION STATUS:P2

Coll.: J.A. Curnow 4799 Date: 14 09 1994 ( PERTH 05939658 )

LOCALITY Between Neerabup National Park and developing suburb of Kinross, 28 km NNW of Perth WA

LAT 31 Deg 43 Min Sec S LONG 115 Deg 45 Min Sec E

Fertile moss. On trunk of Macrozamia. Emergent large Banksia over Macrozamia, Hibbertia, Xanthorrhoea, grasses, weeds and thick Dryandra regrowth.

Previous det.: Fabronia hampeana Sond.

Grevillea thelemanniana  
Endl. (Proteaceae)  
CONSERVATION STATUS:P4  
Coll.: J.J. Havel H 31 Date: 28 07 1965 ( PERTH 04235487 )  
LOCALITY W of Lake Joondalup, Wanneroo WA

LAT 31 Deg 44 Min 35.000 Sec S LONG 115 Deg 46 Min 48.000 Sec E

Hibbertia helianthemoides  
(Turcz.) F.Muell. (Dilleniaceae)  
CONSERVATION STATUS:P3  
Coll.: J.J. Havel H 224 Date: 10 12 1965 ( PERTH 06263542 )

LOCALITY W Gironde, Gnangara WA  
LAT 31 Deg 47 Min Sec S LONG 115 Deg 52 Min Sec E  
Previous det.: Hibbertia helianthemoides (Turcz.) F.Muell.

Hibbertia spicata  
subsp. leptotheca J.R.Wheeler  
(Dilleniaceae)  
CONSERVATION STATUS:P3  
Coll.: G.J. Keighery 11492 Date: 21 09 1990 ( PERTH 03096424 )  
LOCALITY Burns Beach; 26 km N of Perth WA

LAT 31 Deg 44 Min 0.000 Sec S LONG 115 Deg 43 Min 0.000 Sec E

Domed green shrub, to 30 cm x 40 cm. Flowers yellow, reflexed over sepals when in flower. In full flower.

Sea cliff. Grey-black sand over limestone. Low Melaleuca cardiophylla closed heath.

Abundance: common.

Previous det.: Hibbertia spicata subsp. ? leptotheca J. Wheeler

Jacksonia sericea  
Benth. (Papilionaceae)  
CONSERVATION STATUS:P4  
Coll.: B. Keighery s.n. Date: 15 06 1999 ( PERTH 05437806 )

LOCALITY Bushplan Site 463, ca 1 km W of  
Gnangara Road in bushland W of Sydney  
Road WA

LAT 31 Deg 47 Min 0.000 Sec S LONG  
115 Deg 51 Min 59.000 Sec E  
Prostrate shrub 0.1 m high, 1 m wide; sterile.  
Side of Spearwood Dune, grey sand over deep  
yellow sand.  
Banksia attenuata and B. menziesii woodland.  
Frequency: scattered.

Jacksonia sericea  
Benth. (Papilionaceae)  
CONSERVATION STATUS: P4  
Coll.: M.A. Langley 869 Date: 15 05 1990 (   
PERTH 02171449 )

LOCALITY NW corner of Ocean Reef road  
and Joondalup Drive, Woodvale WA

LAT 31 Deg 46 Min 30.000 Sec S LONG  
115 Deg 46 Min 53.000 Sec E  
Low spreading shrub to .3 m high. Brown  
pods. In yellowish/brown sand on low  
ground.

In open woodland over low heath and  
disturbed areas, with Banksia  
attenuata, B. menziesii, Gomphlobium  
aristatum, Xanthorrhoea sp., Eucalyptus  
gomphocephalum.

Jacksonia sericea  
Benth. (Papilionaceae)  
CONSERVATION STATUS: P4  
Coll.: P. Bridgewater s.n. Date: 11 1979 (   
PERTH 1131176 )

LOCALITY Lake Joondalup (Edgewater)  
WA

LAT 31 Deg 45 Min 0.000 Sec S LONG  
115 Deg 47 Min 0.000 Sec E  
Low spreading shrub 0.5 m high. Highly  
disturbed. Highly disturbed Tuart/Jarrah  
forest.

Jacksonia sericea  
Benth. (Papilionaceae)  
CONSERVATION STATUS: P4  
Coll.: E.M. Bennett s.n. Date: 07 2001 (   
PERTH 06410731 )  
LOCALITY Lot 21, Flynn Drive, Neerabup,  
Shire of Wanneroo WA  
LAT 31 Deg 41 Min Sec S LONG  
115 Deg 46 Min Sec E  
Slope/flat. Dry grey sand over limestone.  
Eucalyptus marginata, Banksia attenuata, B.  
menziesii Woodland. Associated  
species: Banksia attenuata, B. grandis,  
Allocasuarina fraseriana, Dryandra sessilis,  
Calothamnus sp.  
Condition of population: healthy.

Jacksonia sericea

Benth. (Papilionaceae)  
CONSERVATION STATUS: P4  
Coll.: D. Lullfitz 1 Date: 14 10 2002 (   
PERTH 06730620 )  
LOCALITY Periwinkle Park, Periwinkle  
Road, Mullaloo WA  
LAT 31 Deg 47 Min Sec S LONG  
115 Deg 44 Min Sec E  
Shrub 30-60 cm high x 1 m wide. Perennial,  
prostrate, dense spreading. Flowers orange.  
Hillside. Dry sand. Old soil disturbance.  
Tuart, Banksia, Allocasuarina woodland.  
Previous det.: Jacksonia sericea Benth.  
Frequency: over 50 plants, quite widespread.

Jacksonia sericea  
Benth. (Papilionaceae)  
CONSERVATION STATUS: P4  
Coll.: G.J. Keighery 9498 Date: 20 01 1988 (   
PERTH 1131192 )

LOCALITY Ocean Reef Road, Wanneroo, 30  
km N Perth WA

LAT 31 Deg 45 Min 0.000 Sec S LONG  
115 Deg 46 Min 0.000 Sec E  
Prostrate shrub, 50 cm x 1.5 m diam. Flowers  
orange-yellow; eye yellow. Hilltop, sand  
over limestone.

Banksia low woodland.  
Abundance: common.  
Previous det.: Jacksonia calcicola Chappill

Pithocarpa corymbulosa  
Lindl. (Asteraceae)  
CONSERVATION STATUS: P2  
Coll.: Y. Chadwick 999 Date: 06 06 1963 (   
PERTH 06209874 )

LOCALITY 3 miles N of Pinjar Forestry  
Headquarters, Wanneroo WA

LAT 31 Deg 37 Min Sec S LONG  
115 Deg 49 Min Sec E  
Field No. Y 64.

Pityrodia axillaris  
(Endl.) Druce (Lamiaceae)  
CONSERVATION STATUS: R  
Coll.: L.D. O'Grady s.n. Date: 1953 (   
PERTH 02693976 )  
LOCALITY Gnangarra WA  
LAT 31 Deg 47 Min 0.000 Sec S LONG  
115 Deg 51 Min 59.000 Sec E  
Previous det.: Pityrodia axillaris (Endl.) Druce

Rhodanthe pyrethrum  
(Steetz) Paul G. Wilson (Asteraceae)  
CONSERVATION STATUS: P3  
Coll.: B.J. Keighery 2164 Date: 10 11 1994 (   
PERTH 06427367 )  
LOCALITY SE end off Perry Road, Lake  
Pinjar Bushland (System 6 Area M8,

Bush Forever 382), Lake Pinjar, in System 6 Update quadrat pinj02 WA  
 LAT 31 Deg 38 Min 19.400 Sec S LONG 115 Deg 48 Min 53.100 Sec E  
 Flowers white. Seasonal Wetland, flat ground, dark brown clay loam some peat, over ?clay, poor drainage, wet during winter/spring. Open Low Scrub A. Associated species: *Astartea fascicularis*.

*Sarcozona bicarinata*  
 S.T.Blake (Aizoaceae)  
 CONSERVATION STATUS:P3  
 Coll.: P. Wenham PW 97032 Date: 02 03 1997 ( PERTH 4583744 )  
 LOCALITY Iluka-Beaumaris Estate near Sales Office, 100 m N of Miami Beach Promenade, Location B (refer to map attached) WA  
 LAT 31 Deg 44 Min 0.000 Sec S LONG 115 Deg 44 Min 0.000 Sec E  
 Herbaceous succulent 8 cm high and spreading to generally less than 30 cm across the ground. Leaves dull grey, green in colour; seeds brown and rough all over. Grey sand over rocky limestone outcrops. Exposed sunny areas. Edge of *Dryandra sessilis* (Parrot Bush) heathlands and cleared area for housing. No evidence of recent fire but few plants (3 only) found on edge of bushland where the area has been cleared for housing development.  
 Previous det.: *Carpobrotus* sp.Hepburn

*Sarcozona bicarinata*  
 S.T.Blake (Aizoaceae)  
 CONSERVATION STATUS:P3  
 Coll.: P. Wenham PW 97031 Date: 02 03 1997 ( PERTH 4583736 )  
 LOCALITY Iluka-Beaumaris Estate (near Burns Beach), track off Burns Beach Road, Location A (refer to map attached) WA  
 LAT 31 Deg 44 Min 0.000 Sec S LONG 115 Deg 44 Min 0.000 Sec E  
 Herbaceous succulent 8 cm high and spreading to generally less than 30 cm across the ground. Leaves dull grey, green in colour; seeds brown and rough all over. Grey sand over rocky limestone outcrops. Exposed sunny areas. Fire approximately 12 months prior to collection. The fire most probably stimulates seed germination and opens up the very dense *Dryandra* heath providing a sunny environment for this species to flourish for a few years until the *Dryandra* once

again dominates by forming impenetrable heaths. *Dryandra sessilis* (Parrot Bush) heathlands.  
 Abundance: this species is common throughout the fire burnt area but did not occur outside where the *Dryandra sessilis* formed closed dense heath nor did it occur in adjacent unburnt *Banksia* bushland.  
 Previous det.: *Carpobrotus* sp.Hepburn

*Stachystemon axillaris*  
 A.S.George (Euphorbiaceae)  
 CONSERVATION STATUS:P4  
 Coll.: Havel H 177 Date: ( PERTH 05619556 )  
 LOCALITY Plot A8, Neaves Road, NE of Wanneroo, WA  
 LAT 31 Deg 41 Min Sec S LONG 115 Deg 49 Min Sec E  
 Previous det.: *Stachystemon axillaris*  
 A.S.George

*Stylidium longitubum*  
 Benth. (Stylidiaceae)  
 CONSERVATION STATUS:P3  
 Coll.: B.J. Keighery 2114 Date: 10 11 1994 ( PERTH 06511120 )  
 LOCALITY SE end off Perry Road, Lake Pinjar Bushland (System 6 Area M8, Bush Forever 382). Lake Pinjar, in System 6 Update quadrat pinj 03 WA  
 LAT 31 Deg 38 Min 21.100 Sec S LONG 115 Deg 49 Min 2.200 Sec E  
 Annual, flowers purple. Seasonal Wetland, flat ground, dark brown clay loam, over ?clay. Poor drainage, wet during winter/spring. Dwarf Scrub C. Associated species: *Calothamnus lateralis*, *Pericalymma elipticum*.

*Stylidium longitubum*  
 Benth. (Stylidiaceae)  
 CONSERVATION STATUS:P3  
 Coll.: B.J. Keighery 2152 Date: 10 11 1994 ( PERTH 06511546 )  
 LOCALITY SE end off Perry Road, Lake Pinjar Bushland (System 6 Area M8, Bush Forever 382). Lake Pinjar, in System 6 Update quadrat pinj 02 WA  
 LAT 31 Deg 38 Min 19.400 Sec S LONG 115 Deg 48 Min 53.100 Sec E  
 Flowers pink. Seasonal Wetland, flat ground. Dark brown clay loam some peat, over ?clay. Poor drainage, wet during winter/spring. Open Low Scrub A. Associated species: *Astartea fascicularis*.

*Stylidium maritimum*

Lowrie, Coates & Kenneally  
(Stylidiaceae)  
CONSERVATION STATUS:P3  
Coll.: A. Lowrie 1358 Date: 22 10 1995 (   
PERTH 04430921 )  
LOCALITY Just N of the tavern on Wanneroo  
Road, Carabooda, WA  
LAT 31 Deg 37 Min Sec S LONG  
115 Deg 44 Min Sec E  
Flowers pink-mauve, throat white, outer petal  
surface white to pale pink, upper  
winged throat appendages pink, lower throat  
appendages white-red tipped, leaves 3 per  
papery sheath.  
On limestone outcrops in crater-like  
depressions filled with black sandy soil.  
Area surrounded by low coastal heath and  
open *Banksia menziesii* woodland.  
Previous det.: *Stylidium maritimum*  
Lowrie, Coates & Kenneally

*Stylidium maritimum*  
Lowrie, Coates & Kenneally  
(Stylidiaceae)  
CONSERVATION STATUS:P3  
Coll.: P.G. Armstrong s.n. Date: 25 10 1996 (   
PERTH 05982103 )  
LOCALITY 200 m from coast, Alkimos  
Estate, WA  
LAT 31 Deg 36 Min Sec S LONG  
115 Deg 40 Min Sec E  
Slope; on stable sand dunes; dry white  
sand; long unburnt. Low heath 0.5 m tall,  
70-100 % cover.  
Previous det.: *Stylidium maritimum*  
Lowrie, Coates & Kenneally  
Frequency: c. 10 mature plants in a 5 x 5 m  
area.

*Tripterococcus paniculatus*  
W.R.Barker ms (Stackhousiaceae)  
CONSERVATION STATUS:P1  
Coll.: B.J. Keighery 2168 Date: 10 11 1994 (   
PERTH 06427405 )  
LOCALITY SE end off Perry Road, Lake  
Pinjar Bushland (System 6 Area M8,  
Bush Forever 382), Lake Pinjar, in System 6  
Update quadrat pinj01 WA  
LAT 31 Deg 38 Min 25.600 Sec S LONG  
115 Deg 48 Min 53.300 Sec E  
Flowers yellow. Seasonal Wetland, flat  
ground, black fine peaty clay loam sand, poor  
drainage,  
wet during winter/spring. Open Herbs.  
Associated species: *Lepyrodia muirii*, *Baumea*  
*articulata*, *Baumea vaginalis*.  
Previous det.: *Tripterococcus*  
*sp.* Cannington (A.S. George 16201)  
W.R.Barker

## **Appendix D**

### **CALM Threatened Fauna Database Search**

## DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

### THREATENED FAUNA INFORMATION

#### Conditions In Respect Of Supply Of Information

- \* All requests for data to be made in writing to the Executive Director, Department of Conservation and Land Management, Attention: Senior Zoologist, Wildlife Branch.
- \* The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided without the prior consent of the Executive Director, Department of Conservation and Land Management.
- \* Specific locality information for Threatened Fauna is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for Threatened Fauna may not be used in reports without the written permission of the Executive Director, Department of Conservation and Land Management. Reports may only show generalised locations or, where necessary, show specific locations without identifying species. The Senior Zoologist is to be contacted for guidance on the presentation of Threatened Fauna information.
- \* Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data, they may be present. The Department of Conservation and Land Management accepts no responsibility for this.
- \* Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
- \* It should be noted that the supplied data do not necessarily represent a comprehensive listing of the Threatened Fauna of the area in question. Its comprehensiveness is dependent of the amount of survey carried out within a specified area. The receiving organisation should employ a biologist/zoologist, if required, to undertake a survey of the area under consideration.
- \* Acknowledgment of the Department of Conservation and Land Management as the source of data is to be made in any published material. Copies of all such publications are to be forwarded to the Department of Conservation and Land Management, Attention; Senior Zoologist, Wildlife Branch.

31.6 °S 115.667 °E / 31.7917 °S 115.875 °E

Cnr Wanneroo Rd &amp; Flynn Dr

* Date	Certainty	Seen	Location Name	Method
--------	-----------	------	---------------	--------

**Schedule 1 - Fauna that is rare or is likely to become extinct**

<i>Dasyurus geoffroii</i>	Chuditch	1 records
---------------------------	----------	-----------

This carnivorous marsupial occupies large home ranges, is highly mobile and appears able to utilise bush remnants and corridors.

1	Nowergup	Fossil
---	----------	--------

<i>Petrogale lateralis lateralis</i>	Black-flanked Rock-wallaby	1 records
--------------------------------------	----------------------------	-----------

This species thrives in steep, complex rocky habitats providing tunnels, caves and crevices for shelter and protection from predators.

1	Nowergup	Fossil
---	----------	--------

<i>Botaurus poiciloptilus</i>	Australasian Bittern	2 records
-------------------------------	----------------------	-----------

This species inhabits beds of tall dense reeds and sedges in freshwater swamps.

1982	1	1	Jandabup Lake Nature Reserve
1983	1	1	Jandabup Lake Nature Reserve

<i>Calyptorhynchus latirostris</i>	Carnaby's Black-Cockatoo	18 records
------------------------------------	--------------------------	------------

This species moves around seasonally in flocks to feeding areas in proteaceous scrubs and heaths and eucalypt woodlands as well as pine plantations. Breeding occurs in winter/spring, mainly in the eastern forests and wheatbelt where they can find mature hollow-bearing trees to nest in.

1993	1	1	Lake Joondalup	Day sighting
2000	1	10	Neerabup National Park	Day sighting
2000	1	100	Curumbine	Day sighting
2000	1	6	Neerabup	Caught or trapped
2000	1	3	Neerabup	Caught or trapped
2000	1	2	Neerabup	Caught or trapped
2003	1	6	Nowergup	Day sighting
2003	1		Carabooda	Day sighting
2003	1		Gnangara	Day sighting
2003	1		Mariginiup	Day sighting
2003	1		Mindarie	Day sighting
2003	1		Mindarie	Day sighting
2003	1		Neerabup	Day sighting
2003	1		Nowergup	Day sighting
2003	1		Ridgewood	Day sighting
2003	1		Tamala Park	Day sighting
2003	1		Wanneroo	Day sighting
2003	1		Wanneroo	Day sighting

<i>Synemon gratioia</i>	Graceful Sunmoth	5 records
-------------------------	------------------	-----------

This species has been recorded in a few locations from Wanneroo to Mandurah and is under great pressure from land development.

1984	1	16	Wanneroo	Caught or trapped
1985	1	2	Wanneroo	Caught or trapped
1995	1		Neerabup	Caught or trapped
1996	1	14	Neerabup	Caught or trapped
1996	1	7	Neerabup	Caught or trapped

**Schedule 4 - Other specially protected fauna**

31.6 °S 115.667 °E / 31.7917 °S 115.875 °E

Cnr Wanneroo Rd &amp; Flynn Dr

* Date	Certainty	Seen	Location Name	Method
<i>Falco peregrinus</i>			Peregrine Falcon	1 records
This species is uncommon and prefers areas with rocky ledges, cliffs, watercourses, open woodland or margins with cleared land.				
2003	1	1	Pinjar/Banksia Grove	Caught or trapped

**Priority Two: Taxa with few, poorly known populations on conservation lands**

<i>Ixobrychus flavicollis australis</i>			Black Bittern	1 records
This species inhabits freshwater pools, swamps and lagoons, well screened with trees.				
1987	1	1	Lake Joondalup	Day sighting

**Priority Three: Taxa with several, poorly known populations, some on conservation lands**

<i>Austrosaga spinifer</i>			<i>Austrosaga spinifer</i>	2 records
This species of cricket is known from heath habitats near Perth and Cervantes.				
1981	1	1	Neerabup National Park	
1982	1	1	Neerabup National Park	

<i>Hylaeus globuliferus</i>		<i>Hylaeus globuliferus</i>	4 records
This species of native bee is known to feed on the flowers of <i>Adenanthos cygnorum</i> in particular but has also been collected from the flowers of <i>Grevillea cagiana</i> , <i>Banksia grossa</i> and <i>Banksia attenuata</i> .			
1995	1	Neerabup	
1995	1	Neerabup	
1995	1	Neerabup	
1996	1	Neerabup	

<i>Leioproctus contrarius</i>			<b>Leioproctus contrarius</b>	<i>1 records</i>
This species of native bee is apparently dependent on flowers of Goodeniaceae and possibly <i>Lechenaultia stenosepala</i> . Recent surveys have shown that it is more widespread than previously thought.				
1982	1	1	GNANGARA	Caught or trapped

**Priority Four: Taxa in need of monitoring**

<i>Macropus irma</i>			Western Brush Wallaby		4 records
This species occurs in areas of forest and woodland supporting a dense shrub layer.					
2000	1	1	Neerabup National Park	Day sighting	
2003	1		Neerabup	Day sighting	
2003	1		Nowergup	Day sighting	
2003	1		Nowergup	Day sighting	

<i>Ixobrychus minutus</i>			Little Bittern	4 records
This cryptic species inhabits dense reeds and rushes bordering swamps, lakes and watercourses.				
1983	1	2	Jandabup Lake Nature Reserve	Day sighting
1986	1	4	Jandabup	Day sighting
2001	2	0	Wanneroo	Heard
2001	1	1	Wanneroo	

<i>Falcunculus frontatus leucogaster</i>	Crested Shrike-tit (south-western ssp)	1 records
This species is an uncommon inhabitant of woodlands.		



31.6 °S 115.667 °E / 31.7917 °S 115.875 °E

Cnr Wanneroo Rd &amp; Flynn Dr

* Date	Certainty	Seen	Location Name	Method
1943	1	1	Wanneroo	Caught or trapped

***Westralunio carteri*** **Westralunio carteri** *1 records*

This species of freshwater mussel is endemic to Western Australia.

1	Nowergup	Fossil
---	----------	--------

**Priority Five: Taxa in need of monitoring (conservation dependent)**

***Bettongia penicillata ogilbyi*** **Woylie** *1 records*

This species of rat-kangaroo occupies a variety of habitats with a clumped low understorey of tussock grasses or woody shrubs.

1	Nowergup	Fossil
---	----------	--------

***Isoodon obesulus fusciventer*** **Quenda** *14 records*

This species prefers areas with dense understorey vegetation, particularly around swamps and along watercourses, that provides ample protection from predators.

	1		Nowergup	Fossil
1995	1	1	GUMBLOSSOM PARK RESERVE	Caught or trapped
1997	1	1	Wanneroo	
2000	1	1	Neerabup National Park	Diggings
2000	1	1	Neerabup National Park	Diggings
2000	1	1	Neerabup	Caught or trapped
2003	1	2	Wanneroo	Day sighting
2003	1		Carabooda	Day sighting
2003	1		Gnangara	Day sighting
2003	2	0	Pinjar	Diggings
2003	2		Wanneroo	Diggings
2003	1		Wanneroo	
2003	1		Wanneroo	
2003	2		Wanneroo	Diggings

\* Information relating to any records provided for listed species:-

Date: date of recorded observation

Certainty (of correct species identification): 1=Very certain; 2=Moderately certain; and 3=Not sure.

Seen: Number of individuals observed.

Location Name: Name of reserve or nearest locality where observation was made

Method: Method or type of observation



## **Appendix E**

### **DIA Aboriginal Heritage Database Search**



Search Criteria

0 sites in a search polygon The polygon is formed by these points (in order)

MGA Zone 50	
Northing	Easting
6492987	383217
6492767	383393
6492538	383421
6492806	383189

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

Copyright

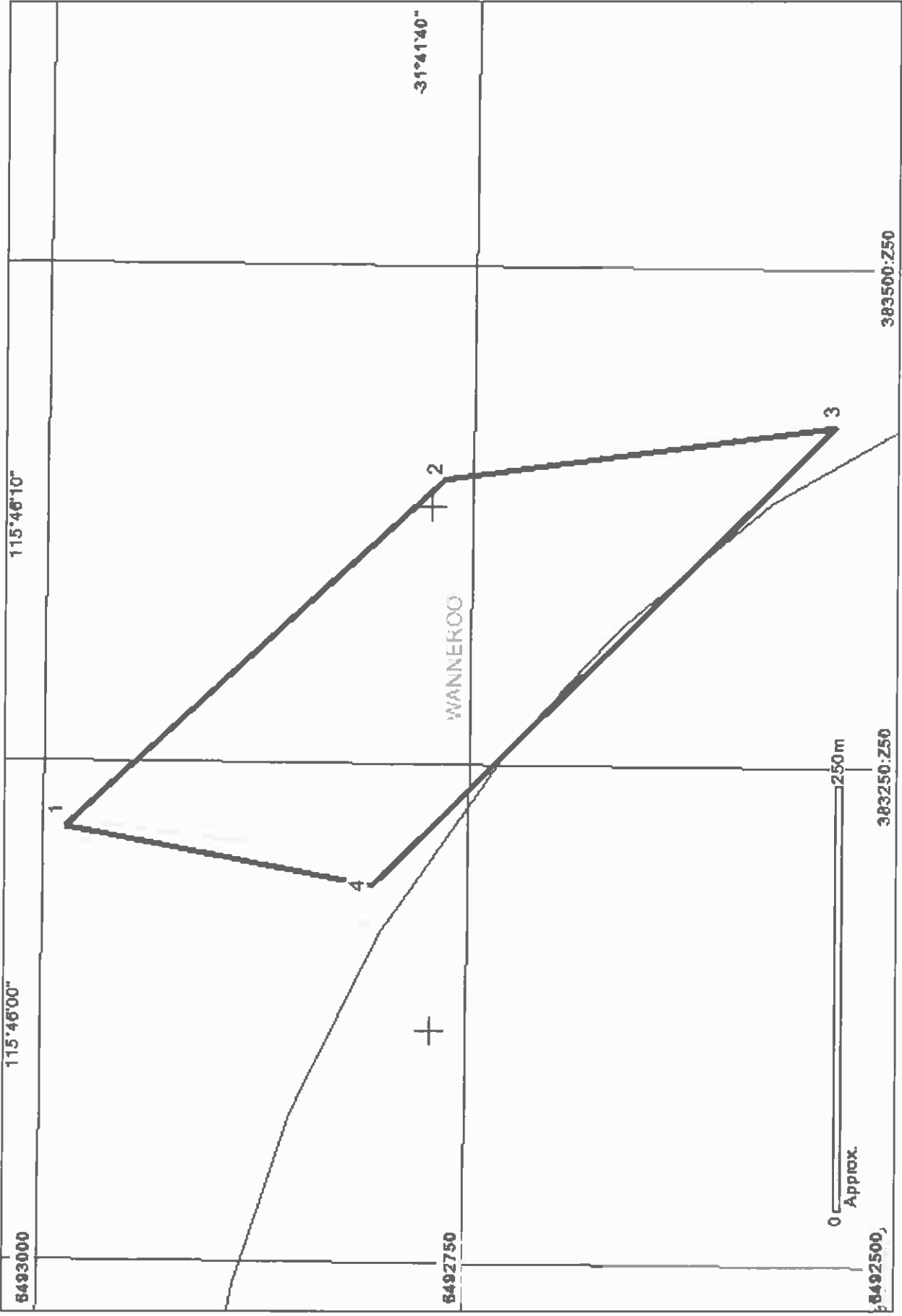
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Legend

Restriction	Access		Status	Coordinate Accuracy	
N No restriction	C	Closed	I Interim register	Accuracy is shown as a code in brackets following the site coordinates.	
M Male access only	O	Open	P Permanent register	[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
F Female access	V	Vulnerable	S Stored data	[Unreliable]	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code "closed" or "vulnerable". Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.



**Legend**

- Highlighted Area
- Town
- Map Area
- Search Area

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Search Criteria

1 sites in a search polygon. The polygon is formed by these points (in order):

MGA Zone 50	
Northing	Easting
6493858	382334
6493858	384334
6491858	384334
6491858	382334

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

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Legend

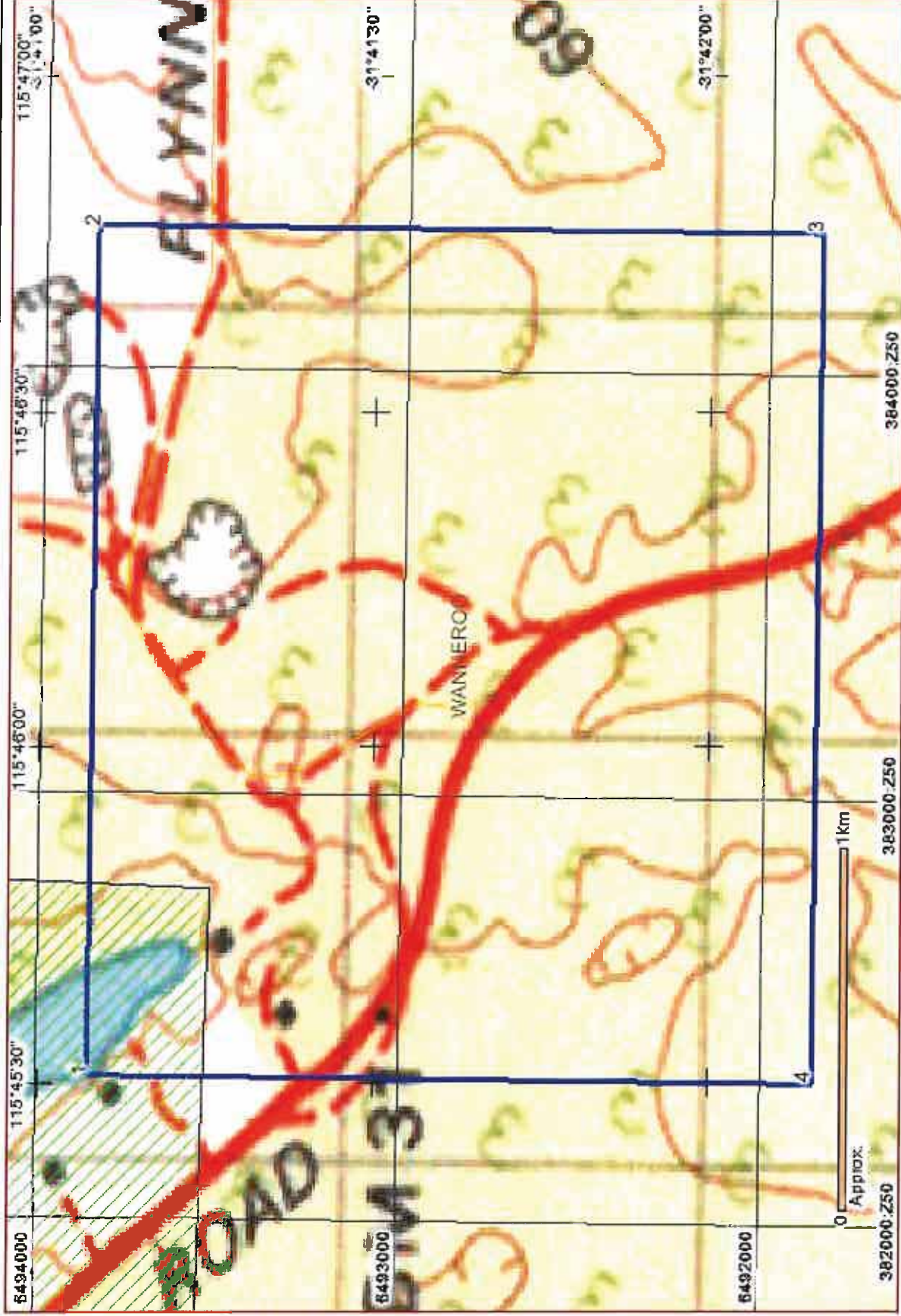
Restriction	Access	Status	Coordinate Accuracy
N No restriction	C Closed	I Interim register	Accuracy is shown as a code in brackets following the site coordinates.
M Male access only	O Open	P Permanent register	[Reliable] The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
F Female access	V Vulnerable	S Stored data	[Unreliable] The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code "closed" or "vulnerable". Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.



Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
3693	I	C	N	Lake Neerabup.		Named Place	*Registered Informant names available from DIA.	382931mE 6495440mN Zone 50 [Reliable]	S02255



Legend

Highlighted Area

Town

Map Area

Search Area

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**LOT 51 FLYNN DRIVE, CARRAMAR  
PROPOSED URBAN REZONING  
ENVIRONMENTAL SUMMARY REPORT**

**Prepared for**

**Woodland Consortium Pty Ltd**

c/- Burgess Design Group  
351 Newcastle Street  
NORTHBRIDGE WA 6003

Report No. J11023  
6 December 2011

**BAYLEY ENVIRONMENTAL SERVICES  
30 Thomas Street  
SOUTH FREMANTLE WA 6162**

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<b>Appendix</b>	<b>Title</b>
A	2006 Botanical Report
B	2011 DEC Rare Flora Database Listing
C	2006 DIA Aboriginal Sites Database Search

## **1.0 INTRODUCTION**

Woodland Consortium Pty Ltd (the proponent) proposes to rezone Lot 51 Flynn Drive, Carramar (the subject land) to permit its subdivision into approximately 47 residential lots. The subject land is currently zoned Special Residential under the City of Wanneroo Town Planning Scheme and Rural under the Metropolitan Region Scheme. An application for rezoning to Urban under the TPS and MRS has been prepared for submission to the City of Wanneroo and the WAPC. This environmental summary report has been prepared in support of that application.

Lot 51 is located at the south-east corner of Flynn Drive and Wanneroo Road, and has a total area of 3.304 hectares. Figure 1 shows an aerial view of the subject land.

The subject land currently contains one house and a number of fenced paddocks. The land was previously used for horse grazing but is currently unused apart from the house.

## **2.0 KEY ENVIRONMENTAL FACTORS**

### **2.1 Geology, Topography and Soils**

The Geological Survey of Western Australia maps the subject land as “LS<sub>2</sub>: Tamala Limestone (Qtl) with abundant karstic phenomena including caves, swallows and dolines” (Gozzard, 1982). The geomorphology is described as “Interbarrier depression with prominent karstic phenomena.” The soils are limestone-derived yellow-brown fine to coarse grained aeolian sands.

The subject land lies at an elevation of 40m to 50m AHD, sloping gently downwards from north to south at gradients of 2% to 8%.

#### **2.1.1 Karst**

Coffey Geosciences investigated the occurrence of karstic features on the subject land in 2005. The study found variable subsurface conditions ranging from dense surface sand to limestone in places from 5m depth and loose sand in zones to at least 5m below ground level.

The Coffey study found potential for differential settlement beneath foundations, with the overall site stability equivalent to Class “S”. The report recommended stiffened footings for buildings and site-specific compaction tests.

Karst expert Lex Bastian inspected the subject land in 2006 looking for evidence of hidden near-surface caves (e.g. collapses, limestone outcrops, washaways). He found no evidence and concluded that there were no hidden near-surface features. He noted, however, that deeper caves were a possibility.

The conclusion that can be drawn from these studies is that surface conditions are suitable for building provided that inspections of each building site are carried out and suitable stiffening of footings is undertaken.

#### **2.1.2 Acid Sulphate Soils**

The limestone soils of the subject land are not prone to occurrence of acid sulphate soils (ASS). The DEC maps the subject land as “low to nil risk” of ASS. No further investigation of this factor is warranted.

## 2.2 Hydrology

### 2.2.1 Surface Water

There is no defined natural surface drainage on the subject land. Surface runoff would occur only over short distances during and immediately following heavy rainfall. There is evidence of short-term ponding in the low-lying southern corner of the lot, which appears to collect runoff from the present embankment of Wanneroo Road and the adjacent old Wanneroo Road alignment.

### 2.2.2 Groundwater

The subject land is located in the south-western outflow zone of the Gngangara Mound. Groundwater is present at 17-18m AHD (22-32m below ground level), flowing west-southwest at a gradient of about 1/200 (GIS data supplied by DEC).

No information on groundwater quality beneath the subject land is available; however, given the limestone soils and the absence of intensive agricultural operations for several kilometres upgradient, the quality is expected to be high.

### 2.2.3 Water Resources

The subject land is located within the Carramar sub-area of the Wanneroo groundwater area. This area is not a proclaimed groundwater area.

As at August 2009, the *Gngangara Groundwater Areas Allocation Plan* listed the total available superficial groundwater resource in the Carramar sub-area as 1,700,000 kL, of which 1,536,390 kL (90%) was already allocated, leaving 10% available for allocation. In November 2011 the percentage allocated had increased to 98.48%, leaving just 1.52% (25,840 kL) available for allocation (DoW, pers. comm.)

The Department of Water has historically allocated water resources on a first come-first served basis up to 100%. This policy is currently under review.

Assuming that a development on Lot 51 includes 10% public open space (0.3ha), and that POS is irrigated at a rate of 7,500 kL/ha/annum (in accordance with DoW policy), then the development would require 2,250 kL/a of groundwater for POS irrigation. This amount is well within the currently available resource. However, there is no guarantee that this amount will still be available when an application for a licence is made. Under current DoW policy, applications for groundwater allocation cannot be made until the water is actually required.

### 2.2.4 Drainage

Water movement within the subject land currently occurs almost entirely through infiltration, with the exception of some minor surface ponding in the southern corner.

The elevated position, sandy soils and deep groundwater table provide ample capacity for infiltration of most runoff from the developed site at or near the source. Current plans are understood to incorporate an infiltration basin in the southern corner to accommodate runoff from storms in excess of 1 year ARI.

Coffey Geotechnics carried out a geotechnical assessment of the southern infiltration basin site in 2007, focussing on karst and potential instability. The assessment found that the site was suitable for a basin provided that buffers of 30m to building envelopes and 20m to Wanneroo Road were maintained as a precaution against subsidence.

## **2.3 Vegetation and Flora**

### **2.3.1 Vegetation Type and Condition**

The vegetation of the subject land is mapped by Heddle *et al.* (1980) as Cottesloe Complex – Central & South, which is described as a mosaic of Tuart woodland and Tuart-Jarrah-Marri open forest on deeper sands. This description was confirmed by botanist Dr Arthur Weston, who inspected the site in 2006. Dr Weston's report is attached in Appendix A.

Weston (2006) described the condition of the remaining vegetation as Completely Degraded to Degraded (according to the condition scale used in *Bush Forever*) as a result of clearing, grazing and trampling by horses. A fenced section of about 2,000m<sup>2</sup> in the central west of the site was in somewhat better condition due to the absence of horses and clearing but had been recently and severely burnt.

Phillip Bayley re-inspected the subject land in November 2011. The property had apparently not been used for horse grazing for some time but no significant regrowth had occurred except in the fenced off section, where some understorey species (particularly *Xanthorrhoea* and *Acacias*) had recovered from the 2006 fire. Many of the larger trees had not recovered. Overall, this section appeared to be in Good condition.

A number of recently dead Jarrah trees were observed on the 2011 site inspection, including some in the fenced off section. The cause of death is unclear but the pattern and timing of the deaths suggests dieback as a cause. Only a small handful of live Jarrah and *Banksia* trees survive on the property.

### **2.3.2 Floristic Communities**

The degraded condition of the vegetation makes accurate assignment of floristic community types impossible. Weston (2006) suggested that the vegetation might belong to FCT 24 (Northern Spearwood shrubland and woodland) and/or FCT 28 (Spearwood *Banksia attenuata* or *B. attenuata* – *Eucalyptus* woodlands), based on the presence of these communities in the nearby Bush Forever Site 383. Neither of these FCTs is listed as threatened in State or Commonwealth databases.

### 2.3.3 Flora

The flora of the subject land is heavily depauperate due to past clearing, grazing, fire and weed invasion.

Weston (2006) carried out a search of the DEC rare flora databases over a radius of 10km around the subject land. The search found no rare species whose preferred habitat appeared to be present at the site.

An updated search of the DEC databases in 2011 for a 5km radius around the subject land (Appendix B) revealed no new records of Declared Rare Flora species beyond those in the 2006 listing. The 2011 list contained several Priority Flora species that did not appear in the 2006 list. These were:

- *Drosera sidjamesii* x (Priority 1)
- *Leucopogon* sp. Yanchep (P3)
- *Melaleuca* sp. Wanneroo (P1)
- *Schoenus griffinianus* (P3)
- *Tetraria* sp. Chandala (P2)
- *Fabronia hampeana* (P2).

Most of these Priority species are unlikely to be present due to either their habitat preferences (e.g. *Drosera sidjamesii*: swamp margins; *Fabronia hampeana*: Zamia Palm thickets; *Schoenus griffinianus*: white sand) or their vulnerability to grazing (*Tetraria* sp. Chandala: a sedge). The habitat preferences of two of the species, *Leucopogon* sp. Yanchep and *Melaleuca* sp. Wanneroo, are unknown and so the possibility of their being present cannot be discounted. However, neither was observed during either the 2006 or 2011 site surveys.

Given the heavily degraded condition of the site vegetation and the results of the site searches, the overall probability of any rare or significant species being present appears low.

## 2.4 **Fauna**

### 2.4.1 Overview

The degraded vegetation of the subject land provides low-quality habitat for a limited range of disturbance-tolerant fauna. The 2011 site inspection produced sightings of common bird species including Galah, Corella, Magpie, Rufous Whistler, Black-faced Cuckoo-shrike and Ringneck (twenty eight) Parrot. No small bush birds (e.g. wrens) were observed. No direct or indirect signs of mammals (e.g. kangaroos) were found.

### 2.4.2 Threatened Fauna

A search was made during the 2011 site inspection for potential breeding habitat trees for Carnaby's Black-cockatoos. The search was made by locating trees with a diameter at breast height (dbh) of at least 0.5m, and examining these with binoculars for evidence of hollows 100mm or more in diameter.

The search found seventeen Tuart trees and four dead Jarrahs with a diameter of 0.5m or more. Of these, six had one or more hollows larger than 100mm, making them potential nesting sites for cockatoos. Six others had hollows smaller than 100mm, meaning that they are not currently suitable as cockatoo nesting trees. No direct (i.e. presence of cockatoos) or indirect (i.e. presence of scratch marks) evidence of current use of any of these hollows was observed.

Given the small number of potentially suitable trees, the presence of corellas and galahs (which compete with cockatoos for nesting sites) and the absence of local food resources (Banksias), it is concluded that the potential for use of the subject land for breeding by cockatoos is low.

## 2.5 **Aboriginal Heritage Sites**

A search of the DIA online Aboriginal Sites Database in 2006 found no registered Aboriginal heritage sites within 1km of the property. The nearest recorded site is associated with Lake Neerabup, located about 1.3km north-west of the property. The results of the DIA database search are attached in Appendix C.

No field search for Aboriginal heritage sites was conducted as part of this investigation. However, the severe vegetation and ground disturbance caused by prolonged horse grazing makes it unlikely that any archaeological material that previously existed would still be identifiable. The property does not contain any significant physical features (hills, rock outcrops, caves, creeks, wetlands etc.) that would suggest a likelihood of any ethnographic significance.

### **3.0 CONCLUSION**

The subject land does not appear to possess any vegetation, fauna or cultural features of any conservation significance. It is therefore concluded that there is no environmental impediment to rezoning and subdivision of the subject land for urban use.

It is noted that groundwater availability in the area is limited and supply for POS irrigation cannot be guaranteed.

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## 4.0 REFERENCES

- Coffey Geosciences Pty Ltd (2005). *Lot 51 Flynn Drive, Carramar. Geotechnical Assessment – Karst*. Report No. P7379.01-AB prepared for Allering Burgess.
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- Gozzard J.R. (1982). *Muchea Sheet 2034 I and part 2134 IV*. Perth Metropolitan Region 1:50,000 Environmental Geology Series. GSWA, Perth.
- Hedde, E.M., Loneragan, O.W. and Havel, J.J. (1980). Vegetation Complexes of the Darling System, Western Australia. In: *Atlas of Natural Resources Darling System, Western Australia*. Western Australian Department of Conservation and Environment, Perth.

## Figures



Figure 1

AERIAL VIEW



Photo location and direction  
(see Figure 2)



1



2



3



4



5

**Figure 2**  
**VIEWS OF THE SITE**

# **Appendix A**

## **2006 Botanical Report**

Arthur S. Weston, PhD (Botany)  
Consulting Botanist  
Phone (08) 9458 9738  
[naomiseg@inet.net.au](mailto:naomiseg@inet.net.au)

ABN/GST No  
54 924 460 919

8 Pitt Street  
ST JAMES  
WA 6102  
AUSTRALIA

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Flora and Vegetation Survey  
Lot 51 Flynn Drive  
Carramar  
City of Wanneroo

REPORT

**Introduction**

The survey area, Lot 51 Flynn Drive, is approximately 2ha in the south-eastern corner of the intersection of Flynn Drive with Wanneroo Road.

This report on the vegetation complexes, vegetation units, vegetation condition, floristic community types, flora and significant flora of Lot 51 is based upon field work on Tuesday morning, 21 March 2006, when we drove just inside the eastern boundary of the property and walked into the centre of the property and through it at several points. We also drove on the roads outside the northern and western boundaries and looked into the property from there.

**Soils**

The Perth 1:250,000 scale sheet of landforms and soils mapping of the Darling System, by Churchward and McArthur, shows the survey area as being in the Cottesloe (Ct) unit, with shallow brown sands over limestone. The Herdsman (Hd) peaty swamp unit is a short distance north-west of the survey area, and the Karrakatta (K) unit, with deep yellow sands over limestone, is further east and south.

**Vegetation Complex**

The Perth 1:250,000 scale sheet of the vegetation complexes of the Darling System, by Heddle *et. al.*, shows the survey area as being in the Cottesloe Complex – Central and South (52), with woodlands and open forest being dominated by tuart (*Eucalyptus gomphocephala*). The Herdsman Complex (53: sedgelands and fringing woodlands) is a short distance north-west of the survey area, and the Karrakatta Complex – Central and South (49: predominantly open forest dominated by tuart) is further east and south.

**Vegetation Units**

The vegetation of Lot 51 Flynn Drive is, for the most part, tuart (*Eucalyptus gomphocephala*) woodland to open woodland over jarrah (*Eucalyptus marginata*) low woodland to open woodland over heavily grazed pasture grasses and bare ground. *Banksia grandis* trees are sparsely dispersed through the lot and there are scattered, heavily browsed balga (blackboy: *Xanthorrhoea preissii*) shrubs there that vary from low open shrubland to shrubland through the property.

The densest remaining native vegetation is a fenced stand of tuart woodland over jarrah – *Banksia grandis* low open woodland to low woodland over balga low heath to open shrubland next to the central part of the south-west boundary of the lot. It is shown in Phil Bayley's Photo 6. Because all of it was burnt within the previous two weeks and has been trampled, though apparently not so heavily as the rest of the property, the ground layer of herbaceous plants and small to medium sized shrubs was almost totally absent at the time of the survey (a few plants of *Dryandra lindleyana* were the exceptions). There are also small trees of *Banksia prionotes* and *Jacksonia sternbergiana* in the stand.

Small trees of peppermint (*Agonis flexuosa*), both planted and spread from plantings, are in the northern part of the property. According to *Leaf and Branch*, by CALM's Robert Powell, peppermint occurs naturally only as far north as Swanbourne and City Beach, not Wanneroo.

*Banksia attenuata* and a few trees of red gum (*Corymbia calophylla*) and *Banksia menziesii* are in the central and southern parts of the lot. One or a few *Eucalyptus tottiana* trees are on the east side.

### **Vegetation Condition**

All of the vegetated parts of the property have been heavily grazed, and most grass, other herbaceous plants and small shrubs are absent; they have been trampled or eaten by horses. Furthermore, part of the property, including the fenced most densely vegetated part, in the southern half of the lot, was burnt earlier in March.

Consequently, the condition of most of the vegetation, over 90% of the lot, is assessed as Completely Degraded. The condition of the fenced, burnt stand of tuart woodland referred to above, covering under 5% of the lot, is assessed as Degraded.

### **Floristic Community Types and Threatened Ecological Communities**

It probably would be impossible to determine which FCT(s) is (are) represented in Lot 51, either by sampling or inferring, even in spring. However, *Bush Forever* lists two upland, sand-based floristic community types (FCT, SCP) as sampled in the Bush Forever Site nearest the Lot 51 survey area – Site 383, which includes Neerabup National Park. These floristic community types are 24 and 28.

Neither FCT 24 nor FCT 28 is the December 2005 list of communities on CALM's Threatened Ecological Community database, nor is either listed in *Bush Forever* Volume 2, Table 10.

### **Flora and Significant Flora**

Due largely to heavy grazing by horses, the flora of Lot 51 is depauperate.

Native shrubs recorded in Lot 51 are *Xanthorrhoea preissii*, *Hakea lissocarpa*, *Jacksonia sternbergiana*, *Acacia saligna* and *Macrozamia riedlei*. Established alien shrubs and small trees recorded in Lot 51, but not native to the area, include *Agonis flexuosa*, *Chamaelaucium uncinatum*, *Acacia decurrens*, *Acacia longifolia* and *Acacia iteaphylla*. Established alien herbaceous plants include *Asphodelus fistulosus*, *Dittrichia graveolens*, *Euphorbia peplus*, *Euphorbia terracina*, *Foeniculum vulgare*, *Pelargonium capitatum* and *Conyza* spp.

No species of Declared Rare or Priority Flora was identified in the survey area, nor was any other species listed in Table 13 of Volume 2 of *Bush Forever* as a significant species.

It is unlikely that there is any habitat in Lot 51 suitable for any significant species, except possibly in the fenced, burnt stand of vegetation referred to above.

# **Appendix B**

## **2011 DEC Rare Flora Database Listing**



Department of  
**Environment and Conservation**

*Our environment, our future*



Your Ref:

Our Ref: **07-1211FL**

Enquiries: Jessica Donaldson

Phone: (08) 9334 0123

Fax: (08) 9334 0278

Email: [jessica.donaldson@dec.wa.gov.au](mailto:jessica.donaldson@dec.wa.gov.au)

**Bayley Environmental Services**

30 Thomas Street  
South Fremantle WA 6162

Attention: Phil Bayley

Dear Phil Bayley,

**REQUEST FOR RARE FLORA INFORMATION**

I refer to your request of 28 November 2011 for Threatened Flora information in the Carramar area. The search was conducted within a 5km radial area from the central coordinate you submitted.

A search was undertaken for this area of **(1)** the Department's *Threatened (Declared Rare) Flora* database (for results, *if any*, see "DEFL" – coordinates are GDA94), **(2)** the *Western Australian Herbarium Specimen* database for priority species opportunistically collected in the area of interest (for results, *if any*, see "WAHERB" – coordinates are GDA94 – see condition number 9 in the attached 'Conditions in Respect of Supply' and **(3)**, the Department's *Declared Rare and Priority Flora List* [this list is searched using 'place names'. This list, which may also be used as a species target list, contains species that are declared rare (Conservation Code R or X for those presumed to be extinct), poorly known (Conservation Codes 1, 2 or 3), or require monitoring (Conservation Code 4) – for results, *if any*, see "DP List"]. The results are attached electronically to this email.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the seventh point, which refers to the requirement to undertake field investigations for the accurate determination of rare flora occurrence at a site. *The information supplied should be regarded as an indication only of the rare flora that may be present and may be used as a target list in any surveys undertaken.*

The information provided does not preclude you from obtaining and complying with, where necessary, land clearing approvals from other agencies.

An invoice for \$300 (plus GST) to supply this information will be forwarded.

It would be appreciated if any populations of rare flora you encounter in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss rare flora management, please contact Dr Ken Atkins, Manager, Species and Communities Branch, on (08) 9334 0455.

Yours faithfully

Jessica Donaldson

.....  
for Keiran McNamara  
DIRECTOR GENERAL

6 December 2011

**Species and Communities Branch**

17 Dick Perry Ave, Technology Park, Kensington

Phone: (08) 9334 0455 Fax: (08) 9334 0278

Locked Bag 104, Bentley Delivery Centre, Bentley, Western Australia 6983

[www.dec.wa.gov.au](http://www.dec.wa.gov.au)

# DEPARTMENT OF ENVIRONMENT AND CONSERVATION

## RARE FLORA INFORMATION

### CONDITIONS IN RESPECT OF SUPPLY OF INFORMATION

1. All requests for data to be made in writing to the Director General, Department of Environment and Conservation, Attention: Threatened Flora Database Officer, Species and Communities Branch.
2. The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided, without the prior written consent of the Director General, Department of Environment and Conservation.
3. Specific locality information for Declared Rare Flora is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for DRF may not be used in public reports without the written permission of the Director General, Department of Environment and Conservation. Publicly available reports may only show generalised locations or, where necessary, show specific locations without identifying species. The Department is to be contacted for guidance on the presentation of rare flora information.
4. Note that the Department of Environment and Conservation respects the privacy of private landowners who may have rare flora on their property. Rare flora locations identified in the data as being on private property should be treated in confidence, and contact with property owners made through the Department of Environment and Conservation.
5. Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data provided, they may be present. The Department of Environment and Conservation accepts no responsibility for this.
6. Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
7. **It should be noted that the supplied data do not necessarily represent a comprehensive listing of the rare flora of the area in question. Its comprehensiveness is dependant on the amount of survey carried out within the specified area. The receiving organisation should employ a botanist, if required, to undertake a survey of the area under consideration.**
8. Acknowledgment of the Department of Environment and Conservation as source of the data is to be made in any published material. The unique reference number that is given upon the request for information should be quoted. Copies of all such publications are to be forwarded to the Department of Environment and Conservation, Attention: The Manager, Species and Communities Branch.
9. The development of the PERTH Herbarium database was not originally intended for electronic mapping (eg. GIS ArcView). The latitude and longitude coordinates for each entry are not verified prior to being databased. It is only in recent times that collections have been submitted to PERTH with GPS recorded in latitude and longitude coordinates. Therefore, be aware when using this data in ArcView that some records may not plot to the locality description given with each collection.

#### Species and Communities Branch

17 Dick Perry Ave, Technology Park, Kensington

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Locked Bag 104, Bentley Delivery Centre, Bentley, Western Australia 6983

[www.dec.wa.gov.au](http://www.dec.wa.gov.au)

THE DEPARTMENT OF ENVIRONMENT AND CONSERVATION

DECLARED RARE AND PRIORITY FLORA LIST

for Western Australia

CONSERVATION CODES

R: Declared Rare Flora - Extant Taxa

**Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.**

X: Declared Rare Flora - Presumed Extinct Taxa

**Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.**

1: Priority One - Poorly known Taxa

**Taxa which are known from one or a few (generally <5) populations which are under threat**, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two - Poorly Known Taxa

**Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat** (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three - Poorly Known Taxa

**Taxa which are known from several populations, and the taxa are not believed to be under immediate threat** (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.

4: Priority Four - Rare Taxa

**Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors.** These taxa require monitoring every 5-10 years.

Note, the need for further survey of poorly known taxa is prioritised into the three categories depending on the perceived urgency for determining the conservation status of those taxa, as indicated by the apparent degree of threat to the taxa based on the current information.

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Phone: (08) 9334 0455 Fax: (08) 9334 0278

Locked Bag 104, Bentley Delivery Centre, Bentley, Western Australia 6983

[www.dec.wa.gov.au](http://www.dec.wa.gov.au)

# ABBREVIATIONS USED IN THREATENED FLORA DATABASE PRINTOUTS

## VESTING

|     |                                          |
|-----|------------------------------------------|
| AAP | Aboriginal Planning Authority            |
| AGR | Chief Executive, Dep. of Agriculture     |
| ALT | Aboriginal Land Trust                    |
| APB | Agricultural Protection Board of WA      |
| BGP | Botanical Gardens & Parks Authority      |
| BSA | Boy Scouts Association                   |
| CC  | Conservation Commission – NPNCA - LFC    |
| CGT | Crown Grant in Trust                     |
| COM | Commonwealth of Australia                |
| CRO | Crown Freehold-Govt Ownership            |
| CRW | Crown                                    |
| DAG | Dep. of Agriculture                      |
| DOW | Dep. of Water                            |
| DPI | Dep. of Planning & Infrastructure        |
| EXD | Exec Direc CALM                          |
| FES | Fire and Emergency Services Aust.        |
| HOW | Dep. of Housing/State Housing Commission |
| ILD | Industrial Lands Develop. Auth           |
| LAC | LandCorp                                 |
| MAG | Minister for Agriculture                 |
| MBC | Metropolitan Cemeteries Board            |
| MED | Ministry of Education                    |
| MHE | Minister for Health                      |
| MIN | Minister for Mines                       |
| MPL | Ministry for Planning                    |
| MPR | Minister for Prisons                     |
| MRD | Main Roads WA                            |
| MTR | Minister for Transport                   |
| MWA | Minister for Water Resources             |
| MWO | Minister for Works                       |
| NAT | Natural Trust of Australia WA            |
| NON | Not Vested                               |
| PLB | Pastoral Lands Board                     |
| PRI | Private/Freehold                         |
| RAI | Public Transport Authority               |
| REL | Religious Organisation                   |
| SEC | Synergy (ex Western Power)               |
| SHI | Shire                                    |
| SPC | State Planning Commission                |
| SWA | State of Western Australia               |
| TEL | Telstra                                  |
| UNK | Unknown                                  |
| WAT | Water Corporation                        |
| WEL | Minister Community Welfare               |
| WRC | Water & Rivers Commission                |
| XPL | Ex-Pastoral Lease                        |

## PURPOSES

|     |                               |
|-----|-------------------------------|
| ABR | Aboriginal Reserve            |
| ACC | Access Track                  |
| AER | Aerodrome                     |
| AIR | Airport                       |
| ARS | Agricultural Research Station |
| BAP | Baptist Union of WA           |
| CAM | Camping                       |
| CAR | Caravan park                  |
| CEM | Cemetery                      |
| CFA | Conservation of Fauna         |
| CFF | Conservation Of Flora & Fauna |
| CFL | Conservation of Flora         |
| CHU | Church                        |
| CPK | Car Park                      |
| CMN | Communications                |
| COM | Common                        |

|     |                                           |
|-----|-------------------------------------------|
| CON | Conservation Park                         |
| DEF | Defence                                   |
| DRA | Drain                                     |
| EDE | Educational Endowment                     |
| EDU | Educational purposes UWA                  |
| ENE | Enjoyment of Natural Environ.             |
| EXC | Excepted from sale                        |
| EXL | Exploration Lease                         |
| EXP | Experimental Farm                         |
| FIR | Firing Range                              |
| FOR | State Forest                              |
| GE  | General Lease                             |
| GHA | Grain Handling                            |
| GOL | Golf                                      |
| GRA | Gravel Pit                                |
| GVT | Government Requirements                   |
| HAR | Harbour Purposes                          |
| HEP | Heritage Purposes                         |
| HER | Heritage trail                            |
| HOS | Hospital                                  |
| KEN | Kennels                                   |
| LPR | Landscape Protection                      |
| MIN | Mining lease                              |
| MUN | Municipal Purposes                        |
| NPK | National Park                             |
| NRE | Nature Reserve                            |
| OTH | Other                                     |
| PAR | Parkland (& Recreation)                   |
| PAS | Pastoral lease                            |
| PFF | Protection of Flora & Fauna               |
| PFL | Protection of Flora                       |
| PIC | Picnic ground                             |
| PLA | Plantation                                |
| POS | Public Open Space                         |
| PRS | Prison site                               |
| PUR | Purchase Lease                            |
| PUT | Public Utility                            |
| QUA | Quarry                                    |
| RAD | Radio Station                             |
| RAC | Racecourse                                |
| REC | Recreation                                |
| REH | Rehabilitation/Re-establish Native Plants |
| RRE | Railway Reserve                           |
| RUB | Rubbish                                   |
| SAN | Sand                                      |
| SCH | School-site                               |
| SET | Settlers requirements                     |
| SHI | Shire Requirements                        |
| SHO | Showgrounds                               |
| SNN | Sanitary                                  |
| SOI | Soil Conservation                         |
| STO | Stopping place                            |
| TIM | Timber                                    |
| TOU | Tourism                                   |
| TOW | Town-site                                 |
| TRA | Training Ground                           |
| TRI | Trig station                              |
| UCL | Unallocated Crown Land                    |
| UNK | Unknown                                   |
| VER | Road Verge                                |
| VPF | Vermin Proof Fence                        |
| WAT | Water                                     |
| WLS | Wildlife Sanctuary                        |
| WOO | Firewood                                  |

**DEPARTMENT OF ENVIRONMENT AND CONSERVATION  
DECLARED RARE AND PRIORITY FLORA LIST  
16 September 2010**

| SPECIES / TAXON                                               | CONS<br>CODE | DEC<br>REGION | DISTRIBUTION                                                                                            | FLOWER<br>PERIOD |
|---------------------------------------------------------------|--------------|---------------|---------------------------------------------------------------------------------------------------------|------------------|
| <i>Acacia benthamii</i>                                       | 2            | SW            | Wanneroo, Kings Park, Stake Hill                                                                        |                  |
| <i>Calectasia</i> sp. Pinjar (C Tauss 557)                    | 1            | SW            | Pinjar (Wanneroo)                                                                                       | Jul-Oct          |
| <i>Drosera sidjamesii</i> x                                   | 1            | SW            | Gnangarra, Wanneroo, Beechboro                                                                          | Nov-Mar          |
| <i>Grevillea thelemanniana</i> subsp.<br><i>thelemanniana</i> | 4            | SW            | Cannington, Kenwick, Wattle Grove,<br>Forrestdale, Jervoise Bay, Joondalup                              | Jun-Sep          |
| <i>Jacksonia sericea</i>                                      | 4            | SW            | Wanneroo, Trigg, Perth, Karrinyup,<br>Mandurah-Pinjarra, Neerabup NPK,<br>Ardross, Stakehill, Singleton | Dec-Feb          |
| <i>Leucopogon</i> sp. Yanchep (M. Hislop<br>1986)             | 3            | SW            | Yanchep N.P., Gnangarra-Moore River<br>S.F., Neerabup N.P.                                              | Apr-Jun,<br>Sep  |
| <i>Melaleuca</i> sp. Wanneroo (G.J.Keighery<br>16705)         | 1            | SW            | Wanneroo                                                                                                | Dec              |
| <i>Sarcozona bicarinata</i>                                   | 3            | SW,SC         | Hepburn Heights, Burns Beach,<br>Wanneroo, Yanchep, Seabrid,<br>Espereance, Guilderton, S. Aust,        |                  |
| <i>Schoenus griffinianus</i>                                  | 3            | MW,WB,SW      | Eneabba, Wongan Hills,Greenough,<br>Chittering, Hazelmere, Wanneroo                                     | Oct-Nov          |
| <i>Tetraria</i> sp. Chandala (G. J. Keighery<br>17055)        | 2            | SW            | Gingin, Wanneroo, Muchea                                                                                |                  |

DECFL.csv

| SPNAME                 | CONSVCODE | POPID1 | POPID2 | GDA94LAT  | GDA94LONG | VESTING | PURPOSE1 |
|------------------------|-----------|--------|--------|-----------|-----------|---------|----------|
| Acacia benthamii       | 2         | 1      |        | -31.71544 | 115.80703 | PRI     |          |
| Acacia benthamii       | 2         | 4      |        | -31.67142 | 115.73042 | MRD     | VER      |
| Conostylis bracteata   | 3         | 4      |        | -31.731   | 115.78739 | NON     | UCL      |
| Eucalyptus argutifolia | T         | 14     | A      | -31.65128 | 115.77648 | PRI     |          |
| Fabronia hampeana      | 2         | 2      |        | -31.71667 | 115.75139 | PRI     |          |
| Fabronia hampeana      | 2         | 4      | A      | -31.70183 | 115.71828 | PRI     |          |
| Fabronia hampeana      | 2         | 4      | B      | -31.69836 | 115.71644 | PRI     |          |
| Fabronia hampeana      | 2         | 4      | C      | -31.69617 | 115.71853 | PRI     |          |
| Fabronia hampeana      | 2         | 4      | D      | -31.70028 | 115.72097 | PRI     |          |
| Jacksonia sericea      | 4         | 5      | A      | -31.73211 | 115.75148 | NON     |          |
| Jacksonia sericea      | 4         | 5      | B      | -31.73211 | 115.75148 | MRD     |          |
| Jacksonia sericea      | 4         | 5      | C      | -31.73211 | 115.75148 | RAI     |          |
| Jacksonia sericea      | 4         | 5      | D      | -31.73211 | 115.75148 | MRD     | VER      |
| Jacksonia sericea      | 4         | 5      | E      | -31.73211 | 115.75148 | RAI     |          |
| Jacksonia sericea      | 4         | 5      | F      | -31.73211 | 115.75148 | PRI     |          |

| SPECIES                       | CONSCODE | SITE                                                                                                                                       | VEGETATION                                                                                                                                                                                                           | LOCALITY                                                                                          | LAT       | LONG_    |
|-------------------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------|----------|
| <i>Drosera x sidjamesii</i>   | 1        |                                                                                                                                            |                                                                                                                                                                                                                      | Pinjar Road, Wanneroo                                                                             | -31.67611 | 115.8161 |
| <i>Eucalyptus argutifolia</i> | T        | Dune slope, grey sand over limestone.                                                                                                      | Mallee, <i>Eucalyptus petrensis</i> over heath.                                                                                                                                                                      | Mindarie South, 30 km N of Perth                                                                  | -31.69972 | 115.7333 |
| <i>Eucalyptus argutifolia</i> | T        | Slight gully situation nestles between two limestone ridges. Sand/boulder/brown/yellow/dry/limestone.                                      | Completely open and treeless with dense scrubland. <i>Dryandra's nivea/ sessilus</i> , <i>Hakea trifurcata</i> , <i>Melaleuca huegelii</i> , Blackboys ( <i>Xanthorrhoea preissii</i> ), <i>Templetonia retusa</i> . | Quarry Reserve 5204, 250 m from junction of Myrtle road and 380 m at 195 deg.                     | -31.65277 | 115.7736 |
| <i>Eucalyptus argutifolia</i> | T        | Slight gully situation nestled between two limestone ridges. Limestone/boulder/sand/brown/yellow/dry.                                      | Completely open & treeless with dense scrubland. <i>Dryandra's nivea/ sessilus</i> , <i>Hakea trifurcata</i> , <i>Melaleuca huegelii</i> , Blackboys ( <i>Xanthorrhoea preissii</i> ), <i>Templetonia retusa</i> .   | Quarry Reserve 5204, 250 m from the junction of Myrtle road and 380 m at 195 deg. to rare mallees | -31.65277 | 115.7736 |
| <i>Fabronia hampeana</i>      | 2        | On trunk of <i>Macrozamia</i> .                                                                                                            | Emergent large <i>Banksia</i> over <i>Macrozamia</i> , <i>Hibbertia</i> , <i>Xanthorrhoea</i> , grasses, weeds and thick <i>Dryandra</i> regrowth.                                                                   | Between Neerabup National Park and developing suburb of Kinross, 28 km NNW of Perth               | -31.71666 | 115.75   |
| <i>Fabronia hampeana</i>      | 2        | Private property in depression between limestone outcrops with yellow sand. Potential threat by urban development. Last burnt summer 2001. | <i>Banksia</i> low open woodland with occasional <i>Eucalyptus decipiens</i> , <i>Macrozamia riedlei</i> , <i>Acacia rostellifera</i> and <i>Hypocalymma angustifolium</i> .                                         | Lot 17 Marmion Avenue, Clarkson (along W boundary of the site), 34 km N of Perth CBD              | -31.69616 | 115.7185 |

|                                              |   |                                                                                                                          |                                                                                                                                                                                    |                                                                                                                             |           |          |
|----------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------|----------|
| Jacksonia sericea                            | 4 | Slope/flat. Dry grey sand over limestone.                                                                                | Eucalyptus marginata, Banksia attenuata, B. menziesii<br>Woodland. Associated species: Banksia attenuata, B. grandis, Allocasuarina fraseriana, Dryandra sessilis, Calothamnus sp. | Lot 21, Flynn Drive, Neerabup, Shire of Wanneroo                                                                            | -31.68333 | 115.7667 |
| Jacksonia sericea                            | 4 |                                                                                                                          |                                                                                                                                                                                    | Small remnant of Wanneroo road near Lake Neerabup                                                                           | -31.66063 | 115.7501 |
| Melaleuca sp. Wanneroo (G.J. Keighery 16705) | 1 | Rugged limestone ridge. Mossy black sand.                                                                                | Melaleuca cardiophylla, M. sp., M. systema tall closed shrubland.                                                                                                                  | Wanneroo Shire Reserve, Wattle Avenue, Neerabup                                                                             | -31.65467 | 115.7661 |
| Sarcozona bicarinata                         | 3 | Private property; limestone outcrops with dry white sand. Potential threat by urban development. Last burnt summer 2001. | Open Banksia sessilis heathland. Banksia sessilis, Opercularia vaginata, Scaevola crassifolia and Desmodium flexuosus.                                                             | Lot 17, Marmion Avenue Clarkson (NW corner of site near Marmion Avenue and Neerabup Road intersection) 34 km N of Perth CBD | -31.69467 | 115.7173 |

# **Appendix C**

## **2006 DIA Aboriginal Sites Database Search**



## Search Criteria

0 sites in a search polygon. The polygon is formed by these points (in order):

| MGA Zone 50 |         |
|-------------|---------|
| Northing    | Easting |
| 6492987     | 383217  |
| 6492767     | 383393  |
| 6492538     | 383421  |
| 6492806     | 383189  |

## Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

## Copyright

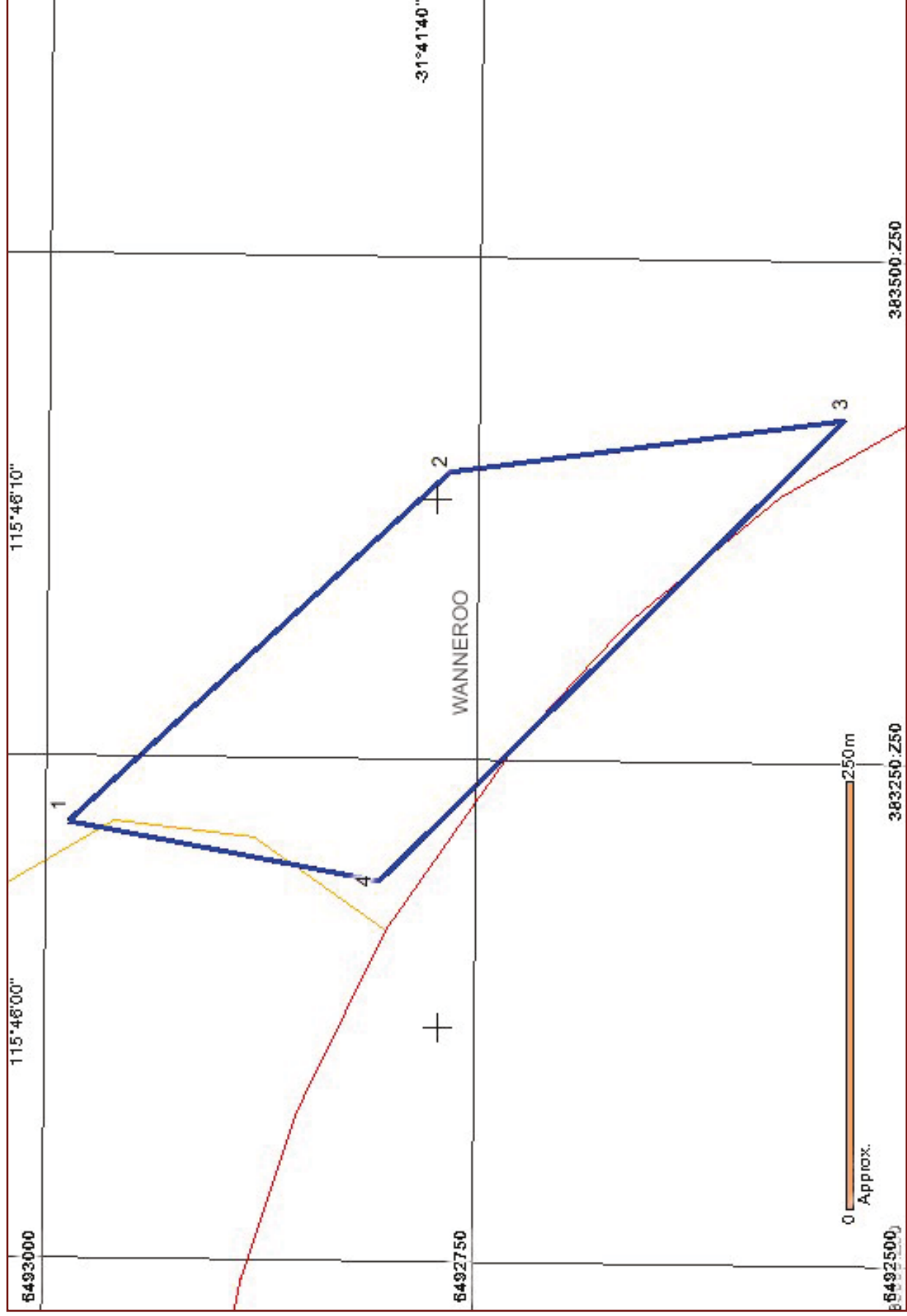
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## Legend

| Restriction        | Access       | Status               | Coordinate Accuracy                                                                                                                                                             |
|--------------------|--------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| N No restriction   | C Closed     | I Interim register   | Accuracy is shown as a code in brackets following the site coordinates.                                                                                                         |
| M Male access only | O Open       | P Permanent register | [Reliable] The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.                                                               |
| F Female access    | V Vulnerable | S Stored data        | [Unreliable] The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported. |

## Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code "closed" or "vulnerable". Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.



**Legend**

- Highlighted Area
- Town
- Map Area
- Search Area

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## Search Criteria

1 sites in a search polygon. The polygon is formed by these points (in order):

| MGA Zone 50 |         |
|-------------|---------|
| Northing    | Easting |
| 6493858     | 382334  |
| 6493858     | 384334  |
| 6491858     | 384334  |
| 6491858     | 382334  |

## Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

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## Legend

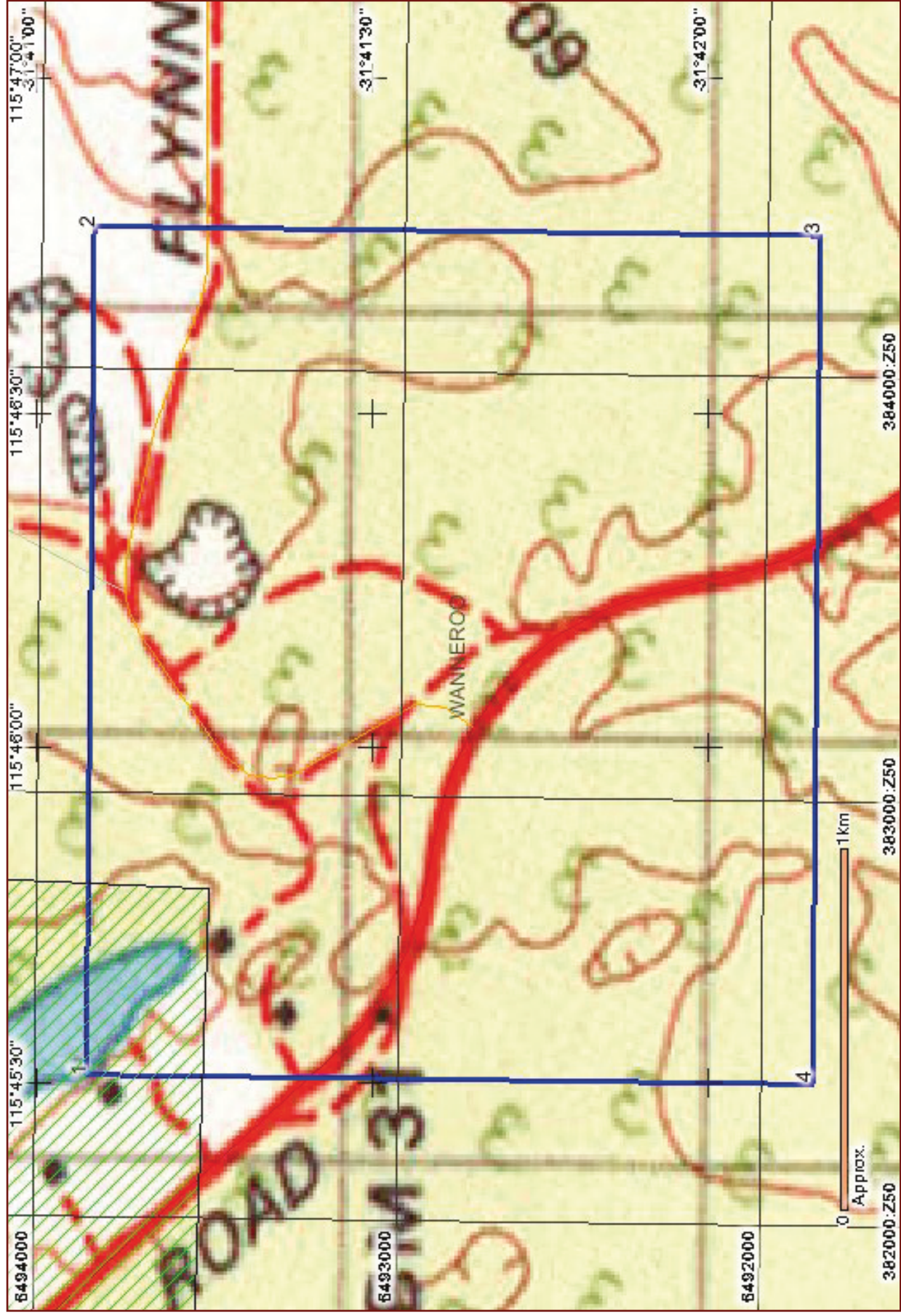
| Restriction        | Access       | Status               | Coordinate Accuracy                                                                                                                                                             |
|--------------------|--------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| N No restriction   | C Closed     | I Interim register   | Accuracy is shown as a code in brackets following the site coordinates.                                                                                                         |
| M Male access only | O Open       | P Permanent register | [Reliable] The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.                                                               |
| F Female access    | V Vulnerable | S Stored data        | [Unreliable] The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported. |

## Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code "closed" or "vulnerable". Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.



| Site ID | Status | Access | Restriction | Site Name      | Site Type | Additional Info | Informants                                      | Coordinates                                 | Site No. |
|---------|--------|--------|-------------|----------------|-----------|-----------------|-------------------------------------------------|---------------------------------------------|----------|
| 3693    | I      | C      | N           | Lake Neerabup. |           | Named Place     | *Registered Informant names available from DIA. | 382931mE<br>6495440mN<br>Zone 50 [Reliable] | S02255   |



Legend

- Highlighted Area
- Town
- Map Area
- Search Area

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Our Ref: 0000388AB

12 March 2014

Mark Szabo  
Associate Director  
Burgess Design Group  
101 Edward St, Perth WA 6000  
Via Email: [mark@burgessdesigngroup.com.au](mailto:mark@burgessdesigngroup.com.au)

Dear Mark

### **Tree Assessment at Lot 51 Flynn Drive, Carramar**

## **1. Background**

360 Environmental Pty Ltd (360) was commissioned by Burgess Design Group in February 2014 to undertake a tree assessment at Lot 51 Flynn Drive, Carramar (Project Area), as part of a local structure plan for the City of Wanneroo (Figure 1).

## **2. Objectives**

The primary objective of the assessment was to identify the trees in the Project Area that are worthy of being retained and those that may require clearing as a result of works associated with potential development. The gathered information would then be used to inform the design of any future development, with the objective of minimising the number of trees that are required to be cleared to implement the project.

## **3. Methodology**

The field survey was undertaken on the 18<sup>th</sup> February 2014, with one Zoologist and one Environmental Scientist from 360 Environmental undertaking the survey. The primary focus of

the field survey was identifying the species of each tree and measuring each tree's diameter at breast height (DBH), height and location with a GPS.

Trees considered to be worthy of retention included those that were relatively large. This was based on the height and a diameter at breast height (DBH) of greater than 50 cm. The presence of any hollows was also noted. The location of each tree considered worthy of retention was recorded with a GPS and physically marked with pink flagging tape. Photographs were taken of each tree considered to be worthy of retention (see Appendix A).

It is important to note that the methodology employed for this tree survey is not intended to be compliant with any Western Australia State or Federal Government Authority survey guidelines.

## 4. Results and Discussion

A total of 21 trees comprising three taxa (*Corymbia calophylla*, *Eucalyptus marginata* and *Eucalyptus gomphocephala*) were recorded in the Project Area. The species, DBH, height and GPS coordinates for each tree are presented in Table 1 and also the location of each tree in the Project Area is illustrated in Figure 1.

Table 1: Native Tree species recorded during the survey, their dimensions and location (co-ordinates are in UTM's [GDA94]).

| TREE No. | TAXA                        | DBH (CM) | HEIGHT (M) | NO OF HOLLOWES | HOLLOW SIZE (CM) | NORTHING | EASTING | WITHIN FOOTPRINT | NEAR FOOTPRINT | PHOTO No. |
|----------|-----------------------------|----------|------------|----------------|------------------|----------|---------|------------------|----------------|-----------|
| 1        | Corymbia calophylla         | 62       | 16         | 0              | -                | 0383409  | 6492623 |                  | ✓              | 363       |
| 2        | Eucalyptus marginata (dead) | 99       | 14         | 0              | -                | 0383390  | 6492632 |                  | ✓              | 364       |
| 3        | Eucalyptus gomphocephala    | 67       | 13         | 0              | -                | 0383382  | 6492645 |                  | ✓              | 365       |
| 4        | E. gomphocephala            | 75       | 18         | 0              | -                | 0383364  | 6492646 |                  | ✓              | 366       |
| 5        | E. gomphocephala            | 111      | 20         | 0              | -                | 0383353  | 6492684 | ✓                |                | 368       |
| 6        | E. gomphocephala            | 72       | 18         | 0              | -                | 0383372  | 6492700 |                  | ✓              | 369       |
| 7        | E. gomphocephala            | 71       | 15         | 0              | -                | 0383369  | 6492719 |                  | ✓              | 370       |
| 8        | E. gomphocephala            | 56       | 14         | 0              | -                | 0383382  | 6492727 |                  | ✓              | 371       |
| 9        | E. gomphocephala            | 100      | 18         | 0              | -                | 0383362  | 6492723 |                  | ✓              | 372       |
| 10       | E. gomphocephala            | 58       | 19         | 0              | -                | 0383341  | 6492687 | ✓                |                | 373       |
| 11       | E. gomphocephala            | 110      | 22         | 0              | -                | 0383334  | 6492710 | ✓                |                | 376       |
| 12       | E. gomphocephala            | 67       | 22         | 0              | -                | 0383315  | 6492713 | ✓                |                | 374       |
| 13       | E. gomphocephala            | 65       | 22         | 0              | -                | 0383311  | 6492719 | ✓                |                | 375       |
| 14       | E. gomphocephala            | 170      | 20         | 2              | 25/10            | 0383353  | 6492756 |                  | ✓              | 377/378   |
| 15       | E. gomphocephala            | 164      | 22         | 0              | -                | 0383374  | 6492775 |                  | ✓              | 379       |
| 16       | E. gomphocephala            | 79       | 14         | 0              | -                | 0383331  | 6492762 |                  | ✓              | 380       |
| 17       | E. gomphocephala            | 61       | 17         | 0              | -                | 0383326  | 6492774 |                  | ✓              | 381       |
| 18       | E. gomphocephala            | 74       | 19         | 0              | -                | 0383339  | 6492797 |                  | ✓              | No photo  |
| 19       | E. gomphocephala            | 156      | 20         | 0              | -                | 0383239  | 6492838 |                  | ✓              | 382       |
| 20       | E. gomphocephala            | 117      | 20         | 0              | -                | 0383228  | 6492858 |                  | ✓              | 383       |
| 21       | E. gomphocephala            | 107      | 19         | 0              | -                | 0383230  | 6492859 |                  | ✓              | 384       |

Five trees were found to be in the Public Open Space area, four trees were located in the Road Reserves and the remaining 12 trees considered to be worthy of retention were found in the adjacent area. Impact on all 21 trees considered to be worthy of retention would be determined by the size and position of any future projects.

On behalf of

360 Environmental Pty Ltd



Dr Ron Firth – Principal Zoologist

*Enc:*

*Figure 1 – Site Location & Tree Mapping*

*Appendix A - Photos*



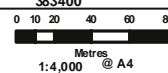
## Legend

- Site Location
- Drainage
- Public Open Space
- Residential
- Road Reserve
- Tree Locations

LOCALITY MAP SOURCED FROM LANDGATE 2006  
STREET DIRECTORY MAP SOURCED FROM STREETSMART 2008

SLIP ENABLER

K:\Admin\Templates\New\_A4L.mxd



NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

## LOCALITY MAP



**360**  
a10 Bermondsey St, West Leederville, 6007 WA  
t(08) 9388 8360  
f(08) 9381 2360  
www.360environmental.com.au

**DRAWING ID**  
388 site location.mxd  
**DATE**  
06-Mar-2014

**HORIZONTAL DATUM AND PROJECTION**  
GDA 1994 MGA Zone 50

| CREATED | CHECKED | APPROVED | REVISION |
|---------|---------|----------|----------|
| CS      | LS      | MRh      | 0        |

**Burgess Design Group**  
Carramar, WA

**Tree Assessment Lot 51,**  
Flynn Drive, Carramar

**Figure 1 - Site Layout**

# APPENDIX A: PHOTOS

Tree No: 1



Tree No: 2



Tree No: 3



Tree No: 4



Tree No: 5



Tree No: 6



Tree No: 7



Tree No: 8



Tree No: 9



Tree No: 10



Tree No: 11



Tree No: 12



Tree No: 13



Tree No: 14



Tree No: 14 - Hollow



Tree No: 15



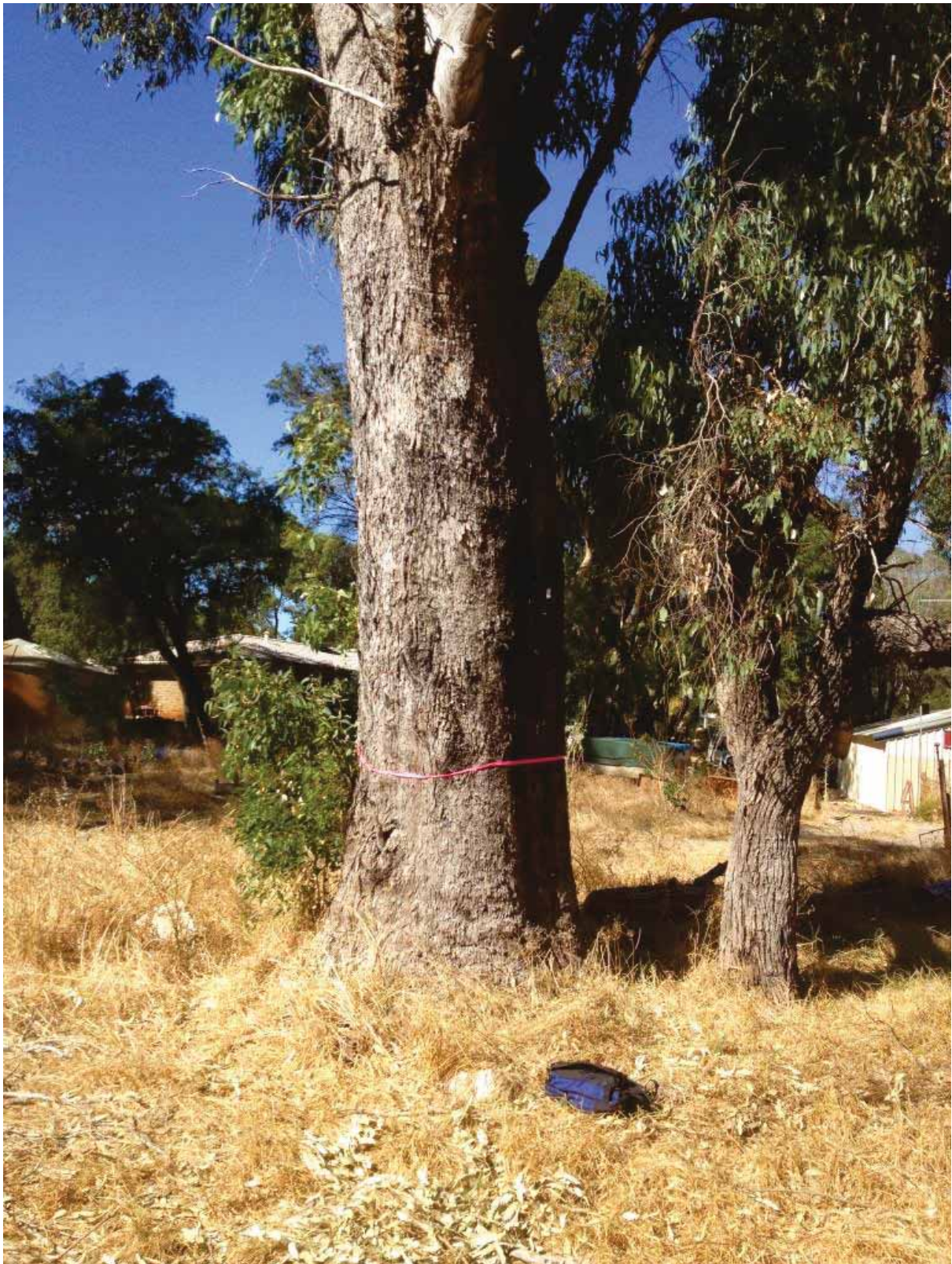
Tree No: 16



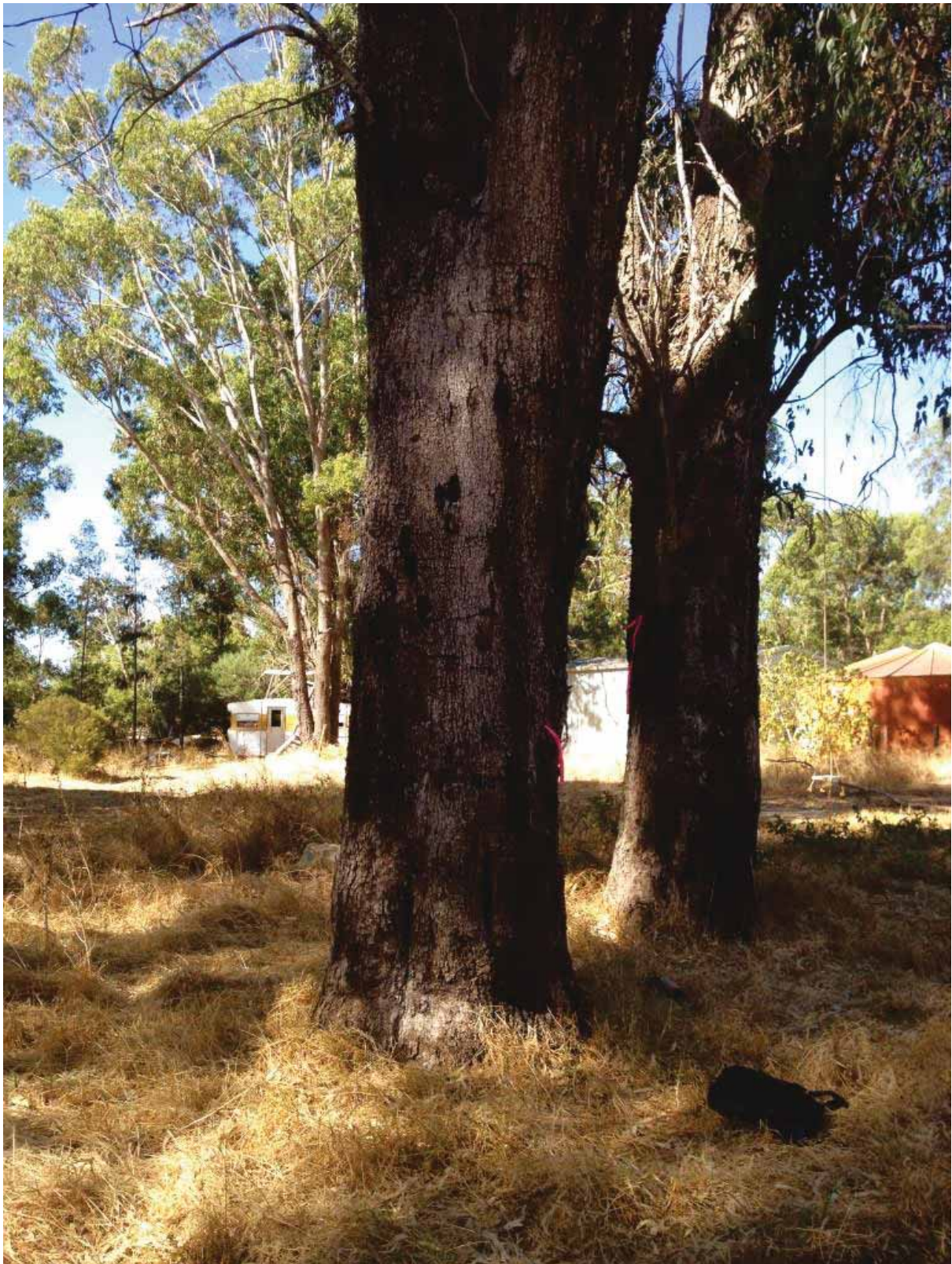
Tree No: 17



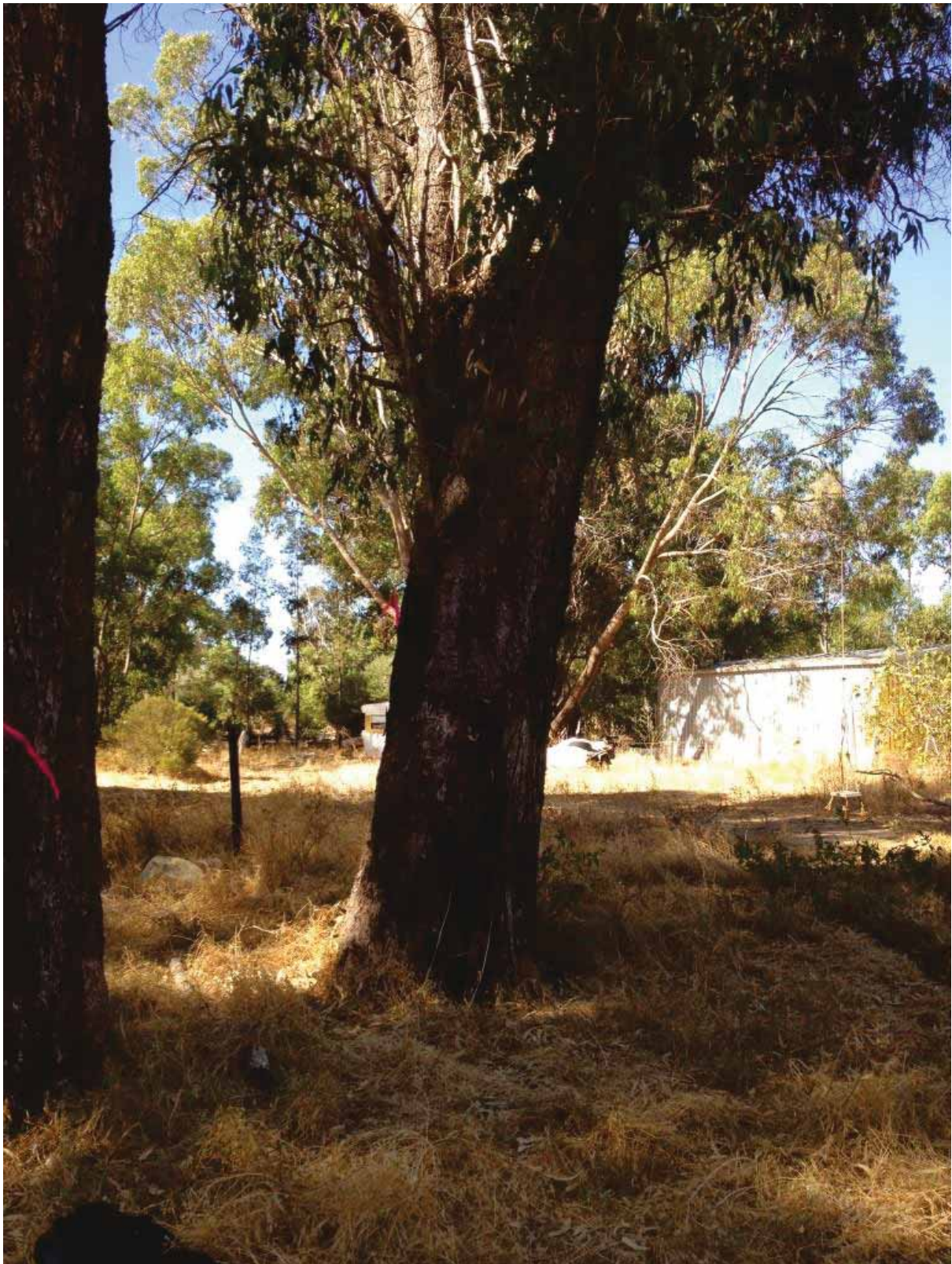
Tree No: 19



Tree No: 20



Tree No: 21



## **APPENDIX 4: Local Water Management Strategy**



CONSULTING CIVIL & TRAFFIC ENGINEERS, RISK MANAGERS.




|             |                         |
|-------------|-------------------------|
| Project:    | Lot 51 Flynn Drive LWMS |
| Client:     | Woodland Consortium     |
| Job Number: | 1606011                 |
| Author:     | Jessica Stanes          |
| Date:       | 29 July 2016            |

1 ST. FLOOR, 908 ALBANY HIGHWAY, EAST VICTORIA PARK WA 6101.

|           |                      |
|-----------|----------------------|
| PHONE     | +61 8 9355 1300      |
| FACSIMILE | +61 8 9355 1922      |
| EMAIL     | admin@shawmac.com.au |

## Document Status

| Version No. | Author    | Reviewed by | Date     | Document Status | Signature                                                                           | Date     |
|-------------|-----------|-------------|----------|-----------------|-------------------------------------------------------------------------------------|----------|
| A           | J. Stanes | R. Needham  | 29-08-16 | Client Review   |  | 29-08-16 |
|             |           |             |          |                 |                                                                                     |          |
|             |           |             |          |                 |                                                                                     |          |
|             |           |             |          |                 |                                                                                     |          |
|             |           |             |          |                 |                                                                                     |          |
|             |           |             |          |                 |                                                                                     |          |

### SHAWMAC PTY LTD

ABN 51 828 614 001

PO BOX 937

SOUTH PERTH WA 6951

T: + 61 8 9355 1300

F: + 61 8 9355 1922

E: admin@shawmac.com.au

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## Better Urban Water Management Checklist

| Local Water Management Strategy                                                                                                                    | Deliverable                                                                     | Provided Y/N | Section | Comments                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|--------------|---------|-----------------------------------------------------------------------------------------------------|
| Executive Summary<br>Summary of the development design strategy, outlining how the design objectives are proposed to be met                        | Table 1: Design elements and requirements for BMP's and critical control points | Y            | 1       |                                                                                                     |
| Introduction<br>Total Water cycle management – principles and objectives<br>Planning Background<br>Previous Studies                                |                                                                                 | Y            | 2       |                                                                                                     |
| Proposed Development<br>Structure plan, zoning and land use.<br>Key landscape features<br>Previous land use                                        | Site context plan<br>Structure plan                                             | Y            | 3       | A landscaping concept is currently being prepared and will be included in the LWMS at a later stage |
| Landscape – proposed POS areas, POS credits, water sources, bore(s), lake details (if applicable), irrigation areas                                | Landscape Plan                                                                  | N            |         |                                                                                                     |
| Design Criteria<br>Agreed design objectives and source of objective                                                                                |                                                                                 | Y            | 4       |                                                                                                     |
| Pre-development Environment<br>Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design? |                                                                                 |              | 5       |                                                                                                     |
| Site conditions – existing topography/contours, aerial photo underlay, major physical features                                                     | Site condition plan                                                             | Y            |         |                                                                                                     |
| Geotechnical – topography, soils including acid sulphate soils and infiltration capacity, test pit locations                                       | Geotechnical plan                                                               | Y            |         |                                                                                                     |
| Environmental – areas of significant flora and fauna, wetlands and buffers, waterways and buffers, waterways and buffers, contaminated sites       | Environmental Plan plus supporting data where appropriate                       | Y            |         |                                                                                                     |
| Surface Water – topography, 100 year floodways and flood fringe areas, water quality of flows entering and leaving the site (if applicable)        | Surface Water Plan                                                              | Y            |         |                                                                                                     |
| Ground Water – topography, pre-development groundwater levels and water quality, test bore locations                                               | Groundwater Plan plus details of groundwater monitoring and testing             | Y            |         |                                                                                                     |



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                   |                            |    |                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----|-------------------------------------------------------------------------------------------------------------------------|
| <p>Water use sustainability initiatives</p> <p>Water efficiency measures – private and public open spaces including method of enforcement</p> <p>Water Supply (fit-for-purpose strategy), agreed actions and implementation. If non-potable supply, support with water balance</p> <p>Wastewater Management</p>                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                   | Y                          | 6  |                                                                                                                         |
| <p>Stormwater Management Strategy</p> <p>Flood protection – peak flow rates, volumes and top water levels at control points, 100 year flow paths and 100 year detentions storage areas</p> <p>Manage serviceability – storage and retention required for the critical 5 year ARI event</p> <p>Protect ecology – detention areas for the 1 year 1 hour ARI event, areas for water quality treatment and types of (including indicative locations for) agreed structural and non-structural best management practices and treatment trains. Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages</p> | <p>100 year event plan</p> <p>Long section of critical points</p> <p>5 year event plan</p> <p>1 year event plan</p> <p>Typical cross sections</p> | <p>Y</p> <p>Y</p> <p>Y</p> | 7  |                                                                                                                         |
| <p>Groundwater Management Strategy</p> <p>Post development groundwater levels, fill requirements (including existing and likely final surface levels), outlet controls, and subsoil areas/exclusion zones</p> <p>Actions to address acid sulphate soils or contamination</p>                                                                                                                                                                                                                                                                                                                                                                    | Groundwater/subsoil plan                                                                                                                          | Y                          | 8  | Given the depth to groundwater is between 24 to 33m, the use of controlled groundwater levels and fill is not required. |
| <p>The next stage – subdivision and urban water management plans</p> <p>Content and coverage of future urban water management plans to be completed at subdivision, include areas where further investigations are requirement prior to detailed design.</p>                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                   | Y                          | 9  |                                                                                                                         |
| <p>Monitoring</p> <p>Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                   | Y                          | 10 | Given the site characteristics, ongoing monitoring is unlikely to add value and therefore no monitoring is proposed.    |
| <p>Implementation</p> <p>Developer commitments</p> <p>Roles, responsibilities, funding for implementation</p> <p>Review</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                   | Y                          | 11 |                                                                                                                         |

## 1. Executive Summary

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This Local Water Management Strategy (LWMS) provides guidance for the development of lot 51 Flynn Drive Carramar aimed at managing the total water cycle in a sustainable manner.

This LWMS incorporates strategies that target water conservation, stormwater management and groundwater management.

Water Conservation strategies include:

- Domestic use of rainwater tanks for gardens, toilets and washing machines cold water inlets;
- Use of greywater, roof water or groundwater for residential gardens;
- Waterwise practices in the house, garden and within the development;
- Waterwise fittings; and
- Waterwise landscaping.

Stormwater management strategies include:

- Implementing a drainage design that limits the peak outflow from the development to pre-development levels through storage and infiltration on site;
- Geotechnical recommendations preclude the use of soakwells for on site disposal, and as such it is proposed lot connections be used;
- Provide raingardens that ensure the targets for TSS, phosphorous, nitrogen and gross pollutants reductions are achieved ; and
- Provide two stormwater retention basins that controls outflow for the 1, 5 and 100 year ARI events and ensure that the 1-in-100-year ARI event flood levels are below residential floor levels.

Groundwater management is not considered necessary as the groundwater is expected to be between 33m and 24m below ground level.

## 2. Introduction

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### 2.1. Total Water Cycle Management

The objective of this Local Water Management Strategy (LWMS) is to achieve best practice water management outcomes through strategies that manage the total water cycle in a sustainable manner. The objectives of total water cycle management, as described by the State Planning Policy 2.9 Water Resources<sup>1</sup> (2006) are to:

- Take into account total water cycle management and water-sensitive urban design principles and ensure that development is consistent with current best management practices and best planning practices for the sustainable use of water resources, particularly stormwater.
- Seek to achieve no net difference in water quality and quantity, unless necessary to meet identified environmental water requirements, such that post development water quality and quantity conditions are equal to or better than pre-development conditions.
- Promote management of the urban water cycle as a single system in which all urban water flows are recognised as a potential resource and where the interconnectedness of water supply, stormwater, wastewater, flooding, water quality, waterways, estuaries and coastal waters is recognised.
- Maximise the opportunities for compliance with best practice stormwater management including infiltration/detention of stormwater on site/at the source.
- Promote water conservation mechanisms that increase the efficiency of the use of water, including stormwater.
- Incorporate the re-use and recycling of water, particularly stormwater and grey water, consistent with state water strategy recycling objectives. Black water reuse and recycling should be considered where deep sewerage is not available. Alternative non-potable water sources should be considered where appropriate for fit-for-purpose use.
- Promote the retention and use of local native vegetation in developments to minimise water use and maximise filtration, particularly where landscaping is proposed.

In order to achieve these objectives, the LWMS follows the principles of Water Sensitive Urban Design (WSUD).

### 2.2. Planning Background

This LWMS has been prepared to support the submission of a Local Structure Plan covering Lot 51 Flynn Drive Carramar.

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<sup>1</sup> Government of Western Australia, 2006, State Planning Policy 2.9 Water Resources, Western Australian Planning Commission, Perth, Western Australia.



### 2.3. Previous Studies

There is no District Water Management Strategy (DWMS) prepared for the site.

### 3. Proposed Development

#### 3.1. Existing Site

The Site is located at Lot 51 Flynn Drive in Carramar within the City of Wanneroo. Figure 1 below shows the location of the site in its regional context. The site is bounded by Flynn Drive to the north, Wanneroo Road to the west and remnant vegetation to the east. The site is approximately 5km north east of the Joondalup town centre and 8km north of the Wanneroo town centre.

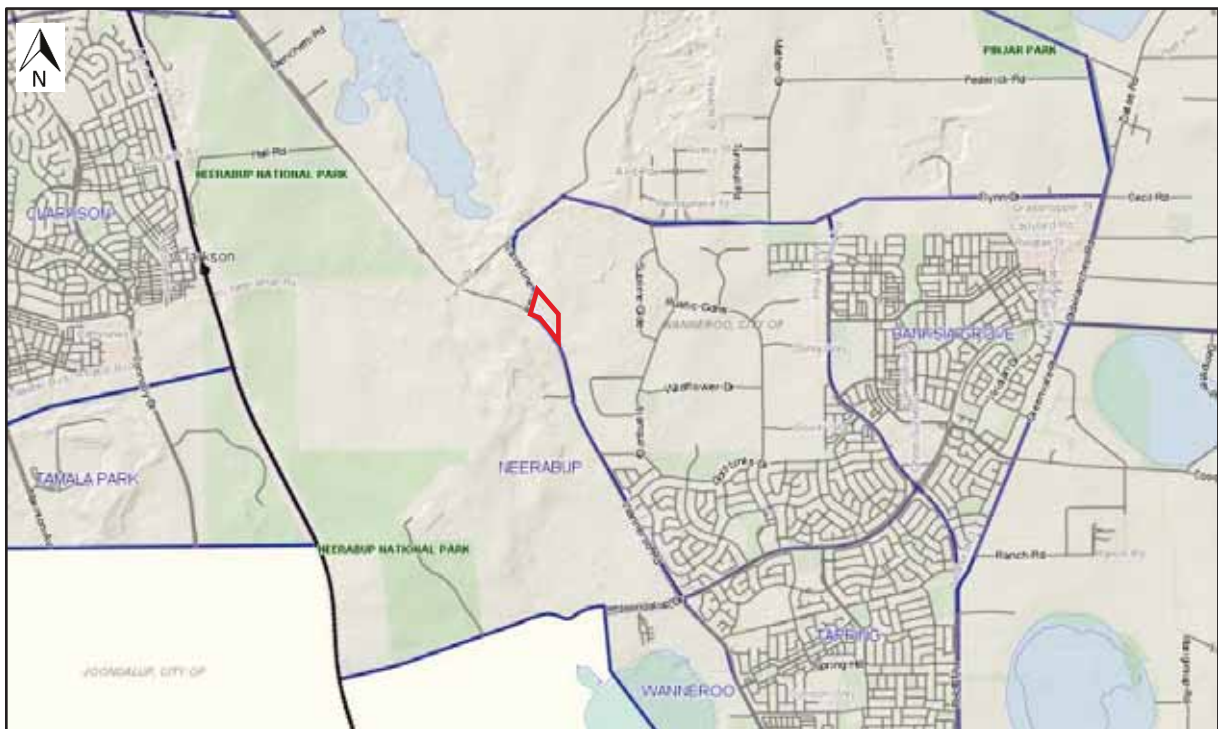


Figure 1: Site Regional Context

The existing site aerial is shown in Figure 2 overleaf.



Figure 2: Existing Site Aerial

The northern section of the site contains a single residence with the remainder of the site consisting of remnant vegetation. The land has not had any other previous use.

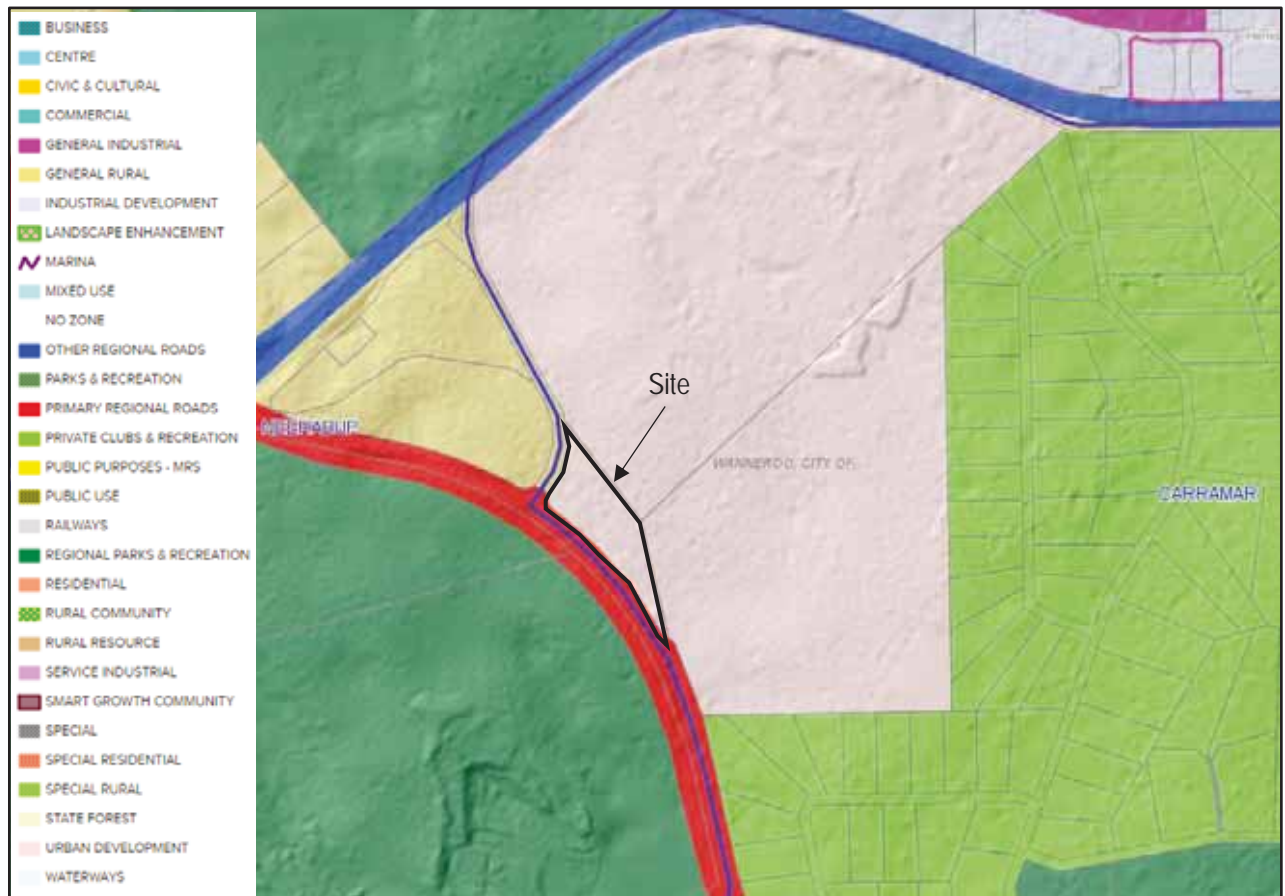


Figure 3: Planning Background

The City of Wanneroo District Planning Scheme No. 2 shown in Figure 3 shows that the site is zoned for Urban Development. The two regional parks and recreation areas, Lake Neerabup to the north and Neerabup National Park to the west, are bush forever sites.

### 3.2. Structure Plan

The subject land is approximately 3.3 ha and the proposal is for residential development with a mix of R20 and R30 zoning including a public open space (POS) and land set aside for drainage. The structure plan is included at Appendix A.

### 3.3. Landscaping

A landscaping concept is currently being prepared and will be included in the LWMS at a later stage.

## 4. Design Criteria

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### 4.1. Water Conservation — Potable and Wastewater

#### 4.1.1. Objective

The use of potable water should be minimised where drinking water quality is not essential, particularly outside the house.

#### 4.1.2. Design Criteria

The guidelines for the preparation of LWMS suggest a consumption target for water of 100 kL/person/yr – as outlined in the State Water Plan<sup>2</sup> (2007) with an aspirational target of not more than 40–60 kL/person/yr scheme water, as provided in Better Urban Water Management<sup>3</sup> (2008).

These targets are well below the 155kL/person/year water use targeted by the State Water Strategy<sup>4</sup> (2003) and is considered to be ambitious. Nonetheless, a target of 40–60 kL/person/yr scheme water is adopted as design criteria.

Assuming an occupancy rate of 2.6 residents per house (based on Australian Bureau of Statistics website, accessed 22/08/16), the target set for the site gives a potable water goal of 104 – 156 kL/house per year.

### 4.2. Water Quantity Management

#### 4.2.1. Objective

Post-development annual discharge volume and peak flow be maintained relative to pre-development conditions, unless otherwise established through determination of ecological water requirements for sensitive environments.

#### 4.2.2. Design Criteria

Ecological protection – For the critical 1-year Average Recurrence Interval (ARI) event, the post-development discharge volume and peak flow rates shall be maintained relative to predevelopment conditions in all parts of the catchment.

Flood management – Manage the catchment runoff for up to the 1-in-100-year ARI event within the development area to pre-development peak flows unless otherwise indicated in an approved water management strategy.

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<sup>2</sup> Government of Western Australia, 2007, State Water Plan, Department of Water, Perth, Western Australia.

<sup>3</sup> Government of Western Australia, 2008, Better Urban Water Management, Western Australian Planning Commission & Department for Planning and Infrastructure, Perth, Western Australia.

<sup>4</sup> Government of Western Australia, 2003, A State Water Strategy for Western Australia, Department of Water, Perth, Western Australia.

## 4.3. Water Quality Management

### 4.3.1. Objective

Reduction in the average annual loads of stormwater pollutants discharged by the development into the surface water and groundwater systems if it used traditional, directly connected stormwater drainage design.

### 4.3.2. Design criteria

Stormwater will be treated through a vegetated basin to reduce nutrient loads leaving the site which will target achievement of the following design parameters:

- at least 80 per cent reduction of total suspended solids;
- at least 60 per cent reduction of total phosphorus;
- at least 45 per cent reduction of total nitrogen; and
- at least 70 per cent reduction of gross pollutants.

## 4.4. Disease Vector and Nuisance Insect Management

To reduce the health risk from mosquitoes, retention and detention treatments will be designed to ensure that detained immobile stormwater is fully dispersed within a time period not exceeding 96 hours.

## 5. Pre-Development Environment

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### 5.1. Site Characteristics

The existing site consists mainly of natural vegetation with a single residence in the northern section. The site is well vegetated with low shrubs and scattered large trees.

### 5.2. Site Conditions

The site has a gentle slope to the south east, with ground levels sloping from 50m AHD in the north corner to 40m AHD in the south corner.

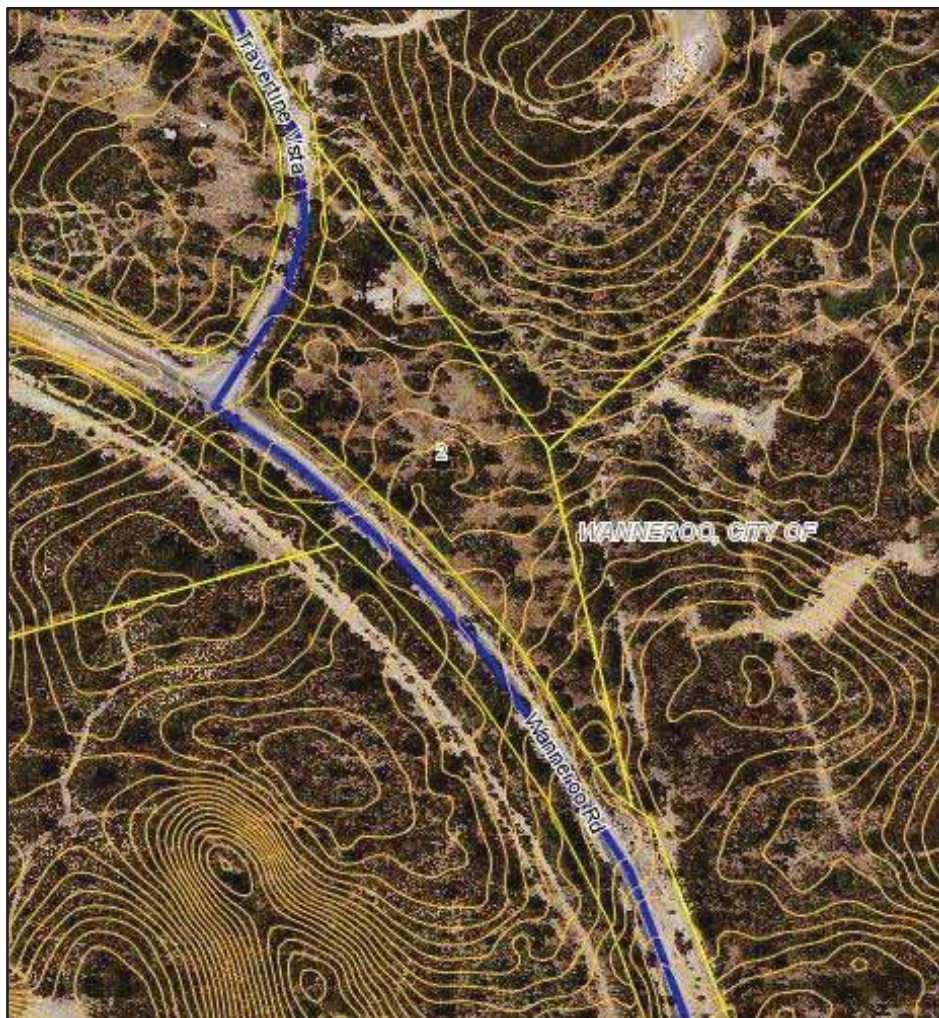


Figure 4: Contours

### 5.3. Geotechnical

The geological map sourced from Geoscience Australia shown in Figure 5 below indicates that the site lies in an area of coastal limestone.

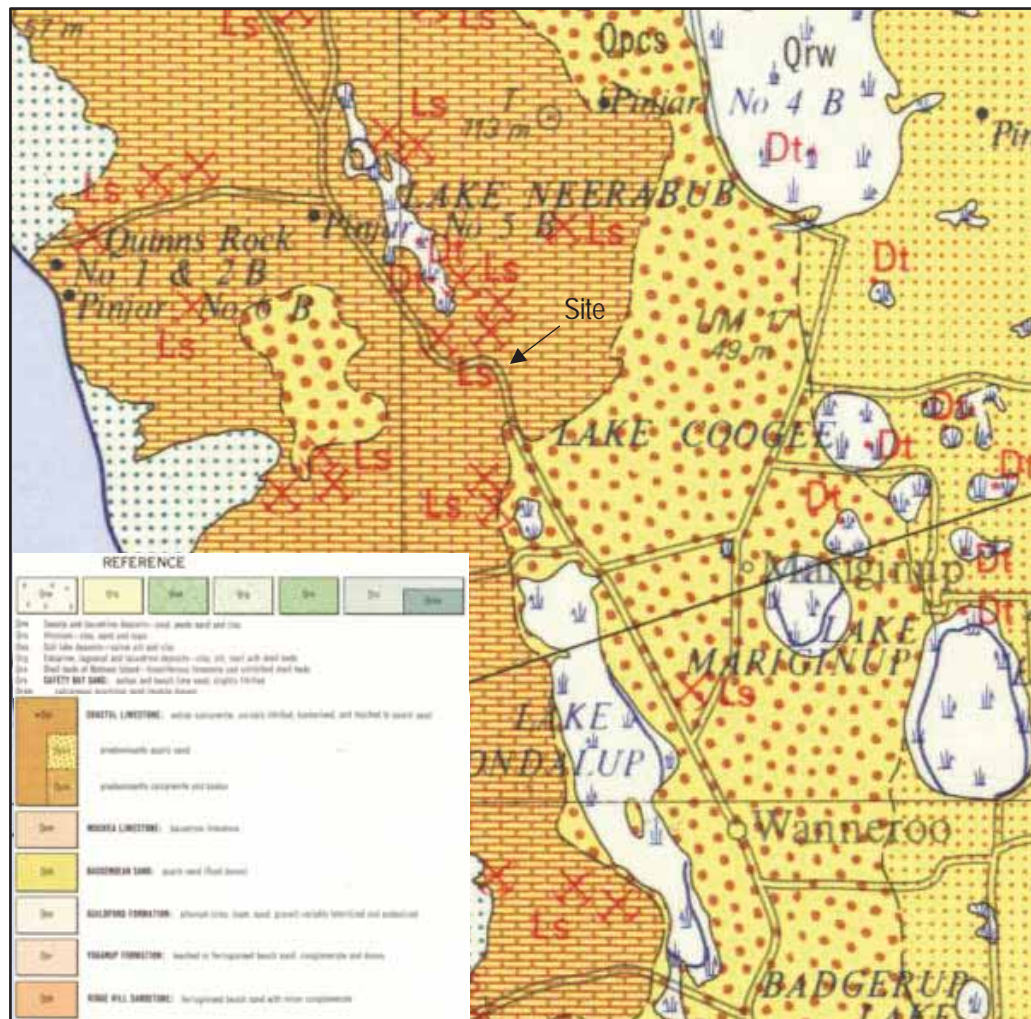


Figure 5: Geological Map Muchea

A geotechnical site investigation was completed by Coffey Geotechnical consultants in 2006 and is included at Appendix B. The report checked the 1:50,000 Environmental Geology (Mucnea), which indicated that the site is within an area underlain by Tamala Limestone. In addition the site is mapped as being within a geomorphological zone described as an "Interbarrier depression with prominent karstic phenomena". The results of field testing indicated that the site is underlain by fine to medium grained, yellow, siliceous dune sand in a dense condition.

A survey for underlying karst formations was undertaken in 2006, included at Appendix B, and focused on the possibilities of karstic features suggesting the presence of hidden caves near the surface. The inspection failed to find any indicators and concluded that the property has no hidden caves near the surface, however

it is concluded that there are likely to be caves at deeper levels. The geotechnical report concluded that the infiltration of concentrated rainwater runoff from roofs, paved areas and roads within potential karst areas has the potential to affect foundation conditions by mobilising the loose sands in the limestone discontinuities. Therefore on site stormwater disposal through soakwells will not be used instead stormwater will be directed towards a drainage area at the southern end of the site which has been deemed adequate by the drainage assessment completed by Coffey Geotechnical consultants in 2007 and is included at Appendix B.

The Acid Sulphate Soil (ASS) Risk Map sourced from the Department of Environmental Regulation through the Landgate WA Atlas, shown in Figure 6 overleaf, shows that the site has no known risk of ASS occurring.

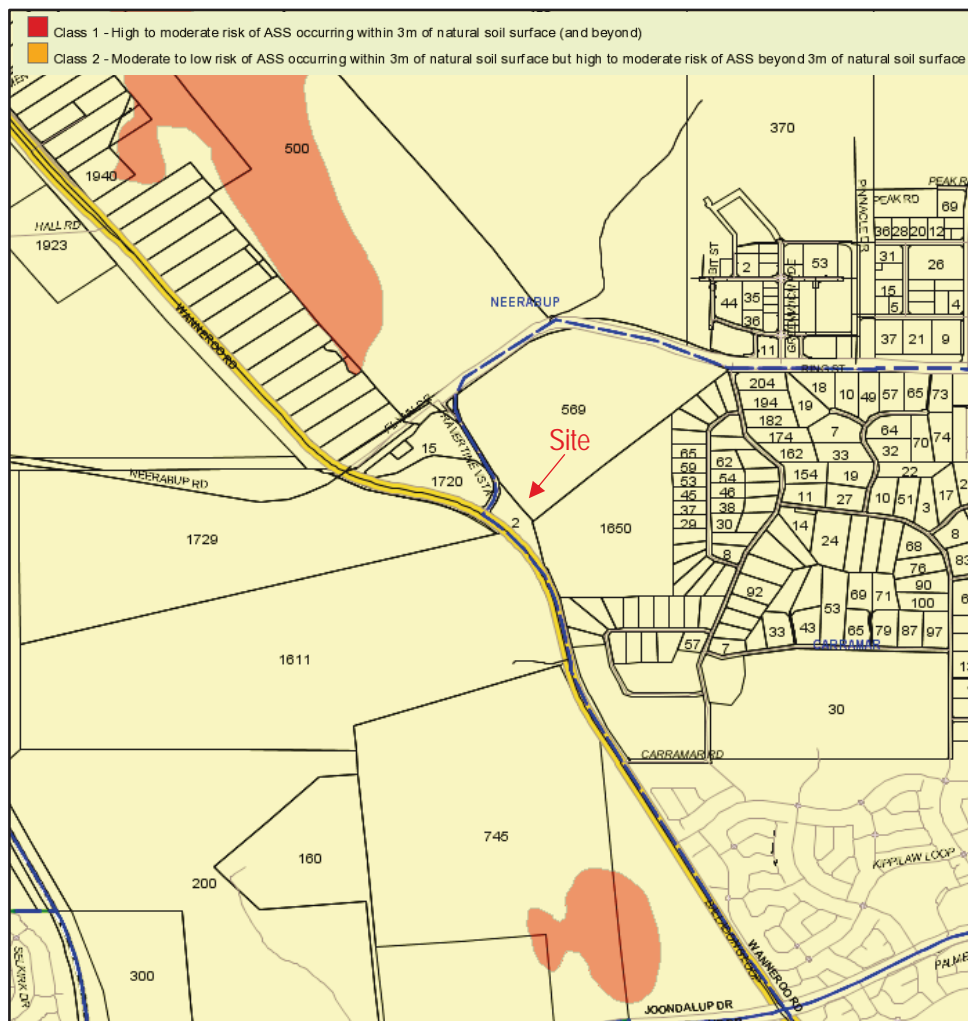


Figure 6: ASS Risk Map

#### 5.4. Environmental

A review of the Landgate WA Atlas showed that the site does not exist in any areas of issue. There are no contaminated sites nearby. The site is not part of an Environmentally Sensitive or Bush Forever area however Lake Neerabup to the north and Neerabup National Park to the west are part of both areas. There are no Aboriginal Heritage Places in the site, Lake Neerabup to the north is has been lodged as an Aboriginal Heritage Place.

## 5.5. Surface Water

### 5.5.1. Topography

The existing site is relatively flat but generally grades to the south east, with ground levels sloping from 50m AHD in the north corner to 40m AHD in the south corner.

### 5.5.2. 100 Year Floodways and Flood Fringe Areas

A review of the Department of Water Geographical Data Atlas showed that the site is not in a 1-in-100-year ARI event floodplain of a river or major watercourse.

### 5.5.3. Surface Water Quality

The quality of the surface water is expected to be very good. This is expected because the lot mostly consists of vegetation and only has a small amount of developed area. The sandy soils mean that there is very limited surface water flows.

### 5.5.4. Surface Water Quantity

Pre-development surface water flows were quantified by calculations as prescribed by Australian Rainfall and Runoff<sup>5</sup> (1986) and the Intensity Frequency Duration (IFD) table sourced from the City of Wanneroo Development Design Specification<sup>6</sup> (2015) and shown in Table 1.

Table 1: IFD Table

| <b>Table 1 Rainfall Intensity-Frequency-Duration (IFD) mm/hr</b> |                                      |            |             |             |              |
|------------------------------------------------------------------|--------------------------------------|------------|-------------|-------------|--------------|
| <b>Duration</b>                                                  | <b>Average Storm Return Interval</b> |            |             |             |              |
|                                                                  | <b>1yr</b>                           | <b>5yr</b> | <b>10yr</b> | <b>50yr</b> | <b>100yr</b> |
| <b>6 min</b>                                                     | 54.8                                 | 95.1       | 111         | 168         | 197          |
| <b>10 min</b>                                                    | 43.8                                 | 74.9       | 87.3        | 130         | 151          |
| <b>30 min</b>                                                    | 24.2                                 | 39.8       | 45.6        | 65.5        | 75.5         |
| <b>1 hour</b>                                                    | 15.96                                | 25.51      | 28.63       | 40.03       | 45.6         |
| <b>10 hour</b>                                                   | 3.57                                 | 5.52       | 6.25        | 8.42        | 9.52         |
| <b>24 hour</b>                                                   | 2.02                                 | 3.16       | 3.54        | 4.89        | 5.54         |
| <b>48 hour</b>                                                   | 1.26                                 | 2.01       | 2.28        | 3.20        | 3.65         |
| <b>72 hour</b>                                                   | 0.94                                 | 1.50       | 1.71        | 2.43        | 2.78         |

For the calculations of the pre-development flows a coefficient runoff of 0.2 was adopted as the site consists mostly of natural vegetation. The pre-development flows are shown in Table 2 overleaf.

<sup>5</sup> Institution of Engineers Australia, 1986, Australian Rainfall and Runoff A Guide to Flood Estimation, Commonwealth of Australia.

<sup>6</sup> City of Wanneroo, 2015, Development Design Specification WD5 Stormwater Drainage Design, City of Wanneroo, Wanneroo, Western Australia.

Table 2: Pre-Development Flows

|           | Area                  | tc       | C   | i          | Q          |
|-----------|-----------------------|----------|-----|------------|------------|
| 1 Year    | 10,300 m <sup>2</sup> | 7.40 min | 0.2 | 54.8 mm/hr | 31.38 L/s  |
| 5 Years   | 10,300 m <sup>2</sup> | 7.40 min | 0.2 | 95.1 mm/hr | 54.46 L/s  |
| 100 Years | 10,300 m <sup>2</sup> | 7.40 min | 0.2 | 197 mm/hr  | 112.81 L/s |

## 5.6. Groundwater

### 5.6.1. Groundwater Levels

A review of the Department of Water Perth Groundwater Atlas showed that the groundwater at the site is expected to be in the vicinity of 30m below the surface (varies from 33m to 24m) and as such groundwater monitoring has not been undertaken.

### 5.6.2. Groundwater Quality

A review of the Department of Water Perth Groundwater Atlas showed that the groundwater at the site is expected to be in the salinity range of 500 to 1,000 mg/L, which means it is marginally fresh, unsuitable for garden bores and low risk of iron staining (low in iron concentration). Groundwater quality monitoring has not been undertaken due to the significant depth of groundwater below the site.

## 6. Water Use Sustainability Initiatives

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### 6.1. Water Efficiency Measures

This LWMS proposes the use of a treatment train approach including source control strategies. Strategies will typically aim at:

- Non Structural Controls such as construction practices and their management, maintenance practices such as street sweeping and stormwater system maintenance and educational and community practices.
- Structural controls such as retention and infiltration of short term (1-year events) within lot boundaries and in vegetated swales / rain gardens and the use of a vegetated detention basin for longer events.
- Structural controls such as gross pollutant traps.
- Management of, road verges, swales and rain gardens to prevent householders modifying infrastructure and adversely affecting their function.

The options for water management considered feasible for this development are:

- Domestic use of rainwater tanks for gardens, toilets and washing machines cold water inlets;
- Use of greywater, roof water or groundwater for residential gardens;
- Waterwise practices in the house, garden and within the development;
- Waterwise fittings; and
- Waterwise landscaping.

#### 6.1.1. Areas for Potential Potable Water Use Reduction

The total water consumption from the developed site can be reduced through the water conservation measures discussed in the following sections. The measures have been included in order to meet the objectives and criteria stated in the LWMS. In addition to in-house potable water use substitution, the use of Waterwise fixtures such as showerheads, taps, toilets and washing machines to reduce water use is recommended.

##### 6.1.1.1. Residential Garden Watering

Residential garden watering may be reduced through the use of Waterwise gardening and substitution of potable water with another source such as roof water or domestic greywater.

#### 6.1.1.2. Roof Water

As rainfall is concentrated over the wet season months, most irrigation demand occurs during the dry season when roof water is not available for irrigation without storage. Given the size of the storage that will be required, this option is not considered feasible as replacement or partial replacement of scheme water, however households should be encouraged to install rainwater tanks to supplement scheme water.

#### 6.1.1.3. Domestic Greywater

Domestic greywater reuse is feasible with householders being responsible for their own greywater treatment systems. Greywater reuse requires the use of special detergents and compliance with certain conditions and restrictions.

#### 6.1.1.4. Waterwise Landscaping

Waterwise landscaping involves reducing the amount of water used for irrigation through the use of low water use plants, soil amendments, reduced areas of lawn and water efficient irrigation systems. Native vegetation may require irrigation for establishment and then possibly limited irrigation during the hotter months. The level of water use reduction will depend on individual application and how individual owners manage and water their garden. Any landscaping packages provided to householders within the site should be Waterwise in order to minimise water use.

#### 6.1.1.5. Waterwise Fittings

An alternative to in-house potable water use substitution is the use of Waterwise fixtures such as showerheads, taps, toilets and washing machines to reduce water use. While it is possible for developers to set conditions requiring the use of Waterwise fitted fixtures such as toilets and taps in a house, the mandating of washing machine type would be difficult as these are not fixed to the house. Water efficient washing machines are covered by the Waterwise Rebate scheme, which subsidises these items.

#### 6.1.1.6. In-House Water Substitution

In-house water substitution involves the substitution of potable water with either rain water or grey water. The options considered most feasible are the use of roof water for toilet flushing, washing machine cold water and garden watering.

### 6.2. Water Supply

Potable water will be sourced via extension to the existing water reticulation network through the development area.



### 6.3. Waste Water

Wastewater will be discharged into deep sewer reticulation mains.

## 7. Stormwater Management Strategy

The post development catchment areas are shown in a catchment plan included at Appendix A. A summary of the catchments is shown in Table 3 below.

Table 3: Post Development Catchments

| Catchment Name | Raingarden | Basin   | Catchment Area (Total) | Catchment Area (Lot) | Catchment Area (Road) | Catchment Area (POS) |
|----------------|------------|---------|------------------------|----------------------|-----------------------|----------------------|
| CA01           | RG01       | Basin 1 | 4250 m <sup>2</sup>    | 2430 m <sup>2</sup>  | 1820 m <sup>2</sup>   | -                    |
| CA02           | RG02       | Basin 1 | 5890 m <sup>2</sup>    | 4520 m <sup>2</sup>  | 1370 m <sup>2</sup>   | -                    |
| CA03           | RG03       | Basin 1 | 2176 m <sup>2</sup>    | 780 m <sup>2</sup>   | 1396 m <sup>2</sup>   | -                    |
| CA04           | RG04       | Basin 1 | 5022 m <sup>2</sup>    | 3652 m <sup>2</sup>  | 1370 m <sup>2</sup>   | -                    |
| CA05           | -          | Basin 1 | 3671 m <sup>2</sup>    | -                    | -                     | 3671 m <sup>2</sup>  |
| CA06           | RG05       | Basin 1 | 4831 m <sup>2</sup>    | 3555 m <sup>2</sup>  | 1276 m <sup>2</sup>   | -                    |
| CA07           | RG06       | Basin 2 | 2686 m <sup>2</sup>    | 1110 m <sup>2</sup>  | 1576 m <sup>2</sup>   | -                    |
| CA08           | RG06       | Basin 2 | 597 m <sup>2</sup>     | -                    | -                     | 597 m <sup>2</sup>   |

The coefficients of runoff used as part of the preliminary drainage assessment is shown in Table 4 below.

Table 4: Post Development Coefficients of Runoff

| C (Lot) | C (Road) | C (POS) |
|---------|----------|---------|
| 0.60    | 0.80     | 0.20    |

A preliminary drainage design was completed for the 1-in-1-year, 1-in-5-year and 1-in-100-year ARI events and it was concluded that the critical storm for each event was the 1 hour storm.

### 7.1. Flood Protection

The road and lot levels on the site will be designed to provide a flood route that maintains a clearance of 500mm between flood surface water levels and the habitable floor levels of adjacent lots with outfalls along pre-developed flow lines. A drainage concept plan is attached at Appendix A.

The 1-in-100-year ARI event lot and street drainage is proposed to be directed to 6 raingardens spread across the site as well as a storage basin in the drainage area of the structure plan and a storage basin in the POS area which discharges at the pre-development flow rate. The raingardens are sized for the 1-in-1-year ARI event, for the larger storm events the stormwater will bypass the raingardens into the street system and be directed via pipe into the storage basins. There will be no soakwells used for this site due to the risks involved with karst areas therefore lot connections are required to transport the stormwater.

Basin 1 will store a volume of 570 m<sup>3</sup> and have a maximum outflow of 117 L/s, basin 2 will store a volume of 16m<sup>3</sup>, for more detail refer to Table 5 and Table 6 below.

Table 5: Basin Details

|            | Basin 1<br>(POS)    | Basin 2<br>(Drainage Area) |
|------------|---------------------|----------------------------|
| Base Level | 41.3 m AHD          | 38.8 m AHD                 |
| Base Area  | 300 m <sup>2</sup>  | 50 m <sup>2</sup>          |
| Top Level  | 42.3                | 39.15                      |
| Top Area   | 1000 m <sup>2</sup> | 200 m <sup>2</sup>         |
| Volume     | 800 m <sup>3</sup>  | 44 m <sup>3</sup>          |

Table 6: 100 Year ARI Event Basin Detail

| Basin   | Max Water Level | Max Depth of Water | Inundated Area     | Volume             | Max Outflow | Time to Empty |
|---------|-----------------|--------------------|--------------------|--------------------|-------------|---------------|
| Basin 1 | 42.17 m AHD     | 1.1 m              | 900 m <sup>2</sup> | 570 m <sup>3</sup> | 117 L/s     | 2 hr 20 min   |
| Basin 2 | 39.0 m AHD      | 0.21 m             | 112 m <sup>2</sup> | 16 m <sup>3</sup>  | 0 L/s       | 30 min        |

## 7.2. Manage Serviceability

The 1-in-5-year ARI event lot and street drainage is proposed to be directed to 6 raingardens spread across the site as well as a storage basin in the drainage area of the structure plan and a storage basin in the POS area which discharges at the pre-development flow rate. The raingardens are sized for the 1-in-1-year ARI event, for the larger storm events the stormwater will bypass the raingardens into the street system and be directed via pipe into the storage basins. There will be no soakwells used for this site due to the risks involved with karst areas therefore lot connections are required to transport the stormwater.

Preliminary design was completed using XPSWMM software and determined that the required pipe size is 300mm diameter. The hydraulic gradient line and long section of the pipe from the preliminary design for the lot connections to basin 1 is shown in Figure 7 below, and for the lot connections to basin 2 is shown in Figure 8 overleaf.

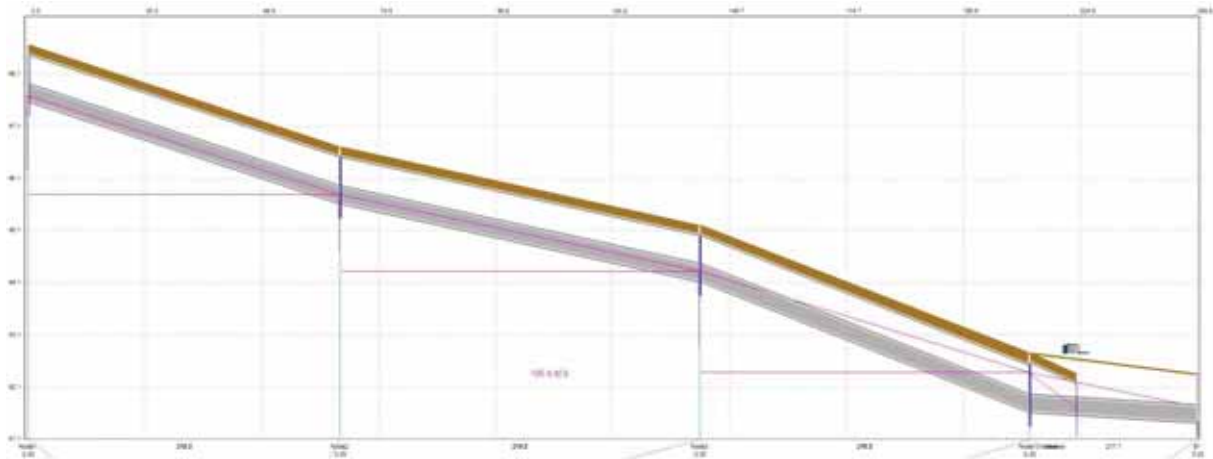


Figure 7: Lot Connections to Basin 1

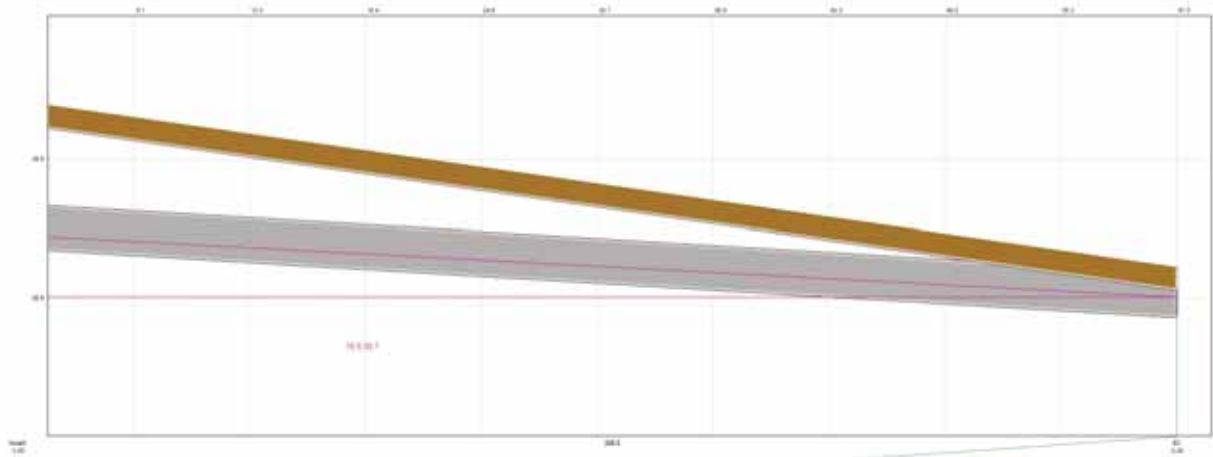


Figure 8: Lot Connections to Basin 2

Basin 1 will store a volume of 320 m<sup>3</sup> and have a maximum outflow of 63 L/s, basin 2 will store a volume of 9m<sup>3</sup>, for more detail refer to Table 5 and Table 7.

Table 7: 5 Year ARI Event Basin Detail

| Basin   | Max Water Level | Max Depth of Water | Inundated Area     | Volume             | Max Outflow | Time to Empty |
|---------|-----------------|--------------------|--------------------|--------------------|-------------|---------------|
| Basin 1 | 41.82 m AHD     | 0.72 m             | 640 m <sup>2</sup> | 320 m <sup>3</sup> | 63 L/s      | 1 hr 15 min   |
| Basin 2 | 38.94 m AHD     | 0.14 m             | 90 m <sup>2</sup>  | 9 m <sup>3</sup>   | 0 L/s       | 20 min        |

### 7.3. Protect Ecology

The 1-in-1-year ARI event lot and street drainage is proposed to be directed to 6 raingardens spread across the site as well as a storage basin in the drainage area of the structure plan and a storage basin in the POS area which discharges at the pre-development flow rate. There will be no soakwells used for this site due to the risks involved with karst areas therefore lot connections are required to transport the stormwater.

The raingardens were sized for the 1 year 1 hour duration storm and a summary of the required size is shown in Table 8 and a typical details drawing of the raingardens is included at Appendix A. Detailed calculations for the raingarden sizing are included at Appendix C. Basin 1 will store a volume of 210 m<sup>3</sup> and have a maximum outflow of 32 L/s, basin 2 will store a volume of 7m<sup>3</sup>, for more detail refer to Table 5 and Table 9.

Table 8: Raingarden Sizing

| Raingarden | Storage Depth (m) | Width (m) | Length (m) |
|------------|-------------------|-----------|------------|
| RG01       | 0.25              | 1.85      | 27.5       |
| RG02       | 0.25              | 1.85      | 21.0       |
| RG03       | 0.25              | 1.85      | 21.0       |
| RG04       | 0.25              | 1.85      | 21.0       |
| RG05       | 0.25              | 1.85      | 19.5       |
| RG06       | 0.25              | 1.85      | 24.0       |

Table 9: 1 Year ARI Event Basin Detail

| Basin   | Max Water Level | Max Depth of Water | Inundated Area     | Volume             | Max Outflow | Time to Empty |
|---------|-----------------|--------------------|--------------------|--------------------|-------------|---------------|
| Basin 1 | 41.64 m AHD     | 0.54 m             | 540 m <sup>2</sup> | 210 m <sup>3</sup> | 32 L/s      | 15 min        |
| Basin 2 | 38.9 m AHD      | 0.11 m             | 82 m <sup>2</sup>  | 7 m <sup>3</sup>   | 0 L/s       | 0 min         |



## 8. Groundwater Management Strategy

---

Given the depth to groundwater is between 24 to 33m, the use of controlled groundwater levels and fill is not required.

## 9. The Next Stage – Subdivision and UWMP

---

The works identified for the UWMP stage includes:

- Review, assessment and detailed design of stormwater drainage infrastructure;
- Detailed landscaping design

## 10. Monitoring

---

Given the site characteristics, ongoing monitoring is unlikely to add value and therefore no monitoring is proposed.

## 11. Implementation

The developer shall be responsible for the development of an UWMP at the subdivisional stage which shall address the following:

- Objectives as outlined in this LWMS and demonstration of compliance with those objectives;
- Approved measures to achieve water conservation and efficiencies of use;
- Detailed stormwater management design;
- Details of structural and non-structural Best Management Practices (BMP's) and treatment trains;
- Management of subdivisional works;
- Management of disease vector insects;
- Monitoring program; and
- Implementation Plan.

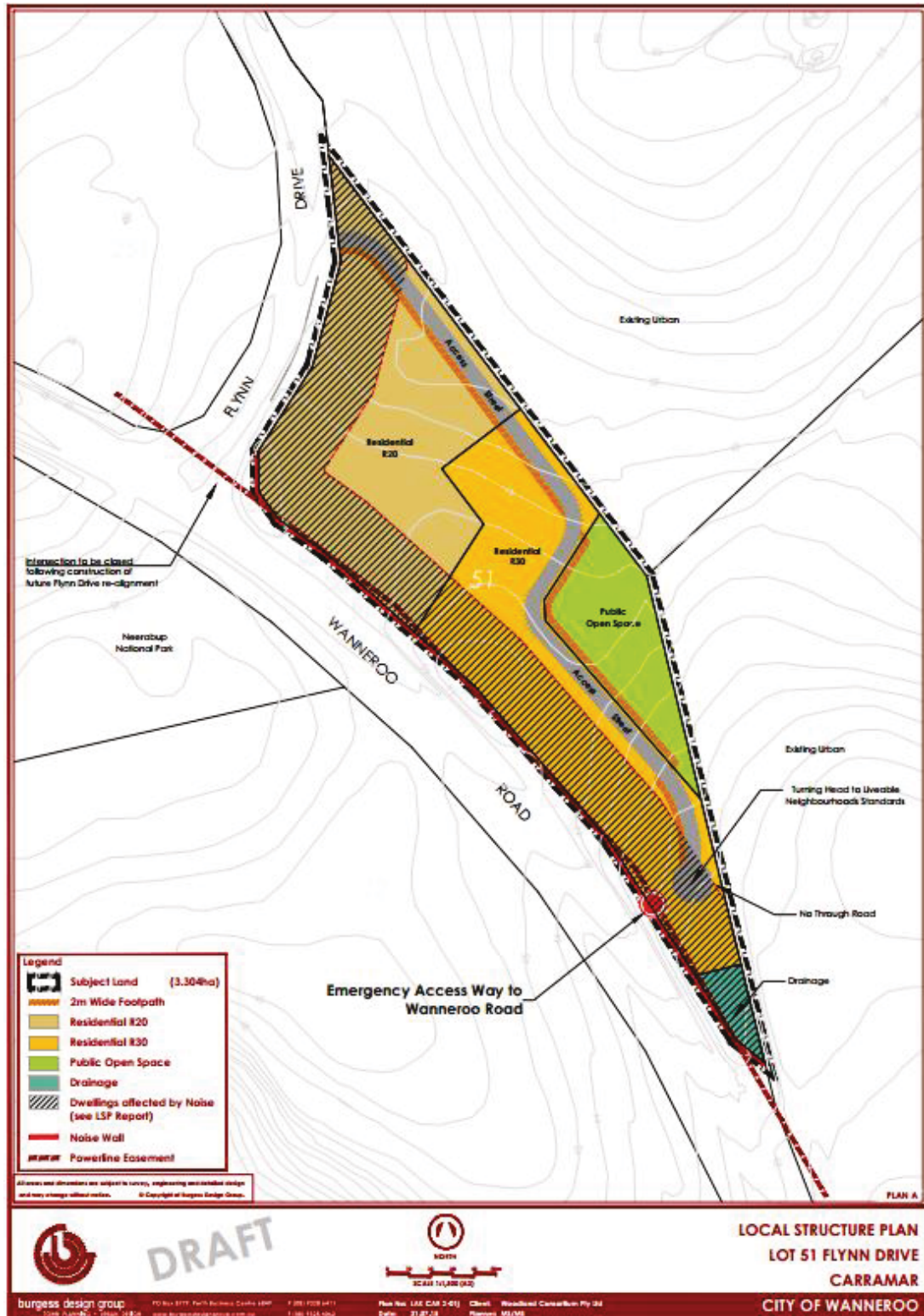
With respect to the systems implementation, operation and management, the developer confirms the following responsibilities as shown below in Table 10.

Table 10: Implementation Plan

| Item                          | Scheme Development                                   | Interim Maintenance (First two years)                                                                             | Long-term Maintenance |
|-------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------|
| Rainwater Tanks               | Developer (residents to construct their own systems) | Residents                                                                                                         | Residents             |
| Landscaping                   | Residents                                            | Residents                                                                                                         | Residents             |
| Waterwise Fittings            | Developer (residents to construct their own systems) | Residents                                                                                                         | Residents             |
| Education Campaigns           | Developer                                            | Developer to undertake initial education campaign regarding source control practices.                             | Council               |
| Drainage System               | Developer                                            | Developer responsible for the removal of debris, street sweeping, checks on drainage function.                    | Council               |
| Swales and Basin              | Developer                                            | Developer responsible for the removal of sedimentation and unwanted vegetation from basins, maintenance of swale. | Council               |
| Monitoring of the Development | Developer                                            | Developer for two years following practical completion of each stage.                                             | Council               |

## Appendix A – Drawings

### Structure Plan











[illegible]

The figure is a topographic map of a site for proposed development. It features contour lines indicating elevation, with labels such as 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325, 330, 335, 340, 345, 350, 355, 360, 365, 370, 375, 380, 385, 390, 395, 400, 405, 410, 415, 420, 425, 430, 435, 440, 445, 450, 455, 460, 465, 470, 475, 480, 485, 490, 495, 500, 505, 510, 515, 520, 525, 530, 535, 540, 545, 550, 555, 560, 565, 570, 575, 580, 585, 590, 595, 600, 605, 610, 615, 620, 625, 630, 635, 640, 645, 650, 655, 660, 665, 670, 675, 680, 685, 690, 695, 700, 705, 710, 715, 720, 725, 730, 735, 740, 745, 750, 755, 760, 765, 770, 775, 780, 785, 790, 795, 800, 805, 810, 815, 820, 825, 830, 835, 840, 845, 850, 855, 860, 865, 870, 875, 880, 885, 890, 895, 900, 905, 910, 915, 920, 925, 930, 935, 940, 945, 950, 955, 960, 965, 970, 975, 980, 985, 990, 995, 1000, 1005, 1010, 1015, 1020, 1025, 1030, 1035, 1040, 1045, 1050, 1055, 1060, 1065, 1070, 1075, 1080, 1085, 1090, 1095, 1100, 1105, 1110, 1115, 1120, 1125, 1130, 1135, 1140, 1145, 1150, 1155, 1160, 1165, 1170, 1175, 1180, 1185, 1190, 1195, 1200, 1205, 1210, 1215, 1220, 1225, 1230, 1235, 1240, 1245, 1250, 1255, 1260, 1265, 1270, 1275, 1280, 1285, 1290, 1295, 1300, 1305, 1310, 1315, 1320, 1325, 1330, 1335, 1340, 1345, 1350, 1355, 1360, 1365, 1370, 1375, 1380, 1385, 1390, 1395, 1400, 1405, 1410, 1415, 1420, 1425, 1430, 1435, 1440, 1445, 1450, 1455, 1460, 1465, 1470, 1475, 1480, 1485, 1490, 1495, 1500, 1505, 1510, 1515, 1520, 1525, 1530, 1535, 1540, 1545, 1550, 1555, 1560, 1565, 1570, 1575, 1580, 1585, 1590, 1595, 1600, 1605, 1610, 1615, 1620, 1625, 1630, 1635, 1640, 1645, 1650, 1655, 1660, 1665, 1670, 1675, 1680, 1685, 1690, 1695, 1700, 1705, 1710, 1715, 1720, 1725, 1730, 1735, 1740, 1745, 1750, 1755, 1760, 1765, 1770, 1775, 1780, 1785, 1790, 1795, 1800, 1805, 1810, 1815, 1820, 1825, 1830, 1835, 1840, 1845, 1850, 1855, 1860, 1865, 1870, 1875, 1880, 1885, 1890, 1895, 1900, 1905, 1910, 1915, 1920, 1925, 1930, 1935, 1940, 1945, 1950, 1955, 1960, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, 2005, 2010, 2015, 2020, 2025, 2030, 2035, 2040, 2045, 2050, 2055, 2060, 2065, 2070, 2075, 2080, 2085, 2090, 2095, 2100, 2105, 2110, 2115, 2120, 2125, 2130, 2135, 2140, 2145, 2150, 2155, 2160, 2165, 2170, 2175, 2180, 2185, 2190, 2195, 2200, 2205, 2210, 2215, 2220, 2225, 2230, 2235, 2240, 2245, 2250, 2255, 2260, 2265, 2270, 2275, 2280, 2285, 2290, 2295, 2300, 2305, 2310, 2315, 2320, 2325, 2330, 2335, 2340, 2345, 2350, 2355, 2360, 2365, 2370, 2375, 2380, 2385, 2390, 2395, 2400, 2405, 2410, 2415, 2420, 2425, 2430, 2435, 2440, 2445, 2450, 2455, 2460, 2465, 2470, 2475, 2480, 2485, 2490, 2495, 2500, 2505, 2510, 2515, 2520, 2525, 2530, 2535, 2540, 2545, 2550, 2555, 2560, 2565, 2570, 2575, 2580, 2585, 2590, 2595, 2600, 2605, 2610, 2615, 2620, 2625, 2630, 2635, 2640, 2645, 2650, 2655, 2660, 2665, 2670, 2675, 2680, 2685, 2690, 2695, 2700, 2705, 2710, 2715, 2720, 2725, 2730, 2735, 2740, 2745, 2750, 2755, 2760, 2765, 2770, 2775, 2780, 2785, 2790, 2795, 2800, 2805, 2810, 2815, 2820, 2825, 2830, 2835, 2840, 2845, 2850, 2855, 2860, 2865, 2870, 2875, 2880, 2885, 2890, 2895, 2900, 2905, 2910, 2915, 2920, 2925, 2930, 2935, 2940, 2945, 2950, 2955, 2960, 2965, 2970, 2975, 2980, 2985, 2990, 2995, 3000, 3005, 3010, 3015, 3020, 3025, 3030, 3035, 3040, 3045, 3050, 3055, 3060, 3065, 3070, 3075, 3080, 3085, 3090, 3095, 3100, 3105, 3110, 3115, 3120, 3125, 3130, 3135, 3140, 3145, 3150, 3155, 3160, 3165, 3170, 3175, 3180, 3185, 3190, 3195, 3200, 3205, 3210, 3215, 3220, 3225, 3230, 3235, 3240, 3245, 3250, 3255, 3260, 3265, 3270, 3275, 3280, 3285, 3290, 3295, 3300, 3305, 3310, 3315, 3320, 3325, 3330, 3335, 3340, 3345, 3350, 3355, 3360, 3365, 3370, 3375, 3380, 3385, 3390, 3395, 3400, 3405, 3410, 3415, 3420, 3425, 3430, 3435, 3440, 3445, 3450, 3455, 3460, 3465, 3470, 3475, 3480, 3485, 3490, 3495, 3500, 3505, 3510, 3515, 3520, 3525, 3530, 3535,

The figure consists of two cross-sections of a water management strategy, labeled A and B.

**Section A: TYPICAL BASIN 1 - SECTION A**  
 This section shows a cross-section of a basin with a 20m width. The top surface is labeled 'PLANTING TO LANDSCAPE DETAILS'. The bottom surface is labeled 'PLANTING TO LANDSCAPE DETAILS'. The slope is indicated as 10%.

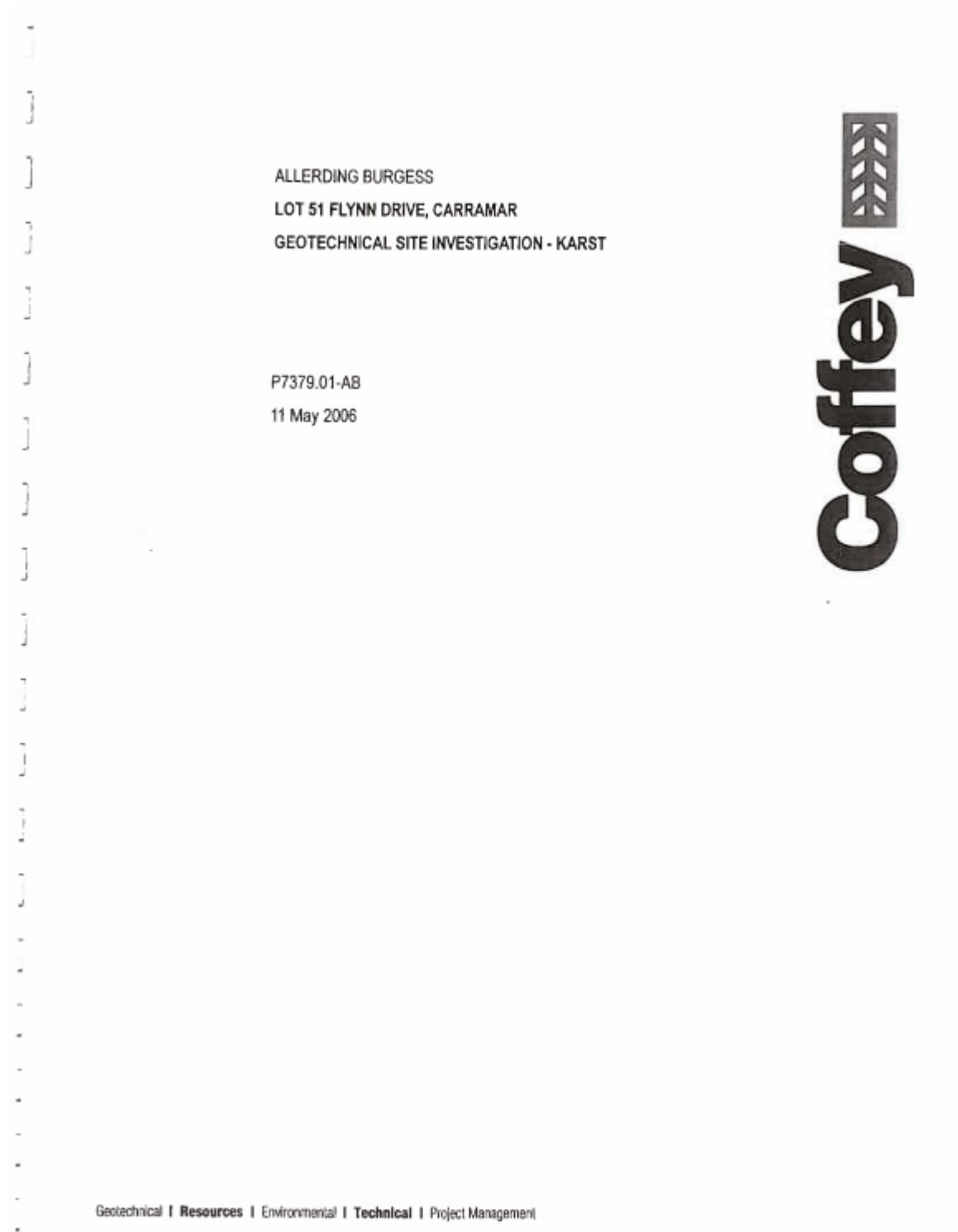
**Section B: TYPICAL BASIN 2 - SECTION B**  
 This section shows a cross-section of a basin with a 10% slope. The top surface is labeled 'PLANTING TO LANDSCAPE DETAILS'. The bottom surface is labeled 'PLANTING TO LANDSCAPE DETAILS'. The slope is indicated as 10%.





## Appendix B - Geotechnical Reports

### Geotechnical Site Investigation





P7379.01-AB  
11 May 2006

Allending Burgess  
310A Newcastle Street  
PERTH WA 6000

Attention: Mr Peter Fitzgerald

Dear Sir

RE: LOT 51 FLYNN DRIVE, CARRAMAR  
GEOTECHNICAL SITE INVESTIGATION - KARST

This letter presents our report on a geotechnical investigation carried out at the above site to assess geotechnical issues relating to karstic limestone.

If you have any questions related to the report or we can be of further assistance, please do not hesitate to contact Mr Philip Mather.

For and on behalf of  
COFFEY GEOSCIENCES PTY LTD

PHILIP MATHER

|               |                  |                                    |
|---------------|------------------|------------------------------------|
| Distribution: | Original held by | Coffey Geosciences Pty Ltd         |
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**Coffey Geosciences Pty Ltd** ACN 056 335 516

24 Hasler Road Hendsman  
WA 6017 Australia  
PO Box 1530  
Osborne Park Business Centre  
WA 6915 Australia  
Telephone +61 8 9347 0000  
Facsimile +61 8 9347 0099  
Email perth@coffey.com.au

P7379.01-AB  
11 May 2006

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Important Information About Your Coffey Report

### FIGURE

1 Test Location Plan

### APPENDICES

A RESULTS OF FIELD INVESTIGATION (1 page)

F:\Geotechnical\Jobs P7000 To P7500\P7379.01 Lot 51 Flynn Dve Karst\P7379.01-AB.Doc

P7379.01-AB  
11 May 2006

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## 1. INTRODUCTION

This report describes geotechnical studies carried out by Coffey Geosciences Pty Ltd (Coffey) for Loyalty Finance on the proposed project located at Lot 51 Flynn Drive, Carramar.

This work was commissioned by Mr Peter Fitzgerald of Allering Burgess on 24 March 2006.

This report is prepared and is to be read subject to the terms and conditions contained in our proposal dated 7 March 2006 and subsequent email message dated 22 March 2006. Our advice is based on the information stated and on the assumptions expressed herein. Should that information or the assumptions be incorrect then Coffey Geosciences Pty Ltd shall accept no liability in respect of the advice whether under law of contract, tort or otherwise.



## 2. PROPOSED DEVELOPMENT

It is understood that the project comprises sub division of the site into 7 special rural Lots.

## 3. OBJECTIVES

The objectives of the geotechnical investigation were to assess the following:

- Soil, rock and groundwater conditions within the significant foundation support zone and at the number of investigation stations specified within each building envelope area.
- An assessment of the potential for features associated with karst landforms within the site.
- Advice on footing design, drainage restrictions and development setbacks to limit the potential effects arising from karst features within each building envelope.

## 4. INFORMATION SUPPLIED BY OTHERS

Coffey has been provided with plans by Allering Burgess showing an aerial view of the site and the proposed subdivision layout.

## 5. FIELD AND LABORATORY WORK

### 5.1 General

Fieldwork was carried out on 13 April 2006 in the full time presence of personnel from Coffey and comprised a walk over assessment across the site and adjacent areas by an Associate Engineering Geologist and the completion of 6 Perth Sand Penetrometer (PSP) tests to depths of between 4.3m and 5.35m below existing ground surface. Test locations have been set out from existing site features shown on the aerial photograph and are shown on Figure 1. PSP test results are presented in Appendix A.

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## 6. SITE CONDITIONS

### 6.1 Surface Conditions

The site occupies an area of approximately 3ha and is situated in gently to moderately sloping topography with closed depressions characteristic of potential karstic areas on the Swan Coastal Plain. Apart from scattered large trees, the site has been largely cleared of natural vegetation. Surface soils comprise sand and the site appears well drained.

Existing site development consists of:

- An existing residence within the northern part of the site;
- Fencing;
- A road (former alignment of Wanneroo Road) located along the eastern boundary of the site;
- Piped reticulation system.

Access to the site was by foot from the existing road along the eastern boundary.

Limestone outcrop was observed to the west of the site on the other side of the current Wanneroo Road alignment. Surface karst features such as sink holes were not observed within the site.

### 6.2 Subsurface Conditions

The 1:50,000 Environmental Geology (Muehea) indicates that the site is within an area underlain by Tamala Limestone. In addition the site is mapped as being within a geomorphological zone described as "Interbarrier depression with prominent karstic phenomena".

The results of field testing indicate that the site is underlain by fine to medium grained, yellow, siliceous dune sand. PSP5 refused at a depth of 5.05m which is inferred to be the depth to limestone at that location. Testing indicated that the surface layer of sand is in a dense condition. Below about 1m depth the density index of the sand decreases and loose sand zones were encountered extending to depths in excess of 5m below ground surface.

### 6.3 Groundwater Levels

Groundwater was not encountered during the investigation.

The Perth Groundwater Atlas, published by the Water & Rivers Commission of Western Australia, indicates that the highest probable groundwater levels at the site are in the order of 20m below current ground surface.

## 7. DISCUSSION AND RECOMMENDATIONS

### 7.1 General

It should be noted that the ground encountered by the PSP testing represent the ground conditions at the location where the tests have been undertaken and as such are an extremely small proportion of the site to be developed. Accordingly, variations to the ground conditions are likely and allowance should be made for variability in the design and construction budgets.

The loose pockets formed by the weathering/collapse of limestone, are inferred to be at discrete locations distributed within the subsurface profile at the site. These loose pockets cannot be detected with geophysical exploration techniques known to Coffey. Detection by probing and drilling is "hit and miss" and is therefore not a definitive approach.

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11 May 2006

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## 7.2 Settlements

The effect of comparatively randomly distributed loose sand/collapsed features is that a significant risk exists of differential settlements to occur for loads partly over a deep loose sand/collapsed feature, and partly over dense sand. The magnitude of differential settlement can be judged by estimating the settlement that would take place as a result of a loose profile identified by the PSP field testing, and comparing this to the settlement that would take place if the loose zone did not exist in the overall profile.

Coffey has previously undertaken analysis using the Sydney University program FLEA5 (Finite Layer Elastic Analysis) to assess the settlement under the load of a residence (loads as defined in AS2870 parts 1 and 2). For analysis purposes, a house was assumed to extend over a 15m x 15m area, and exert a uniform load of 15kPa (representing a two storey structure). In addition, engineering judgement has been applied to assessing the potential for possible future settlement due to consolidation of loose and uncemented sand zones within the limestone inducing settlement within the overlying sand. Based on the results of PSP testing within the site the range of differential settlements is anticipated to be less than about 20mm.

A critical factor with regard to surface settlements within the potential karst area is that concentration of surface water runoff from roofs, roads and paved areas may induce or accelerate the flow of sand into subsurface voids leading to ground settlement.

## 7.3 Shallow Footings

A suitable approach to the design of residential structures for differential settlement of the magnitude outlined in Section 7.2 is to stiffen the footings and provide architectural relief to the structure (articulation of wall elements, use of flexible wall design such as masonry veneer rather than full masonry).

The range of magnitude of movement estimated for this site is similar to that anticipated for an "S" classification site as indicated by AS2870 – 1996, Table 2.3. Similar footing reinforcements would therefore be anticipated for structures within this site.

Builders should check compaction underneath proposed footings at the time of construction of residences and compact any localised loose zones identified. Earthworks should be carried out in accordance with AS3798-1996.

## 7.4 Surface Water Management

The infiltration of concentrated rainwater runoff from roofs, paved area and roads within potential karst areas such as Lot 51 Flynn Drive has the potential to affect foundation conditions, by mobilising (or causing to settle) the loose sands in the limestone discontinuities. For this reason the following constraints on residential development are recommended for this site:-

- Roof runoff may be discharged to soak wells, provided they are located a minimum 10m from any structure (including retaining walls, fences, driveways and roads).
- Runoff from paved areas should be shed widely onto grassed areas/ gardens and not at concentrated areas of infiltration.
- Provide a development (including road pavements) exclusion zone of at least 30m wide around the perimeter of all road stormwater drainage soakage basins.

## 8. IMPORTANT INFORMATION ABOUT YOUR COFFEY REPORT

The reader's attention is drawn to the important information about this report which follows the main text.

# Information

## Important information about your Coffey Report

*As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.*

### **Your report is based on project specific criteria**

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

### **Subsurface conditions can change**

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

### **Interpretation of factual data**

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by

earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

### **Your report will only give preliminary recommendations**

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

### **Your report is prepared for specific purposes and persons**

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

## Important information about your Coffey Report

### Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they have incorporated the report findings.

### Data should not be separated from the report\*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

### Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

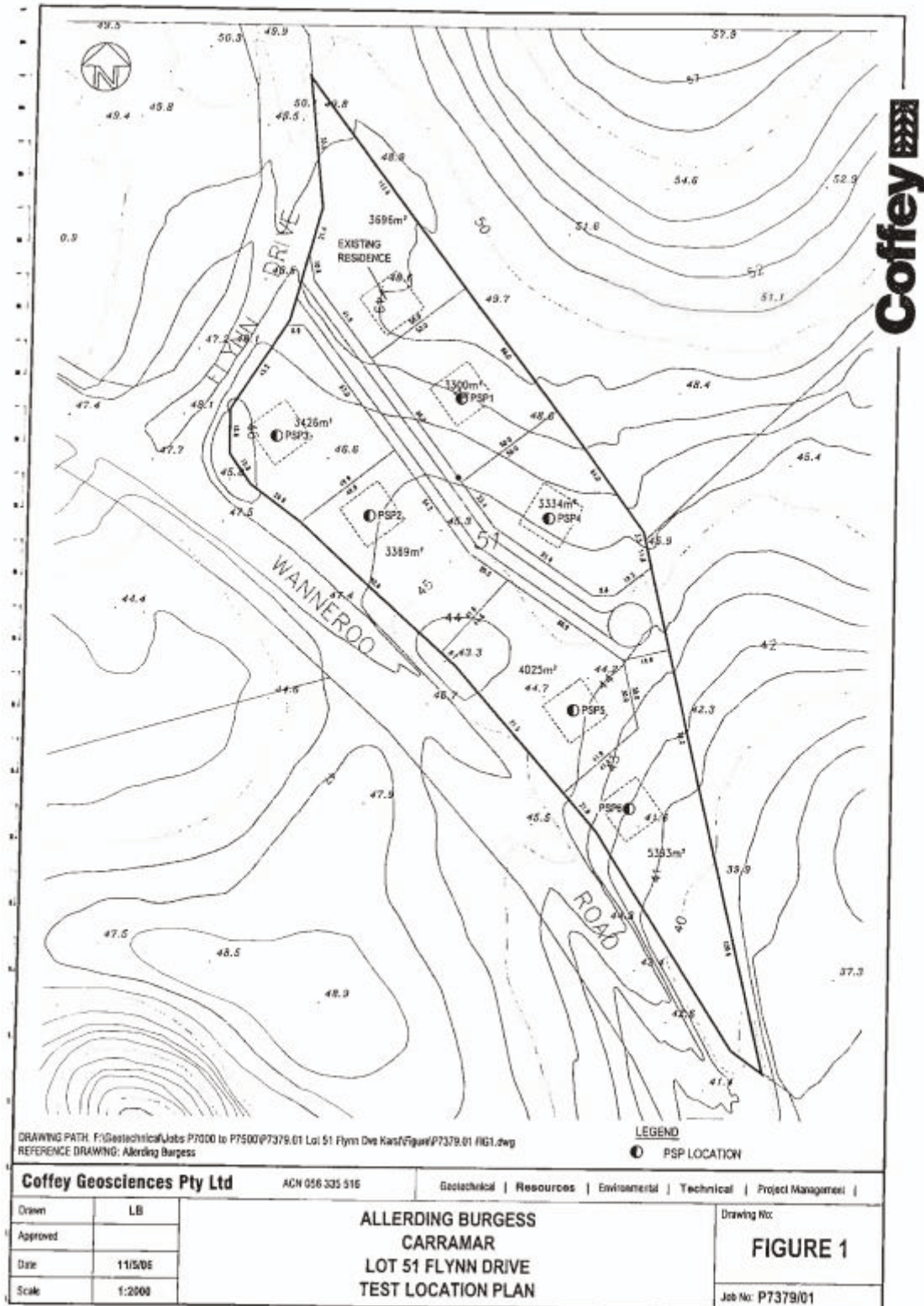
### Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design toward construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

### Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

*\* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by the Institution of Engineers Australia, National Headquarters, Canberra, 1987.*





P7379.01-AB  
11 May 2006

APPENDIX A  
RESULTS OF FIELD INVESTIGATION

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**Coffey** 

**Coffey Geosciences Pty Ltd** ACN 050 335 516

PERTH SAND PENETROMETER

AS1289.6.3.3 - 1997

SCALA PENETROMETER TEST

AS1289.6.3.2 - 1997

Test Report No. P7379.01-PSP.doc

Job No: P7379/01

Office: Perth

Client: Allering Burgess

Principal: :

Project: Lot 51 Flynn Drive

Location: Carramar

Soil type: Sand

Soil moisture:

Depth to water: &gt;5m

date: 13/4/06

tested by: PJM

hammer mass: 9kg

hammer drop: 600mm

penetrometer used: CP5

| Test Location | PSP1        | PSP2 | PSP3 | PSP4 | PSP5                | PSP6   |
|---------------|-------------|------|------|------|---------------------|--------|
| Test Depth mm | Blows/150mm |      |      |      |                     |        |
| 0-150         | Set         | Set  | Set  | Set  | Set                 | Set    |
| 150-300       | 11          | 5    | 10   | 9    | 12                  | 12     |
| 300-450       | 18          | 4    | 13   | 12   | 13                  | 10     |
| 450-600       | 13          | 3    | 10   | 11   | 12                  | HA Set |
| 600-750       | 12          | 3    | 8    | 8    | 9                   | 8      |
| 750-900       | 10          | 3    | 7    | 6    | 8                   | 6      |
| 900-1050      | 7           | 3    | 7    | 6    | 7                   | 6      |
| 1050-1200     | 8           | 3    | 7    | 5    | 5                   | 6      |
| 1200-1350     | 8           | 2    | 6    | 5    | 6                   | 6      |
| 1350-1500     | 8           | 3    | 6    | 6    | 7                   | 5      |
| 1500-1650     | 10          | 3    | 7    | 7    | 7                   | 5      |
| 1650-1800     | 9           | 3    | 6    | 5    | 8                   | 5      |
| 1800-1950     | 9           | 3    | 5    | 6    | 8                   | 4      |
| 1950-2100     | 9           | 3    | 5    | 6    | 7                   | 5      |
| 2100-2250     | 9           | 4    | 6    | 8    | 6                   | 4      |
| 2250-2400     | 10          | 3    | 8    | 8    | 7                   | 5      |
| 2400-2550     | 11          | 4    | 9    | 8    | 6                   | 5      |
| 2550-2700     | 10          | 4    | 8    | 8    | 8                   | 5      |
| 2700-2850     | 11          | 4    | 8    | 9    | 10                  | 6      |
| 2850-3000     | 10          | 4    | 9    | 9    | 10                  | 5      |
| 3000-3150     | 12          | 4    | 8    | 9    | 9                   | 5      |
| 3150-3300     | 12          | 5    | 8    | 9    | 8                   | 5      |
| 3300-3450     | 12          | 5    | 8    | 9    | 9                   | 6      |
| 3450-3600     | 12          | 5    | 7    | 9    | 9                   | 6      |
| 3600-3750     | 13          | 4    | 8    | 9    | 8                   | 6      |
| 3750-3900     | 12          | 4    | 7    | 10   | 9                   | 7      |
| 3900-4050     | 11          | 4    | 8    | 10   | 9                   | 6      |
| 4050-4200     | 11          | 3    | 9    | 11   | 10                  | 7      |
| 4200-4350     | (12)        | (4)  | (10) | (10) | 10                  | 5      |
| 4350-4500     |             |      |      |      | 9                   | 4      |
| 4500-4650     |             |      |      |      | 9                   | 4      |
| 4650-4800     |             |      |      |      | 9                   | 4      |
| 4800-4950     |             |      |      |      | 7                   | 4      |
| 4950-5100     |             |      |      |      | Refusal             | 4      |
| 5100-5250     |             |      |      |      | Bouncing @<br>5.05m | 4      |
| 5250-5300     |             |      |      |      |                     | (3)    |

Note: Testing was continuous without augering to target depth except where shown.

() indicates test interval of 100mm. Figure reported in brackets is equivalent result scaled up to 150mm interval

Signatory

P97-001

Issue:6

Rev:5

July 2000

F:\Geotechnical\Jobs P7000 To P7500\P7379.01 Lot 51 Flynn Dve Karst\Data\P7379.01-PSP.Doc

**Coffey**

## Karst Features Investigation

KEE CAR RZ.

45 Nautical Grove  
BELDON 6027  
20<sup>th</sup> February 2006

The Manager  
Allerding Burgess  
310A Newcastle Street  
PERTH 6000

21/22/06

Attention: Mr P Fitzgerald

LOT 51 FLYNN DRIVE, NEERABUP

Dear Sir,

The property was inspected on 15<sup>th</sup> February, with a view to ascertaining the presence of caves and/or karst features.

Since it was more or less known to the writer that there would be no actual caves on the property, the inspection focussed on the possibilities of karstic features suggesting the presence of hidden caves near the surface. Features sought included:

- (i) uneven ground, suggestive of fractures in the limestone, caused by cave subsidence,
- (ii) tuart trees, especially those adjacent to the uneven ground, indicating easy root access to the water table,
- (iii) hollows (incipient dolines) where solution has proceeded down a hidden vertical pipe,
- (iv) limestone caprocks standing "proud" of the soil, indicating soil has been slipping down to hidden cavities.

The inspection failed to find any of the above, in fact outcropping limestone was found to be infrequent, the largest patch being in the middle of the horse paddock. This patch projects only slightly above the soil, indicating soil has not been undermined. One or two small outcrops were also noted at the west end of the natural bushland patch in the middle of the property. The terrain as a whole has a gently undulating aspect throughout its general fall to the south, and no distinct hollows were found in it.

An additional feature noted was the presence of two shallow hollows adjacent to sprinklers, where the resident pointed out that pipes had burst. Similar events which occurred recently in known cave areas to the north, had in two cases resulted in serious collapse of the ground due to hidden caves, with development of deep vertical-sided pits several metres deep; and in another case a cloudburst event had opened up large holes in a roadside swale. The pipe burst events on this property again indicate that no hidden cavities were there for the soil to run into.

It was therefore concluded that the property has no hidden caves near the surface.

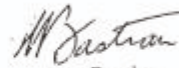
However, the possibility of caves at somewhat deeper levels cannot be discounted. This is supported by the fact that the property is directly aligned with the highly cavernous terrain along the western side of Lake Neerabup, the closest caves being less than one kilometre to the north.

There is also a collapsed cave doline on the eastern side of Wanneroo Road, some two-thirds of a kilometre to the south. The doline is less visible than it used to be, having once had a distinct cliff line on its northern side.

It is well known to cavers that most caves are found in lower terrain, because it is here that limestone fracturing associated with a cave will readily intersect the surface. Since this property is on much higher ground there may well be caves at deeper levels, with its elevation being the main reason for the absence of cave/karst features on the surface.

Therefore it is recommended that a ground-penetrating radar survey be carried out to (hopefully) dispose of this possibility.

Yours faithfully

A handwritten signature in black ink, appearing to read "Lex Bastian".

Lex Bastian

(L V Bastian, B.Sc, OAM)



## Drainage Assessment



### **LOT 51 FLYNN DRIVE, CARRAMAR DRAINAGE ASSESSMENT - KARST**

Burgess Design Group

GEOThERD7379.AB-AB rep  
16 February 2007

Coffey Geotechnics Pty Ltd ABN 93 056 929 483  
24 Hasler Road Hardsman WA 6017 Australia



16 February 2007

Burgess Design Group  
PO Box  
Address 2

Attention: Carolyn Vyner

RE: Lot 51 Flynn Drive Carramar - Drainage Assessment - Karst

This letter presents our report on a geotechnical investigation carried out at the above site.

If you have any questions related to the report or we can be of further assistance, please do not hesitate to contact Mr Philip Mather.

For and on behalf of Coffey Geotechnics Pty Ltd

PHILIP MATHER

|               |                  |                                    |
|---------------|------------------|------------------------------------|
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Coffey Geotechnics Pty Ltd ABN 93 056 929 483  
24 Hasler Road Hardsman WA 6017 Australia  
PO Box 1530 Osborne Park DC 6916 Australia  
T (+61) (8) 9347 0000 F (+61) (8) 9347 0099 [www.coffey.com.au](http://www.coffey.com.au)

GEOETHERD7379.AB-AB rep



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## ATTACHMENTS

### Figure

- 1 Drainage Basin Test Location Plan

### Appendices

- A Results MCP Testing (4 pages)

LOT 51 FLYNN DRIVE, CARRAMAR DRAINAGE ASSESSMENT - KARST

## 1 INTRODUCTION

This report describes geotechnical studies carried out by Coffey Geotechnics Pty Ltd (Coffey) for Mr Joshua Reece Hands on the proposed project located at Lot 51 Flynn Drive, Carramar.

This work was commissioned by Mr Peter Fitzgerald of Burgess Design Group on 3 November 2006.

This report is prepared and is to be read subject to the terms and conditions contained in our proposal dated 20 October 2006. Our advice is based on the information stated and on the assumptions expressed herein. Should that information or the assumptions be incorrect then Coffey Geotechnics Pty Ltd shall accept no liability in respect of the advice whether under law of contract, tort or otherwise.

## 2 PROPOSED DEVELOPMENT

It is understood that the project comprises subdivision of the site into 7 Special Rural lots. Coffey has undertaken previous investigations at the site as outlined in our report P7379.01-AB dated 11 May 2006. The previous work provided a karst assessment of the site and provided footing and drainage recommendations for the proposed lots. Following our earlier report a proposed drainage lot has been designated at the southern end of the site which will receive storm water runoff from roads to be constructed within the development.

## 3 OBJECTIVES

The objective of the current geotechnical investigation is to assess the suitability of the proposed drainage lot at the southern end of the site with respect to the presence of karst features.

## 4 FIELDWORK

Fieldwork was carried out on 8 December 2006 in the full time presence of personnel from Coffey and consisted of 3 Mechanical Cone Penetrometer (MCP) tests extending to depths of between 10.1m and 11.9m below existing ground surface levels. Test locations have been measured relative to existing site boundary fences and known site features and are shown on Figure 1.

Plots of the MCP tests are presented in Appendix A.

Access at the site was through a gate on Flynn Drive and along an existing sealed road way on the eastern side of the site. Limited clearing of vegetation was required to access the southern end of the site.

## 5 SITE CONDITIONS

### 5.1 Surface Conditions

The site occupies an area of 1692m<sup>2</sup> and is situated in gently sloping topography within the Coastal Belt of the Swan Coastal Plain. The site is well vegetated with low shrubs and scattered large trees. Surface soils comprise fine to coarse grained siliceous sand and appears well drained.

LOT 51 FLYNN DRIVE, CARRAMAR DRAINAGE ASSESSMENT - KARST

## 5.2 Subsurface Conditions

The 1:50,000 Environmental Geology (Yanchep Sheet) indicates that the site is within an area of Sand derived from Tamala Limestone. The site is mapped as being within a geomorphological zone described as "Interbarrier depression with prominent karstic phenomena".

The MCP testing intersected sand depths ranging between 8.3m to 11.8m below the existing ground surface. The sand is judged to be in a dense to medium dense condition. MCP refusal, inferred to be on well cemented limestone material occurred at depths of between 10.1m and 11.9m. The MCP probes penetrated between 0.2m and 2.0m into the underlying limestone and did not indicate the presence of any voids.

## 5.3 Groundwater Levels

Groundwater was not encountered during the investigation.

The Perth Groundwater Atlas, published by the Water & Rivers Commission of Western Australia, indicates that the highest probable groundwater levels at the site are in the order of 20m below current ground surface.

## 6 RECOMMENDATIONS

Results of the current investigation indicate that the site of the proposed drainage lot is underlain by approximately 10m of free draining sand, overlying Tamala Limestone. The groundwater level is in the order of 20m below the current ground surface. Loose sand zones, possibly associated with karst features within the underlying limestone have been encountered within other parts of the site during previous investigations but were not encountered at test locations within the proposed drainage lot. Previous geotechnical recommendations included a requirement to stiffen building footings (ie in excess of what would normally be required for a compacted sand site) and stormwater management to limit or control the concentration of stormwater runoff.

Our previous report recommended a 30m development exclusion zone around the perimeter of road stormwater soakage basins within the site. The currently proposed site layout incorporates a 1,692m<sup>2</sup> drainage lot at the southern end of the site that will be used for disposal of stormwater runoff from road pavements. The proposed layout provides a 30m set back from the adjacent proposed building envelope but only provides about 20m set back from the existing Wanneroo Road pavement and about 10m from the eastern site boundary. Despite this departure from the recommendations outlined in our report, the proposed layout is judged to adequately address the potential associated risks arising from karstic limestone features at depth for the following reasons:

- An approximately 10m thick layer of sand overlying the limestone will provide some attenuation of the rate of stormwater infiltration below the sump; and,
- The proposed drainage sump is within an area of the site which has for some time (~30+ years) received stormwater runoff from the former Wanneroo Road alignment along the eastern boundary of the site without the development of any surface observations of karstic features.

## 7 IMPORTANT INFORMATION ABOUT YOUR COFFEY REPORT

The reader's attention is drawn to the important information about this report which follows the main text.



## Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

### **Your report is based on project specific criteria**

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

### **Subsurface conditions can change**

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

### **Interpretation of factual data**

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by

earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

### **Your report will only give preliminary recommendations**

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

### **Your report is prepared for specific purposes and persons**

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.



## Important information about your **Coffey Report**

### **Interpretation by other design professionals**

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

### **Data should not be separated from the report\***

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

### **Geoenvironmental concerns are not at issue**

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

### **Rely on Coffey for additional assistance**

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

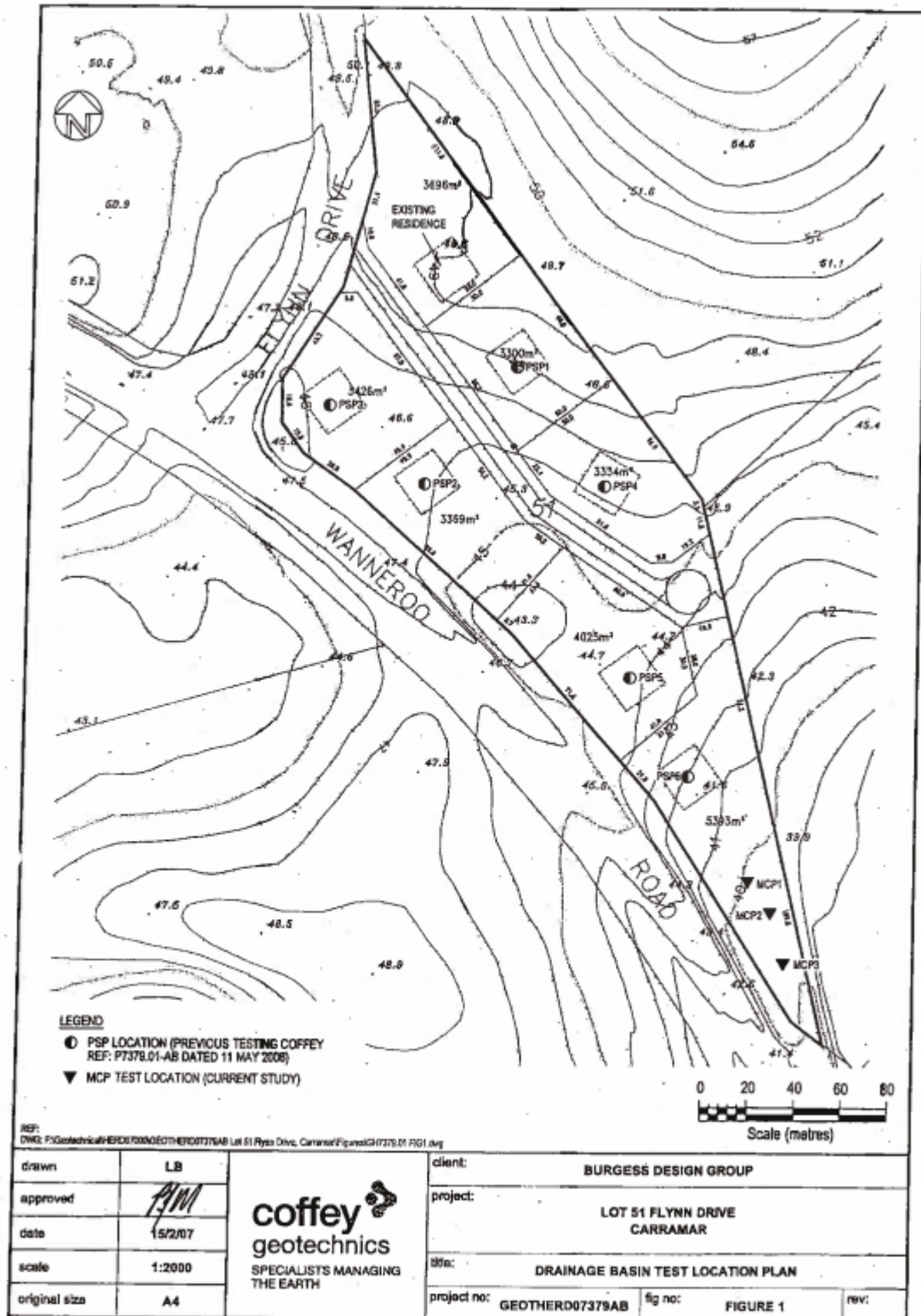
### **Responsibility**

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

\* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.



## Figures





## Appendix A

### Results MCP Testing



**PROBETEC PTY LTD**  
PO Box, 1312, Midland WA 6936  
Phone: 08 9250 8744 Fax: 08 9250 8755 e-mail: [probetec@westnet.com.au](mailto:probetec@westnet.com.au)

[illegible]



Contracted by Coffey Geosciences  
Description LOT 51 FLYNN DRIVE

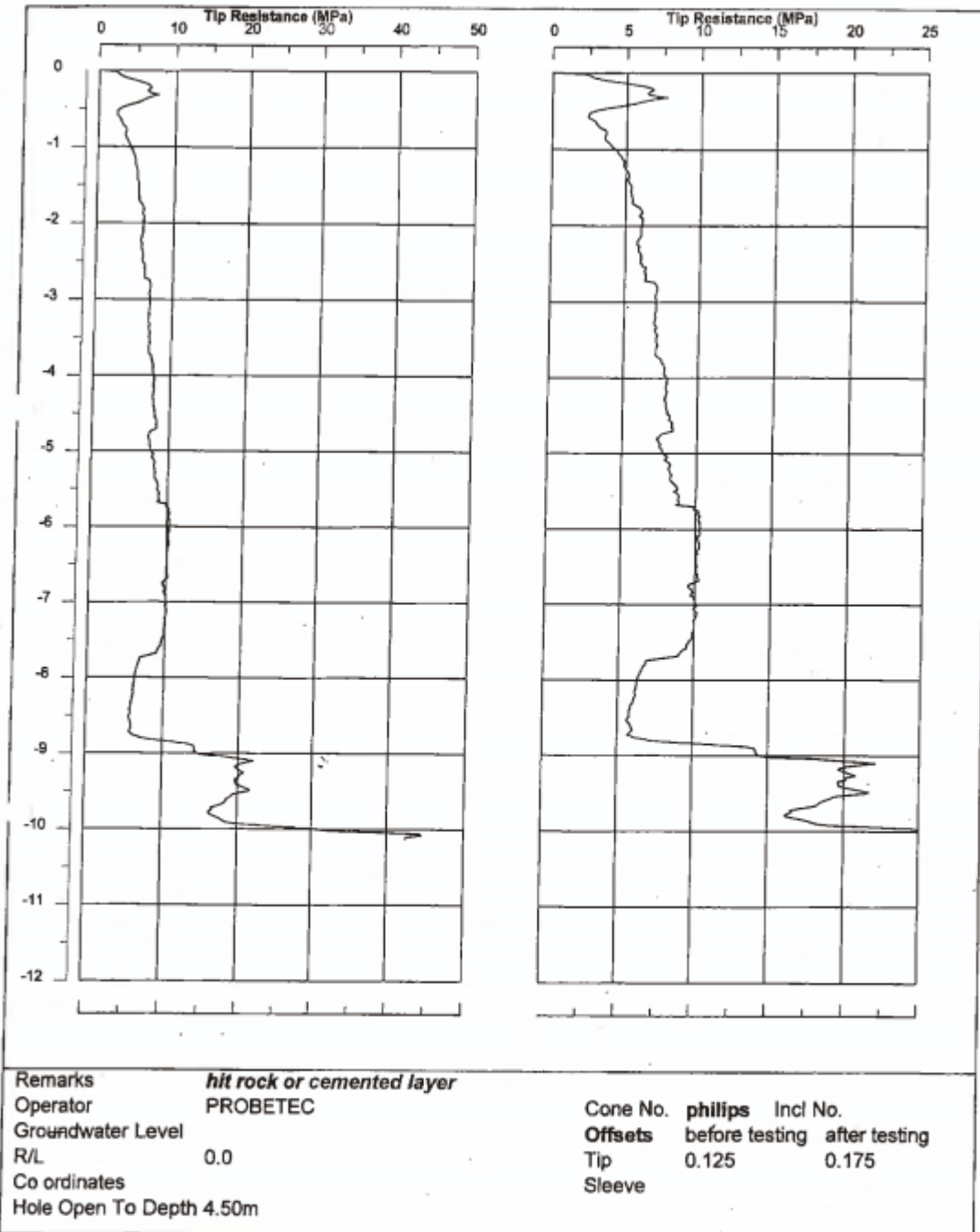
Job no. 0446

Date 8-12-2006

Test MCP 1

File 1

### MECHANICAL CONE PENETROMETER TEST



Telephone: (08) 9 2508744  
Facsimile: (08) 9 2508755  
E-mail: probetec@westnet.com.au

TESTED IN ACCORDANCE WITH AS 1289.6.5.1999  
FRICTION REDUCER USED -42 MM  
20 TONNE REACTION FRAME

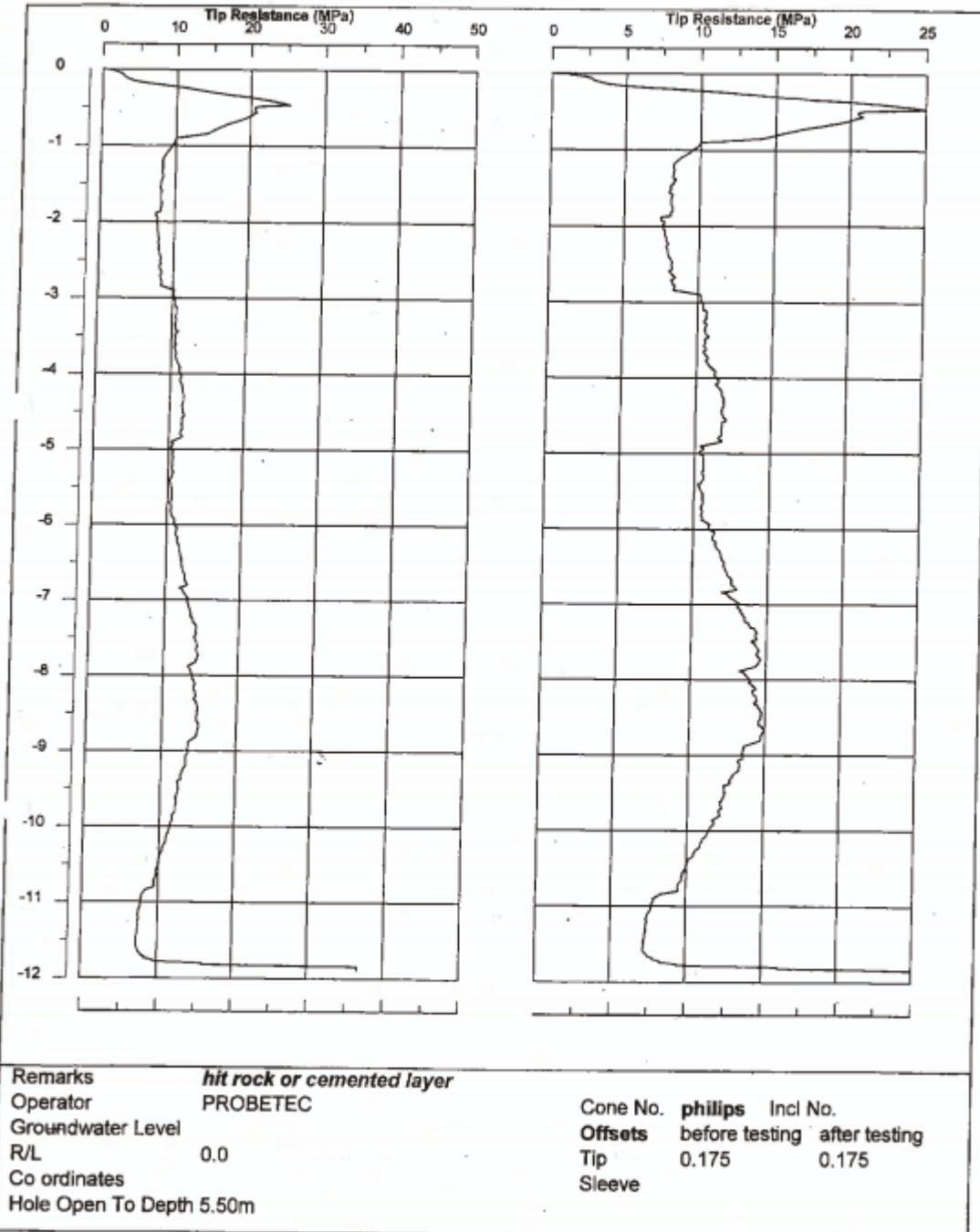


Contracted by Coffey Geosciences  
Description LOT 51 FLYNN DRIVE

Job no. 0446

Date 8-12-2006  
Test MCP 2  
File 2

### MECHANICAL CONE PENETROMETER TEST



Telephone: (08) 9 2508744  
Facsimile: (08) 9 2508755  
E-mail: probetec@westnet.com.au

TESTED IN ACCORDANCE WITH AS 1289.6.5.1999  
FRICTION REDUCER USED -42 MM  
20 TONNE REACTION FRAME

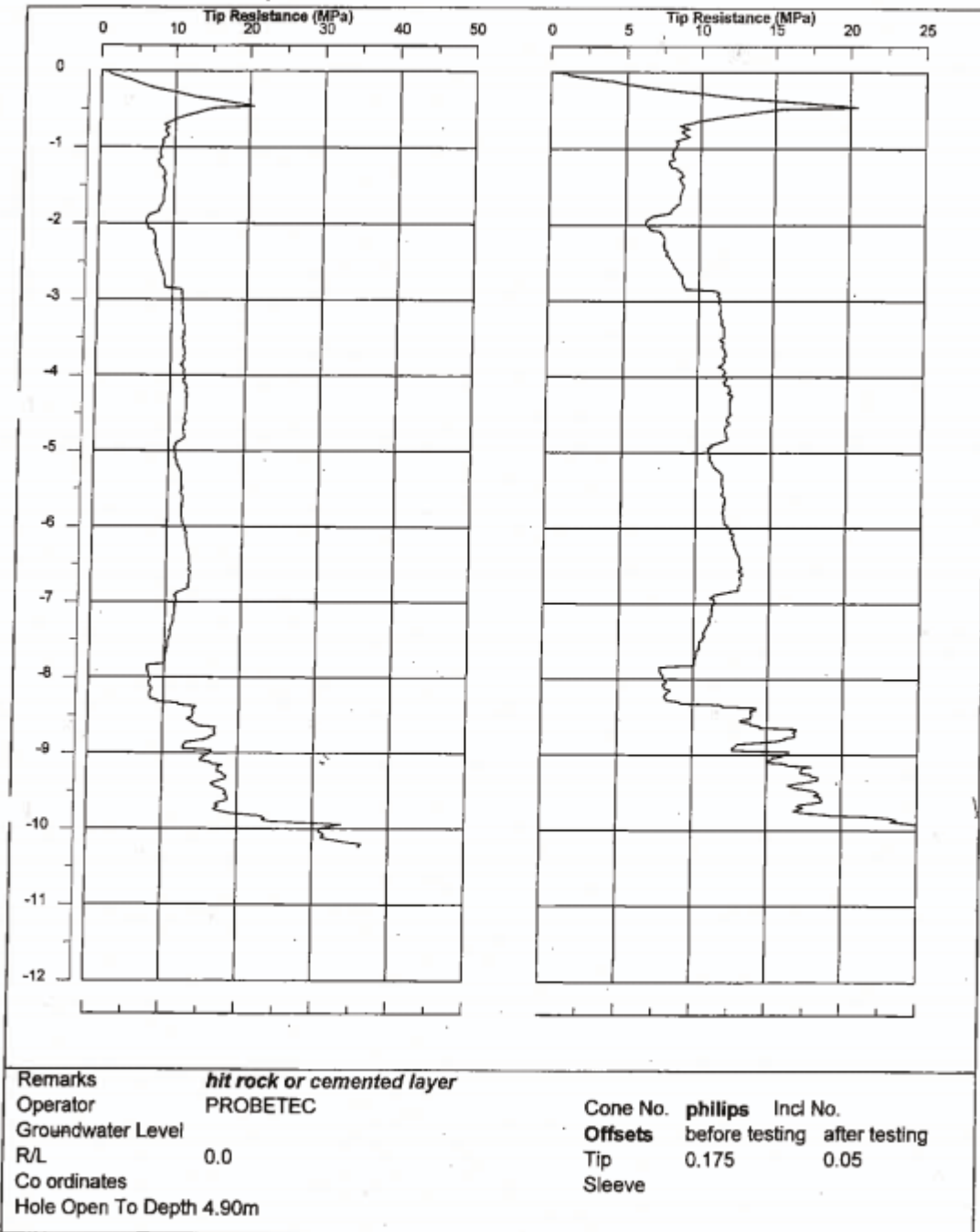


Contracted by Coffey Geosciences  
Description LOT 51 FLYNN DRIVE

Job no. 0446

Date 8-12-2006  
Test MCP 3  
File 3

### MECHANICAL CONE PENETROMETER TEST



Telephone: (08) 9 2508744  
Facsimile: (08) 9 2508755  
E-mail: probetec@westnet.com.au

TESTED IN ACCORDANCE WITH AS 1289.6.5.1999  
FRICTION REDUCER USED -42 MM  
20 TONNE REACTION FRAME

## Appendix C – Raingarden Calculations

The raingardens are sized for the 1 year 1 hour storm. The rainfall intensity value used in the calculations is from the Intensity Frequency Duration (IFD) table shown in Table 1, and the runoff coefficient is from the table shown below, both tables were sourced from the City of Wanneroo Development Design Specification<sup>7</sup> (2015).

| Input Variables                 |        |
|---------------------------------|--------|
| Rainfall Intensity i (mm/h)     | 15.96  |
| Runoff Road/Verge Coefficient C | 0.8    |
| Permeability k (m/hr)           | 0.2083 |
| Raingarden Width W (m)          | 1.85   |
| Raingarden Storage Depth (m)    | 0.25   |

| Table 2 Run-off Coefficients for Sandy Soils |                           |
|----------------------------------------------|---------------------------|
| Development Type                             | Run-off Coefficient       |
| Road Reserve (up to and equal to 40m)        | 0.80 (Full Reserve Width) |
| Road Reserve (greater than 40m)              | 0.65 (Full Reserve Width) |
| Industrial Lots                              | 0.9 – 0.95                |
| Shopping Centre Lots                         | 0.9 – 0.95                |
| City Centre Lots                             | 0.9                       |
| Small Lot Subdivisions (<300sqm)             | 0.95 – 1.0                |

| Catchment | Road/Verge Area A (m <sup>2</sup> ) | Road/Verge Area A (ha) | Ai (m <sup>2</sup> ) | Q (L/s) | V <sub>inflow</sub> (m <sup>3</sup> ) | L (m) | V <sub>infil</sub> (m <sup>3</sup> ) | V <sub>stored</sub> (m <sup>3</sup> ) | Area Provided (m <sup>2</sup> ) | 2% Area (check) |
|-----------|-------------------------------------|------------------------|----------------------|---------|---------------------------------------|-------|--------------------------------------|---------------------------------------|---------------------------------|-----------------|
| 1         | 1820.41                             | 0.182                  | 1456.33              | 6.46    | 23.26                                 | 27.43 | 10.57                                | 12.69                                 | 50.75                           | 36.41           |
| 2         | 1369.80                             | 0.137                  | 1095.84              | 4.86    | 17.50                                 | 20.64 | 7.96                                 | 9.55                                  | 38.19                           | 27.40           |
| 3         | 1396.01                             | 0.140                  | 1116.81              | 4.96    | 17.84                                 | 21.04 | 8.11                                 | 9.73                                  | 38.92                           | 27.92           |
| 4         | 1369.88                             | 0.137                  | 1095.90              | 4.86    | 17.50                                 | 20.64 | 7.96                                 | 9.55                                  | 38.19                           | 27.40           |
| 5         | 0.00                                | 0.000                  | 0.00                 | 0.00    | 0.00                                  | 0.00  | 0.00                                 | 0.00                                  | 0.00                            | 0.00            |
| 6         | 1276.27                             | 0.128                  | 1021.02              | 4.53    | 16.31                                 | 19.23 | 7.41                                 | 8.90                                  | 35.58                           | 25.53           |
| 7         | 1575.98                             | 0.158                  | 1260.78              | 5.59    | 20.14                                 | 23.75 | 9.15                                 | 10.98                                 | 43.94                           | 31.52           |
| 8         | 0.00                                | 0.000                  | 0.00                 | 0.00    | 0.00                                  | 0.00  | 0.00                                 | 0.00                                  | 0.00                            | 0.00            |

<sup>7</sup> City of Wanneroo, 2015, Development Design Specification WD5 Stormwater Drainage Design, City of Wanneroo, Wanneroo, Western Australia.

## **APPENDIX 5: Karst Assessment**





## **APPENDIX 6: Bushfire Management Plan**

**WOODLAND VISTA  
LOT 51 (No.575) FLYNN DRIVE, CARRAMAR**

**CITY OF WANNEROO**

**BUSHFIRE MANAGEMENT PLAN**

Issue 5: October 2016

Prepared for: **Woodland Consortium Pty Ltd**

Prepared by: Burgess Design Group  
101 Edward Street, Perth, 6000  
PO Box 8779, Perth Business Centre, W.A., 6849  
Telephone: (08) 9328 6411  
Facsimile: (08) 9328 4062  
Website: [www.burgessdesigngroup.com.au](http://www.burgessdesigngroup.com.au)  
Email: [reception@burgessdesigngroup.com.au](mailto:reception@burgessdesigngroup.com.au)

Project Planner: Mark Szabo  
Job code: LAK CAR  
File reference: 161021R\_Bushfire Management Plan (v5).docx  
Revision No: 5 (updated to reflect the Guidelines (December 2015))

Quality Assurance

| Issue/Version: | Date:    | Author:     | Reviewer:  |
|----------------|----------|-------------|------------|
| 5              | 21.10.16 | Mitch Bisby | Mark Szabo |
|                |          |             |            |

**DISCLAIMER**

Any representations, statements, opinions and advice whether expressed or implied within this document are based on information contained within the *Guidelines for Planning in Bushfire Prone Areas* (December 2015), the *Australian Standard for the construction of buildings in bushfire prone areas* (AS3959-2009), and an analysis of the land undertaken in 2013/2014.

Any statements, opinions, representations or advice expressed or implied in this document is made in good faith, and on that basis Burgess Design Group is not liable for any damage or loss whatsoever which may occur as a result of action taken or not taken as the case may be in respect to any statements, opinions, representations or advice referred to in this report.

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## Abbreviations:

|              |                                                                                           |
|--------------|-------------------------------------------------------------------------------------------|
| APZ          | - Asset Protection Zone                                                                   |
| AS3959-2009  | - Australian Standard: <i>Construction of Buildings in Bushfire Prone Areas</i> 3959-2009 |
| BAL          | - Bushfire Attack Level                                                                   |
| BHL          | - Bushfire Hazard Level                                                                   |
| BMP          | - Bushfire Management Plan                                                                |
| Guidelines   | - <i>Guidelines for Planning in Bushfire Prone Areas</i> (December 2015)                  |
| HSZ          | - Hazard Separation Zone                                                                  |
| SPP3.7       | - State Planning Policy 3.7 <i>Planning in bushfire Prone Areas</i> (December 2015)       |
| Subject site | - Lot 51 Flynn Drive, Carramar                                                            |

## 1. INTRODUCTION

This Bushfire Management Plan (BMP) has been prepared on behalf of Woodland Consortium Pty Ltd, the registered landowner of Lot 51 Flynn Drive, Carramar (the subject site) (refer **Figure 1**), to support the 'Woodland Vista' Local Structure Plan (refer **Figure 2**).

This BMP demonstrates compliance with the policy measures of State Planning Policy 3.7 *Planning in Bushfire Prone Areas* (December 2015) (SPP3.7), and has been prepared in accordance with the WAPC's *Guidelines for Planning in Bushfire Prone Areas* (December 2015) (Guidelines).

The Site is located within a designated Bushfire Prone Area, being an area designated by the Fire and Emergency Services Commissioner under the *Fire and Emergency Services Act 1998* and shown on the DFES Map of Bushfire Prone Areas. The Bushfire Hazard Level applicable to the site has been assessed as 'moderate' to 'extreme'. The bushfire risk is considered to be manageable.

Bushfire risk management measures will be implemented in accordance with the acceptable solutions listed in Appendix 4 of the Guidelines as detailed herein. This includes establishing appropriate Asset Protection Zones (APZ) and Hazard Separation Zones (HSZ) or the use of Bushfire Attack Level (BAL) Construction Standards, as applicable, in accordance with Australian Standard: *Construction of Buildings in Bushfire Prone Areas* 3959-2009 (AS3959-2009).

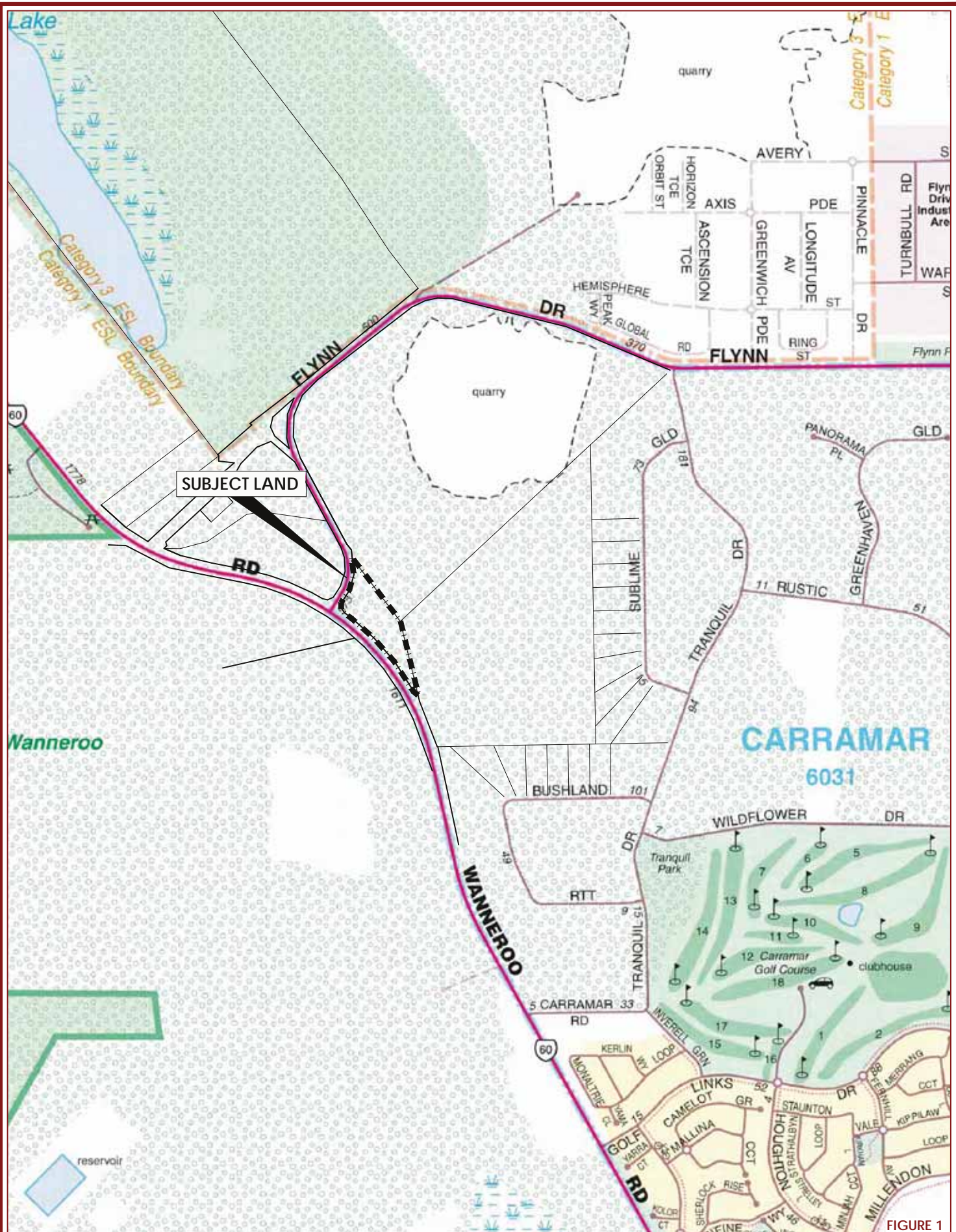


FIGURE 1



LEGEND

 Subject Site

0 25 50 75 100  
SCALE 1:2,500 (A4)



NORTH

Planner: KM  
Client: LAKESHORE BUILDERS

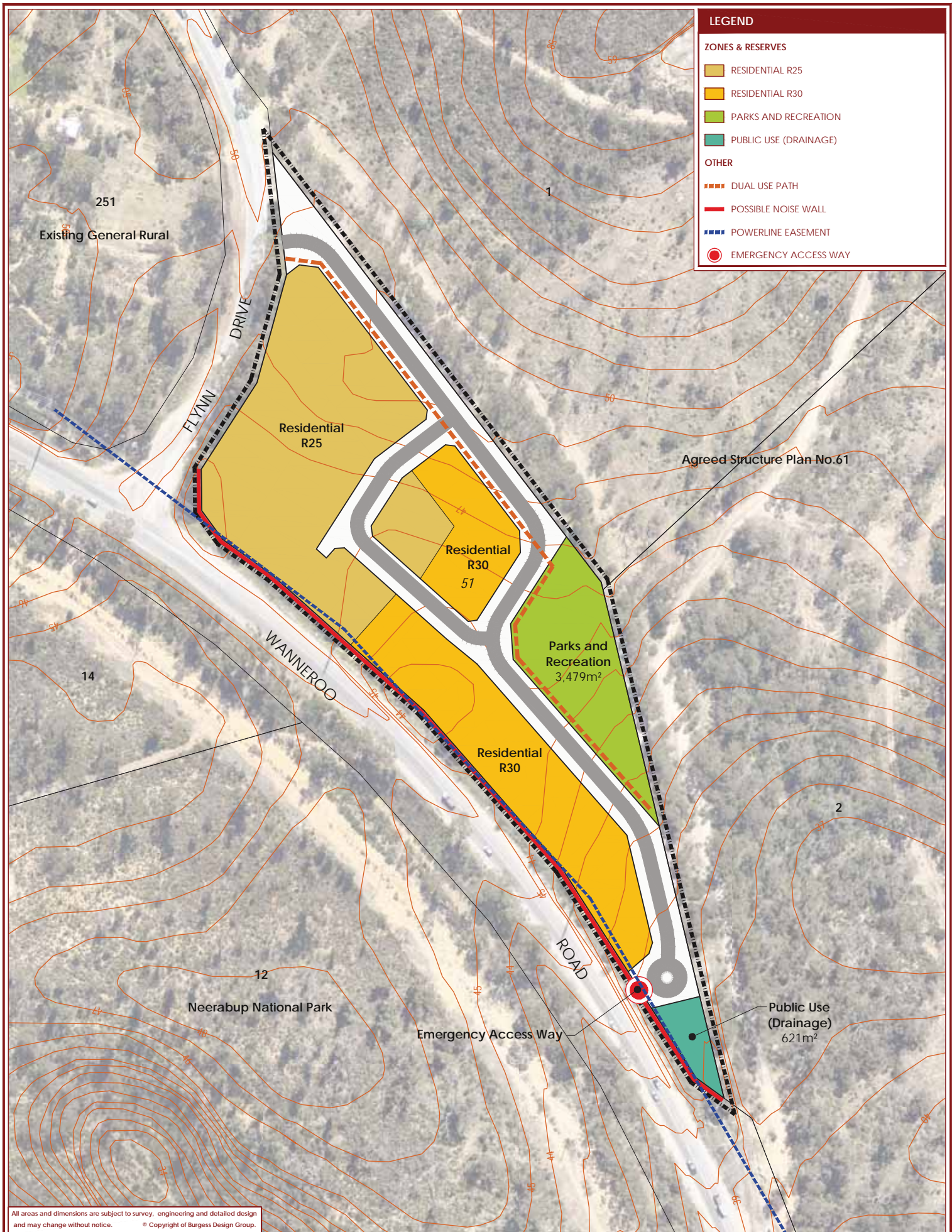
Date: 07.04.14  
Plan No: LAK CAR 2-01f

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www.burgessdesigngroup.com.au

P (08) 9328 6411  
F (08) 9328 4062

**LOCAL LOCATION**  
**LOT 51 FLYNN DRIVE**  
**CARRAMAR**  
**CITY OF WANNEROO**



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Plan No: LAK CAR 02-03-01 Client: Woodland Consortium  
Date: 14.10.16 Planner: MS/MB



NORTH

0 10 20 30 40 50m

SCALE 1:1,500 (A3)

## 2. POLICY REQUIREMENTS

### 2.1 STATE PLANNING POLICY 3.7

SPP3.7 provides a foundation for planning in bushfire prone areas in Western Australia and sets out policy measures and information requirements to assess and plan for the mitigation of bushfire risk.

The Policy Measures of SPP3.7 apply where:

- Development is proposed within a designated bushfire prone area;
- The Bushfire Hazard Level (BHL) or Bushfire Attack Level (BAL) is or will be above 'Low'; and/or
- Development is proposed that may introduce a bushfire hazard.

SPP3.7 provides that strategic planning proposals shall be accompanied by the following information:

- The results of a BHL assessment;
- Where the lot layout is known, a BAL Contour Map;
- The identification of any bushfire hazard issues; and,
- Demonstration that compliance with the Guidelines can be achieved in subsequent planning stages.

The subject site is located within a designated bushfire prone area, and as such, is subject to the policy measures and information requirements of SPP3.7. A summary of compliance with the objectives and policy measures of SPP3.7 is provided in Table 1 overleaf.

| Table 1: Compliance with State Planning Policy 3.7                                                                                       |            |               |                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------|------------|---------------|----------------------------------------------------------------------------------------------|
| Policy Measure                                                                                                                           | Compliance |               | Comments                                                                                     |
|                                                                                                                                          | Y/N        | Section       |                                                                                              |
| SPP 3.7: Planning in Bushfire Prone Areas                                                                                                |            |               |                                                                                              |
| Policy objectives                                                                                                                        |            |               |                                                                                              |
| 5.1: Avoid any increase in the threat of bushfire                                                                                        | Y          | 4.0, 5.2      | Bushfire management measures will avoid any increase to the threat of bushfire.              |
| 5.2: Identify and consider risks at all levels of planning                                                                               | Y          | All           | Risks & management measures have been identified                                             |
| 5.3: Ensure bushfire management measures are considered at the strategic level                                                           | Y          | 5.0           | Management measures form an integral part of the Structure Plan                              |
| 5.4: Achieve a balance between environmental values, landscape character and bushfire management measures                                | Y          | 3.0           | Management measures form part of an integrated strategy to maximise amenity and safety.      |
| Policy measures                                                                                                                          |            |               |                                                                                              |
| 6.1: Higher order strategic planning documents                                                                                           | N/A        |               |                                                                                              |
| 6.2: Strategic planning proposals, subdivisions and development applications                                                             | Y          | 3.0           | The bushfire risk has been assessed as moderate to extreme, and will likely be above BAL-LOW |
| 6.3: Information to accompany strategic proposals                                                                                        | Y          | 3.0, 4.0, 5.0 |                                                                                              |
| 6.4: Information to accompany subdivision applications                                                                                   | N/A        |               |                                                                                              |
| 6.5: Information to accompany development applications                                                                                   | N/A        |               |                                                                                              |
| 6.6: Vulnerable or high-risk land uses                                                                                                   | N/A        |               | None proposed                                                                                |
| 6.7: Strategic planning proposals, subdivision or development applications in areas where an extreme BHL and/or BAL-40 or BAL-FZ applies | N/A        |               |                                                                                              |
| 6.8: Advice of State/relevant authority/s for emergency services to be sought                                                            | N/A        |               |                                                                                              |
| 6.9: Advice of State/relevant authority/s for environmental protection to be sought                                                      | N/A        |               |                                                                                              |
| 6.10: Bushfire conditions may be imposed                                                                                                 | Y          | 6.0           | The WAPC is identified as being responsible for imposing suitable conditions.                |
| 6.11: Precautionary principle                                                                                                            | N/A        |               | The policy measures have been addressed.                                                     |

### **3. ASSESSMENT OF BUSHFIRE RISK**

#### **3.1 BUSHFIRE HAZARD LEVEL ASSESSMENT**

A BHL Assessment, undertaken in accordance with the methodology set out in the Guidelines, can be found at **Figure 3**. Vegetation classifications were made following a physical site inspection, and in accordance with the methodology set out in AS3959-2009.

The BHL applicable to the site and its surrounds has been assessed as 'moderate' to 'extreme'. The BHL within the site can be managed for the life of the development through the implementation of appropriate vegetation management practices by the responsible landowners. The BHL of vegetation surrounding the site can be mitigated through the application of sufficient BAL construction standards and APZ's and HSZ's.

#### **3.2 BAL CONTOUR MAP**

As the site falls [partially] within an area of 'extreme' bushfire risk, an indicative BAL Contour Map has been prepared and can be found at **Figure 4**.

The BAL Contour Map demonstrates that the site is capable of being developed without requiring construction to BAL-40 or BAL-FZ standards. This is largely due to a risk-based approach to the design of development, whereby perimeter roads have been employed to maximise the separation to surrounding bushfire hazards.

#### **3.3 ANTICIPATED VEGETATION CHANGES**

##### **3.3.1 WITHIN THE SITE**

The majority of the site will be cleared as part of subdivisional works to accommodate urban residential land uses. Furthermore, the design, development and management of public roads, recreation areas and private lots shall have regard for bushfire risk. This is likely to have the effect of changing the BHL within the site to 'Low'.

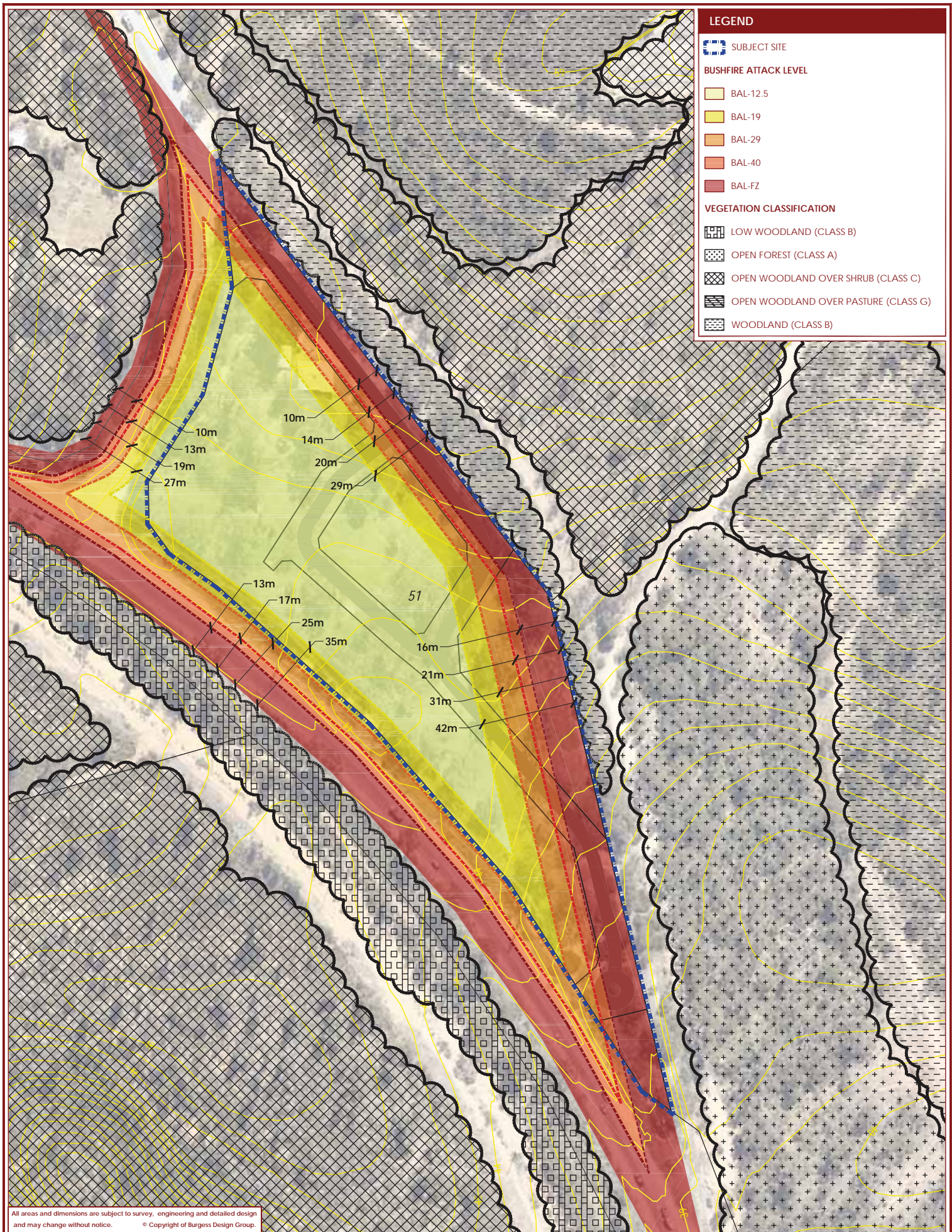
This will be considered as part of any future BAL Contour Assessments prepared to support subdivision applications over the site.

##### **3.3.2 SURROUNDING THE SITE**

Land abutting the eastern and north eastern boundaries of the site is zoned to accommodate 'Urban Development', and falls within the City of Wanneroo's Agreed Structure Plan No.61; which designates predominantly 'Special Residential' and 'Residential' land uses over the site. The development of that land for residential purposes will likely have the effect of reducing the bushfire risk to 'Low'. However, as this adjoining land falls outside of the Woodland Vista Local Structure Plan area, there is no mechanism to compel ongoing management of that land. As such, the bushfire risk can only be assessed in its current state.

Land abutting the north western boundary of the site is zoned 'General Rural', and land to the west of the site is reserved for 'Parks and Recreation'. No change is anticipated to vegetation within that land.





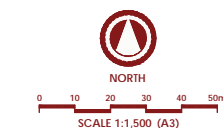
**FIGURE 4: BUILDING ATTACK LEVEL CONTOUR PLAN**  
**WOODLAND VISTA LSP, LOT 51 FLYNN DRIVE**  
**CARRAMAR**  
**CITY OF WANNEROO**



**BUROESS** DESIGN GROUP  
 TOWN PLANNING • URBAN DESIGN

PO Box 8779, Perth Business Centre 6849  
 www.burgessdesigngroup.com.au

P (08) 9328 6411  
 F (08) 9328 4062



Plan No: LAK CAR 09-01-02 Client: WOODLAND CONSORTIUM  
 Date: 11.10.16 Planner: MS/MB

## 4. BUSHFIRE PROTECTION CRITERIA

A summary of compliance with the Bushfire Protection Criteria listed at Appendix 4 of the Guidelines is provided in **Table 2** below.

| Table 2: Compliance with the Bushfire Protection Criteria                                                                                                                                 |                                                                                                                                                                           |            |                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Acceptable Solutions                                                                                                                                                                      | Explanatory Notes                                                                                                                                                         | Compliance |                                                                                                                                                                                                                                                                         |
|                                                                                                                                                                                           |                                                                                                                                                                           | Y/N        | Comment                                                                                                                                                                                                                                                                 |
| <b>Element 1: Location</b>                                                                                                                                                                |                                                                                                                                                                           |            |                                                                                                                                                                                                                                                                         |
| Development is located in an area where the BHL is or will be 'low' or 'moderate' and the risk is manageable.                                                                             |                                                                                                                                                                           |            |                                                                                                                                                                                                                                                                         |
| <b>A1.1:</b><br>Development is located in an area where the BHL is or will be 'low' or 'moderate', or the BAL classification is BAL-29 or below.                                          | Development, other than 'minor' or 'unavoidable' development, will not be permitted within an extreme BHL area, or be subject to BAL-40 for BAL-FZ construction standards | Y          | The bushfire risk can be managed through the application of appropriate BAL construction standards; maintaining the necessary separation distance from classified vegetation; and, maintaining suitable Asset Protection Zones (APZ).                                   |
| <b>Element 2: Siting and Design</b>                                                                                                                                                       |                                                                                                                                                                           |            |                                                                                                                                                                                                                                                                         |
| Siting and design of development minimises the level of bushfire impact                                                                                                                   |                                                                                                                                                                           |            |                                                                                                                                                                                                                                                                         |
| <b>A2.1: APZ</b><br>Every building is surrounded by a 20m minimum APZ, or such a distance that is sufficient to ensure the potential radiant heat impact does not exceed 29kW/m².         | The APZ is a low fuel area surrounding habitable or specified buildings designed to minimise the likelihood of direct flame contact.                                      | Y          | The proposed development will be able to meet the acceptable solutions.                                                                                                                                                                                                 |
| <b>A2.2: HSZ</b><br>Every building and its APZ is surrounded by an 80m (30m for unmanaged grassland) minimum HSZ; or buildings are constructed to appropriate BAL construction standards. | A HSZ should be provided to diminish fire intensity as it approaches development                                                                                          | Y          | The proposed development will be able to meet the acceptable solutions through application of BAL construction standards.                                                                                                                                               |
| <b>Element 3: Vehicular Access</b>                                                                                                                                                        |                                                                                                                                                                           |            |                                                                                                                                                                                                                                                                         |
| Vehicular access to and from a development is available and safe during a bushfire event                                                                                                  |                                                                                                                                                                           |            |                                                                                                                                                                                                                                                                         |
| <b>A3.1: Two Access Routes</b><br>Two different access routes are provided, allowing safe access to the public road network and egress to two different destinations.                     | Two points of access must be provided to allow safe access and egress in the event one becomes blocked.                                                                   | Y          | Development provides two points of access to the public road network, one to Flynn Drive in the form of a public subdivisional road, and another to Wanneroo Road in the form of an emergency access way.                                                               |
| <b>A3.2: Public Road</b><br>Roads shall meet the standards set out in Table 4, Column 1 of the Guidelines.                                                                                | All public roads to allow safe use by two wheel drive vehicles and fire appliances.                                                                                       | Y          | The proposed development will be able to meet the acceptable solutions.                                                                                                                                                                                                 |
| <b>A3.3: Cul-de-sac</b><br>A cul-de-sac shall not exceed 200 metres in length, or 600 metres provided no more than 8 lots are serviced and an emergency access way is provided.           | Cul-de-sac subdivision layouts are not favoured in bushfire prone areas because they do not provide access in different directions.                                       | Y          | The proposed development includes a cul-de-sac accessed from an internal subdivisional road measuring approximately 150m in length. An emergency access way is provided at the end of this cul-de-sac for access to Wanneroo Road in the event of a bushfire emergency. |

| Table 2: Compliance with the Bushfire Protection Criteria                                                                                                                                                                                                              |                                                                                                                                                                                         |            |                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------------------------------------------------------------|
| Acceptable Solutions                                                                                                                                                                                                                                                   | Explanatory Notes                                                                                                                                                                       | Compliance |                                                                                                                |
|                                                                                                                                                                                                                                                                        |                                                                                                                                                                                         | Y/N        | Comment                                                                                                        |
| <b>A3.4: Battle-axe</b><br>Battle-axe legs should be avoided in bushfire prone areas. Where no alternative exists, development shall meet the standards set out in A3.4 of the Guidelines                                                                              | Battle-axe legs should be avoided because they do not provide two way access.                                                                                                           | N/A        | No battle-axe legs are proposed                                                                                |
| <b>A3.5: Private Driveway</b><br>A private driveway is to meet the requirements of A3.5 of the Guidelines                                                                                                                                                              | Driveways longer than 50 metres must meet the standards to allow fire appliances to gain access.                                                                                        | N/A        |                                                                                                                |
| <b>A3.6: Emergency Access Way</b><br>An access way that does not provide access to a public road is to be avoided in bushfire prone areas. In no alternative exists, an emergency access way may be provided subject to the requirements of A3.5 of the Guidelines     | An emergency access way is not a preferred option. However, where no alternative exists, one may be used to provide alternative access and egress in the event of a bushfire emergency. | Y          | The proposed emergency access way shall be constructed in accordance with standards set out in the Guidelines. |
| <b>3.7: Fire Service Access Routes</b><br>Fire service access routes provide access within and around the edge of a subdivision and provide a direct link with the public road network. Such routes shall comply with the standards set out in A3.7 of the Guidelines. | Fire service access routes should be established to separate bushfire prone areas from developed areas and to provide access for fire suppression and prevention work.                  | N/A        | Note: Public roads (proposed & existing) abut the site along most boundaries.                                  |
| <b>3.8: Firebreak Width</b><br>Lots greater than 0.5ha shall have an internal firebreak as specified by the local firebreak notice issued by the local government                                                                                                      |                                                                                                                                                                                         | Y          | The proposed development will comply with the annual firebreak notice issued by the City of Wanneroo.          |
| <b>Element 4: Water</b><br>Sufficient water is available to the development to enable people, property and infrastructure to be defended from bushfire.                                                                                                                |                                                                                                                                                                                         |            |                                                                                                                |
| <b>A4.1: Reticulated Areas</b><br>Development is provided with a reticulated water supply.                                                                                                                                                                             | Reticulated water supply is provided in accordance with the Water Corporation's No.63 Water Reticulation Standard' or equivalent.                                                       | Y          | The development will be serviced with reticulated water to a sufficient standard.                              |
| <b>A4.2: Non-Reticulated Area</b><br>Water tanks shall be provided to the specifications of A4.2 of the Guidelines                                                                                                                                                     | Where reticulated water is not available, water tanks, to a sufficient capacity, shall be provided.                                                                                     | N/A        |                                                                                                                |
| <b>A4.3: Individual lots within a non-reticulated area</b><br>Single lots to provide 10,000 litre capacity tank                                                                                                                                                        |                                                                                                                                                                                         | N/A        |                                                                                                                |

## **5. BUSHFIRE RISK MANAGEMENT MEASURES**

### **5.1 SITING OF DEVELOPMENT AND BAL CONSTRUCTION STANDARDS**

Future habitable and specified buildings shall be located such that they fall outside of any areas with an 'extreme' BHL and/or achieve a BAL classification of BAL-29 or below.

Development has been designed to minimise bushfire risk and maximise separation to bushfire hazards through the strategic use of existing and proposed perimeter roads, and the siting of Public Open Space. Public roads, recreational areas and private lots shall be developed to minimise BHL's.

When the final lot layout and/or location of buildings are known, a final assessment should be completed to determine the appropriate BAL classification/s that will be applicable under AS3959-2009.

### **5.2 VEGETATION MANAGEMENT & BIODIVERSITY VALUE**

#### **5.2.1 BIODIVERSITY VALUE**

Bayley Environmental Services prepared two Environmental Assessment Reports (March 2006 and December 2011) to support the preparation of the Woodland Vista Local Structure Plan. The reports conclude that vegetation on the site is considered to be degraded to completely degraded, and provides no significant habitat for native animals. Some large-sized Tuart and Jarrah trees are present on site and may be retained where suitable, likely over a parkland cleared turf understory, or other managed landscaping.

The biodiversity values of the site are not considered to be in conflict with bushfire management requirements.

#### **5.2.2 VEGETATION MANAGEMENT**

Vegetation shall be managed such that its assessed level of bushfire risk does not increase. This includes the implementation of suitable APZ's and HSZ's, which shall be maintained in a low-fuel state, as specified in the Guidelines.

Private landowners shall be responsible for maintaining vegetation within their lot boundaries, and the Local Government shall be responsible for managing vegetation within public road reserves, recreation areas, and any other land vested in it.

### **5.3 VEHICULAR ACCESS**

The proposed development will be serviced by an internal subdivisional road that gains access to the public road network at two points; to Flynn Drive at the northern end of the site via a subdivisional road; and, an emergency access way to Wanneroo Road at the southern end of the site.

Main Roads has confirmed that it has no objections to the proposed emergency access way to Wanneroo Road.

## 6. RESPONSIBILITIES

A summary of responsibilities is provided in **Table 3** below:

| Table 3: Responsibilities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Implementation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Ongoing Management                                                                                                                                                                                                                                                                                     |
| <b>Developer</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>• Ensure that the BMP is made available to all parties listed as having a responsibility under the Plan.</li> <li>• Review and update the Plan as the proposal progresses through the planning stages.</li> <li>• Ensure the construction of public roads and emergency access ways meets the applicable standards.</li> <li>• Ensure that reticulated water supply meets the applicable standards.</li> <li>• Ensure that public open space is developed in a low fuel state such that it has a 'Low' BHL.</li> <li>• Comply with the Annual Firebreak Notice for land owned by the developer.</li> </ul> | <ul style="list-style-type: none"> <li>• Ensure that POS is maintained such that the assessed bushfire risk does not increase for the developer's maintenance period (usually for two years).</li> </ul>                                                                                               |
| <b>Future landowners/purchasers/proponents</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>• Implement an appropriate APZ &amp; HSZ, as applicable, in accordance with the Guidelines.</li> <li>• Construct any private driveways over 50m in length to the appropriate standard under the Guidelines.</li> <li>• Comply with the Annual Firebreak Notice.</li> <li>• Ensure all new habitable buildings and specified buildings are constructed in accordance with the applicable BAL Construction Standard as set out in AS3959-2009.</li> </ul>                                                                                                                                                    | <ul style="list-style-type: none"> <li>• Maintain any vegetation within the lot boundaries such that the assessed bushfire risk does not increase.</li> <li>• Where subsequent development is proposed, review and update the Plan to ensure bushfire management measures remain effective.</li> </ul> |
| <b>City of Wanneroo</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>• Make a copy of this BMP available to landowners.</li> <li>• Enforce the annual Firebreak Notice.</li> <li>• Enforce the requirements of this BMP.</li> <li>• Assess any proposed development against the requirements of this BMP and the regulatory framework.</li> </ul>                                                                                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>• Develop and maintain district bushfire fighting services and facilities.</li> <li>• Maintain areas of POS, road reserves, and any other vested land such that the assessed bushfire risk does not increase.</li> </ul>                                        |
| <b>Western Australian Planning Commission</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>• Impose conditions of subdivision requiring notifications on titles advising the lot is subject to a Bushfire Management Plan</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                        |

## **APPENDIX 7: Acoustic Report**

# Noise Impact Assessment

## Lot 51 Flynn Drive Carramar MRS Amendment & Structure Plan

Prepared For



December 2011

## Report: 11111983-01

|                                                                                                                  |                                                                          |                                                                        |                                                                      |                                                                            |
|------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------|
| <b>Lloyd George Acoustics Pty Ltd</b><br>ABN: 79 125 812 544<br><br><b>PO Box 717</b><br><b>Hillarys WA 6923</b> |                                                                          |                                                                        |                                                                      |                                                                            |
| <b>Offices:</b>                                                                                                  | <b>Ocean Reef</b>                                                        | <b>Padbury</b>                                                         | <b>Scarborough</b>                                                   | <b>Waterford</b>                                                           |
| Phone:                                                                                                           | 9300 4188                                                                | 9401 7770                                                              | 9245 3223                                                            | 9313 3655                                                                  |
| Fax:                                                                                                             | 9300 4199                                                                | 9401 7770                                                              | 9300 4199                                                            | 9300 4199                                                                  |
| Email:                                                                                                           | <a href="mailto:daniel@lgacoustics.com.au">daniel@lgacoustics.com.au</a> | <a href="mailto:terry@lgacoustics.com.au">terry@lgacoustics.com.au</a> | <a href="mailto:mike@lgacoustics.com.au">mike@lgacoustics.com.au</a> | <a href="mailto:rebecca@lgacoustics.com.au">rebecca@lgacoustics.com.au</a> |
| Mobile:                                                                                                          | 0439 032 844                                                             | 0400 414 197                                                           | 0438 201 071                                                         | 0427 388 876                                                               |
| <b>Member of the Association of Australian Acoustical Consultants – (AAAC)</b>                                   |                                                                          |                                                                        |                                                                      |                                                                            |

This report has been prepared in accordance with the scope of services described in the contract or agreement between Lloyd George Acoustics Pty Ltd and the Client. The report relies upon data, surveys, measurements and results taken at or under the particular times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the Client. Furthermore, the report has been prepared solely for use by the Client, and Lloyd George Acoustics Pty Ltd accepts no responsibility for its use by other parties.

|                     |                                                                                                       |
|---------------------|-------------------------------------------------------------------------------------------------------|
| <b>Prepared By:</b> | Rebecca Ireland  |
| <b>Position:</b>    | Project Director                                                                                      |
| <b>Verified</b>     | Terry George     |
| <b>Date:</b>        | 16 December 2011                                                                                      |

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## **APPENDICES**

- A Deemed-to-Satisfy Construction Standards
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## 1 INTRODUCTION

This report has been prepared to assess road traffic noise on the proposed residential subdivision located at Lot 51 Flynn Drive, Carramar. As this proposed subdivision is located adjacent to Wanneroo Road, an assessment of future transportation noise levels is required to determine the expected noise impact and the extent of noise control that would be required to achieve compliance with relevant criteria.

The locality of the site is shown below on *Figure 1.1*.



**Figure 1.1 – Site Locality**

*Appendix B* contains a description of some of the terminology used throughout this report.

## 2 CRITERIA

The criteria relevant to this assessment is the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (hereafter referred to as the Policy) produced by the Western Australian Planning Commission (WAPC). The objectives in the Policy are to:

- ❑ Protect people from unreasonable levels of transport noise by establishing a standardised set of criteria to be used in the assessment of proposals;
- ❑ Protect major transport corridors and freight operations from incompatible urban encroachment;
- ❑ Encourage best practice design and construction standards for new development proposals and new or redevelopment transport infrastructure proposals;
- ❑ Facilitate the development and operation of an efficient freight network; and

- Facilitate the strategic co-location of freight handling facilities.

The Policy's outdoor noise criteria are shown below in *Table 2.1*. These criteria applying at any point 1-metre from a habitable façade of a noise sensitive premises and in one outdoor living area.

**Table 2.1 – Outdoor Noise Criteria**

| Period              | Target                         | Limit                          |
|---------------------|--------------------------------|--------------------------------|
| Day (6am to 10pm)   | 55 dB L <sub>Aeq</sub> (Day)   | 60 dB L <sub>Aeq</sub> (Day)   |
| Night (10pm to 6am) | 50 dB L <sub>Aeq</sub> (Night) | 55 dB L <sub>Aeq</sub> (Night) |

The 5 dB difference between the *target* and *limit* is referred to as the *margin*.

In the application of these outdoor noise criteria to new noise sensitive developments, the objectives of this policy is to achieve -

- acceptable indoor noise levels in noise-sensitive areas (eg bedrooms and living rooms of houses, classrooms in schools); and
- a 'reasonable' degree of acoustic amenity in at least one outdoor living area on each residential lot.

If a noise sensitive development takes place in an area where outdoor noise levels will meet the *target*, no further measures are required under this policy.

In areas where the *target* is exceeded, but noise levels are likely to be within the 5 dB margin (i.e. less than the *limit*), mitigation measures should be implemented by the developer with a view to achieving the *target* levels in at least one outdoor living area on each residential lot. Where indoor spaces are planned to be facing any outdoor area in the *margin*, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces.

In areas where the *limit* is exceeded (i.e. above L<sub>Aeq</sub>(Day) of 60dB(A) or L<sub>Aeq</sub>(Night) of 55dB(A)), a detailed noise assessment is to be undertaken. Customised noise mitigation measures should be implemented with a view to achieving the *target* in at least one outdoor living area on each residential lot, or if this is not practicable, within the *margin*. Where indoor spaces are planned to be facing outdoor areas that are above the *target*, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces.

For residential buildings, 'acceptable indoor noise levels' are L<sub>Aeq</sub>(Day) of 40dB in living and work areas and L<sub>Aeq</sub>(Night) of 35dB in bedrooms<sup>1</sup>. For all other noise-sensitive buildings, 'acceptable indoor noise levels' under the policy comprise noise levels that meet the Recommended Design Sound Levels under Table 1 of Australian Standard AS 2107:2000

<sup>1</sup> For residential buildings, indoor noise levels are not set for utility spaces such as bathrooms. The policy encourages effective "quiet house" design, which positions these non-sensitive spaces to shield the more sensitive spaces from transport noise.

*Acoustics – Recommended design sound levels and reverberation times for building interiors.*

The guidelines suggest a range of noise mitigation measures to meet the noise criteria. These include—

- ❑ using distance to separate noise-sensitive land uses from noise sources;
- ❑ construction of noise attenuation barriers such as earth mounds and noise walls;
- ❑ building design, such as locating outdoor living areas and indoor habitable rooms away from noise sources;
- ❑ building construction techniques, such as upgraded glazing, ceiling insulation and sealing of air gaps. Note that where upgraded glazing is required, the benefit is only realised when windows are kept closed and, as such, mechanical ventilation should also be considered in these circumstances;

The guidelines also provide detail on the range of noise mitigation measures and their potential for noise reduction. It is expected that noise management and mitigation strategies would be identified and implemented through a noise management plan, having regard to the guidelines, and would be—

- ❑ effective in reducing noise;
- ❑ practical and appropriate for the situation; and
- ❑ compatible with other relevant planning policies.

Where the *target* noise levels cannot be achieved, the policy states that: -

*If the measures outlined previously cannot practicably achieve the target noise levels for new noise-sensitive developments, this should be notified on the certificate of title. Notifications on certificates of title and/or advice to prospective purchasers advising of the potential for noise impacts from major road and rail corridors can be effective in warning people who are sensitive to the potential impacts of transport noise. Such advice can also bring to the attention of prospective developers the need to reduce the impact of noise through sensitive design and construction of buildings and the location of outdoor living areas. The notification is to ensure that prospective purchasers are advised of—*

- ❑ *the potential for transport noise impacts; and*
- ❑ *the potential for quiet house design requirements to minimise noise intrusion through house layout and noise insulation (see the guidelines).*

*Notification should be provided to prospective purchasers and be required as a condition of subdivision (including strata subdivision) for the purposes of noise-sensitive development as well as planning approval involving noise-sensitive development, where noise levels are forecast or estimated to exceed the target outdoor noise criteria, regardless of proposed noise attenuation measures. The requirement for notification as a condition of subdivision and the land area over which the notification requirement applies, should be identified in the*

noise management plan in accordance with the guidelines. An example of a standard form of wording for notifications is presented in the guidelines.

The SPP 5.4 applies a performance-based approach to the management and mitigation of transport noise. It states: -

*It is recognised that in a number of instances it may not be reasonable and practicable to meet the noise target criteria. Where transport noise is above the target level, measures are expected to be implemented that best balance reasonable and practicable considerations, such as noise benefit, cost, feasibility, community preferences, amenity impacts, safety, security and conflict with other planning and transport policies. In these cases the community should also be consulted to assist in identifying best overall solutions. The guidelines assist in outlining ways in which some reasonable and practicable limitations can be addressed in a manner that also minimises transport noise.*

*It is further acknowledged that there may also be situations in which the noise limit cannot practicably be achieved, especially in the case of major redevelopment of existing transport infrastructure. Similarly, it may not be practicable to achieve acceptable indoor noise levels if the new development is located very close to the transport corridor. In these situations the primary focus should be on achieving the lowest level of noise, with other reasonable and practicable considerations being secondary to this objective.*

### 3 METHODOLOGY

Noise measurements and modelling have been undertaken in accordance with the requirements of the Policy as described below in Sections 3.1 and 3.2.

#### 3.1 Site Measurements

Noise monitoring was undertaken at two locations, along Wanneroo Road and Flynn Drive in order to:

- ❑ Quantify the existing noise levels;
- ❑ Determine the differences between different acoustic parameters ( $L_{A10,18\text{hour}}$ ,  $L_{Aeq}(\text{Day})$  and  $L_{Aeq}(\text{Night})$ ); and
- ❑ Calibrate the noise model for existing conditions.

The instruments used were ARL Type 316 noise data loggers (pictured below in Figure 3.1). The loggers were programmed to record hourly  $L_{A1}$ ,  $L_{A10}$ ,  $L_{A90}$ , and  $L_{Aeq}$  levels. This instrument complies with the instrumentation requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The loggers were field calibrated before and after the measurement session and found to be accurate to within +/- 1 dB. Lloyd George Acoustics also holds current laboratory calibration certificate for the loggers.



**Figure 3.1 – Automatic Noise Data Logger**

The measurement locations are shown in *Figure 3.2*.

The noise loggers were set-up to obtain 1 full week, between 18<sup>th</sup> November and 25<sup>th</sup> November 2011. The noise loggers were set up at a distance of 25 metres from Wanneroo Road and the second was set up at a distance of 10 metres from Flynn Drive.

Sound pressure levels were measured in accordance with Australian Standard 2702-1984: *Acoustics - Method For Measurement of Road Traffic Noise*, with the logger positioned in free field conditions with the microphone height at 1.4 metres above ground floor level.

From the hourly measurements, the  $L_{A10,18 \text{ hour}}$ ,  $L_{Aeq,24 \text{ hour}}$ ,  $L_{Aeq \text{ (Day)}}$  and  $L_{Aeq \text{ (Night)}}$  values were determined for each complete measurement day. These results were averaged and the mean level reported.



**Figure 3.2 –Noise Logger Location**

The noise data collected was verified by inspection and professional judgement. Where hourly data was considered atypical, an estimated value was inserted and highlighted by bold italic lettering.

The weather conditions during the measurement period were obtained from the Bureau of Meteorology's Mount Lawley measurement station. This data was compared against the MRWA specifications for measurement conditions and any unacceptable conditions commented on. Note that the project only required that monitoring was undertaken during winds that were not extreme.

### 3.2 Noise Modelling

To assess the road traffic noise levels to the proposed development, the computer programme *SoundPLAN 7.0* was utilised incorporating the *Calculation of Road Traffic Noise* (CoRTN) algorithm. The road algorithms have been modified to reflect local conditions.

These modifications include:

- ❑ Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Classes 1 & 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two sources, at heights of 1.5 metres and 3.6 metres above road level, to represent the engine and exhaust respectively. By splitting the noise source into three, allows for less barrier attenuation for high level sources where barriers are to be considered. Note that corrections are applied to the exhaust of  $-8.0$  dB (based on *Transportation Noise Reference Book, Paul Nelson, 1987*) and to the engine source of  $-0.8$  dB, required to provide consistent results with the CoRTN algorithms for the no barrier scenario.
- ❑ An adjustment of  $-1.7$  dB has been applied to the predicted levels based on the findings of *An Evaluation of the U.K. DoE Traffic Noise Prediction*; Australian Road Research Board, Report 122 ARRB – NAASRA Planning Group 1982.

In determining any requirements for noise barriers between the transport corridor and receiver, the predictions are made at a height of 1.4 metres above ground floor level and at 1.0 metre from an assumed building facade (resulting in a  $+ 2.5$  dB correction due to reflected noise). Noise to upper floors is also predicted, however, is only used to determine the extent of double (or multiple) storey dwellings that are above the *Target* and the facade treatments required to ensure acceptable internal noise levels.

Various input data are included in the modelling such as ground topography, road design, traffic volumes etc and are discussed below.

#### 3.2.1 Ground Topography, Road Design & Cadastral Data

Topographical data was based on that provided by Burgess Design Group, which is from the Department of Land Information (DLI). The contours are in 1 metre intervals and cover the proposed site. At this stage, final ground heights have not been determined across the site, for the purposes of the noise modelling the existing ground heights have been used.

Buildings have also been included as these can provide barrier attenuation when located between a source and receiver, in much the same way as a hill or wall provides noise shielding. All single storey buildings are assumed to have a height of 4 metres. Where double storey buildings are assumed, these have a height of 7.0 metres.

#### 3.2.2 Traffic Data

Traffic data includes:

- ❑ Road Surface –

The noise relationship between different road surface types is shown below in *Table 3.4*.

**Table 3.4 – Noise Relationship Between Different Road Surfaces**

| Road Surfaces |         |         |              |          |              |             |
|---------------|---------|---------|--------------|----------|--------------|-------------|
| Chip Seal     |         |         | Asphalt      |          |              |             |
| 14mm          | 10mm    | 5mm     | Dense Graded | Novachip | Stone Mastic | Open Graded |
| +3.5 dB       | +2.5 dB | +1.5 dB | 0.0 dB       | -0.2 dB  | -1.0 dB      | -2.5 dB     |

The existing road surface is worn 14mm chip seal.

The future road surface is assumed to remain the same. It is understood that Wanneroo Road is proposed to be upgraded into a two lane divided dual carriageway road.

□ Vehicle Speed –

Existing and future posted speeds are 90km/hr on Wanneroo Road and 60km/hr on Flynn Drive at the approach to the Wanneroo Road intersection.

□ Traffic Volumes –

Traffic volume data used in the modelling is shown below in *Table 3.5*. The existing and future volumes were obtained from Transcore.

**Table 3.5 – Traffic Volumes Used in the Modelling**

| Parameter      | Scenario      |             |               |             |
|----------------|---------------|-------------|---------------|-------------|
|                | Existing      |             | Future        |             |
|                | Wanneroo Road | Flynn Drive | Wanneroo Road | Flynn Drive |
| 24 Hour Volume | 17,000        | 1,080       | 17,032        | 1,404       |
| % Heavy        | 8.8%          | 14.7%       | 8.8%          | 14.7%       |

### 3.2.3 Ground Attenuation

The ground attenuation has been assumed to be 0.25 (25%) within the road reserve, 0.6 (60%) throughout the subdivision, except for the public open space, which was set to 1.00 (100%) and 0.9 (90%) outside of the subdivision. Note 0.0 represents hard reflective surfaces such as water and 1.00 represents absorptive surfaces such as grass.

## 4 RESULTS

### 4.1 Noise Monitoring

The results of the noise monitoring are summarised below in *Table 4.1* and shown graphically in *Figure 4.1*.

**Table 4.1 – Measured Average Noise Levels – Monitoring Locations**

| Location      | Average Weekday Noise Level, dB |                         |                        |                          |
|---------------|---------------------------------|-------------------------|------------------------|--------------------------|
|               | L <sub>A10,18hour</sub>         | L <sub>Aeq,24hour</sub> | L <sub>Aeq (Day)</sub> | L <sub>Aeq (Night)</sub> |
| Wanneroo Road | 68.9                            | 65.1                    | 66.2                   | 61.3                     |
| Flynn Drive   | 59.8                            | 58.8                    | 60.2                   | 52.3                     |

The average differences between the L<sub>Aeq (Day)</sub> and L<sub>Aeq (Night)</sub> are 7 dB. This same difference has been assumed to exist in future years. As such, it is the daytime noise levels that will dictate compliance since these are at least 5 dB more than night-time levels.

### 4.2 Noise Modelling

The road traffic noise modelling is provided as L<sub>Aeq (Day)</sub> noise level contour plots on *Figure 4.3* being for the future conditions.







## 5 ASSESSMENT

The objectives of the criteria are for noise at all houses to be no more than the *limit* and preferably no more than the *target*. Noise levels above the *limit* are generally considered unacceptable for residential use. Where the *target* is achieved, no further controls are required. Where the *limit* is achieved or noise levels are within the *margin* (between the *limit* and *target*), further controls are necessary.

With no noise control, traffic noise levels will be above the *target*. As such, consideration has been given to the noise control scenarios discussed in *Sections 6.1* and *6.2*.

From *Figure 4.3* the following can be summarised:

- ❑ The future road noise levels would exceed the *Target* criteria at all lots adjacent to Wanneroo Road and Flynn Drive;
- ❑ The future road noise levels would exceed the *Limit* criteria at majority of the lots adjacent to Wanneroo Road; and
- ❑ The *Target* will be achieved at a distance of approximately 75m from the centre of the road.

As the noise levels exceed the SPP 5.4 *Target* criteria, noise mitigation needs to be considered. The mitigation options that are appropriate for this assessment include a noise barrier along the development boundary adjacent to the road reserve, and/or treatments to the facade of properties exceeding the *Target* criteria. Note it is assumed that improvements to the road surface cannot be negotiated with MRWA.

## 6 RECOMMENDATIONS

From *Figure 4.3*, it can be seen that the majority of the proposed lots fronting Wanneroo Road are predicted to exceed the SPP 5.4 *Limit* criteria at the facades facing the road. It is understood that the use of a quieter road surface, such as open graded asphalt, does not have the approval of Main Roads Western Australia, due to the high installation and maintenance costs.

To mitigate the road traffic noise across the site, it is recommended that an acoustic barrier, 2.5 metre above road height, be erected along the Wanneroo Road frontage of the site. The acoustic barrier is required to extend the length of the Wanneroo Road frontage of the site. The results of the noise modelling with the inclusion of the acoustic barrier are shown as a noise contour plot in *Figure 6.1*.

Based on the predicted noise levels, it is proposed that a combination of noise wall and facade treatment be considered. The proposed treatments will vary depending on the predicted noise levels. For those receivers that are within the margin between the *Target* and *Limit* criteria, the 'deemed to comply package A' as provided in the SPP 5.4 guidelines, can be used. The 'deemed to comply' packages are provided in *Appendix A*.



All dwellings within the margin will also require notification on their titles. An example of this is provided in *Appendix A*.

Multiple storey dwellings within the first two rows of houses should be discouraged. If these are permitted, specialist advice should be obtained from a qualified acoustic consultant (member of the Australian Acoustical Society or Association of Australian Acoustical Consultants). The reason for this is that the proposed barrier will provide negligible noise attenuation to upper floors. For dwellings within the closest blocks to Wanneroo Road, Package A deemed-to-satisfy construction standards will be required to the upper floor.

## **7 CONCLUSION**

The analysis has shown that to comply with the criteria of the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* a combination of noise barriers and architectural treatments will be required.

Should any of the closest residences to Wanneroo Road be proposed as multiple storey, these will require further consideration, as described in *Section 5*.

## **APPENDIX A**

### Deemed-to-Satisfy Construction Standards

## Noise insulation – “Deemed to Comply” packages for residential development

The following “deemed-to-comply” Packages outline noise insulation measures that are designed to ensure that the indoor noise standards in the Policy are achieved for residential developments in areas where outdoor noise levels will exceed the *target* noise levels by up to 8 dB(A).

The deemed-to-comply specifications are intended to simplify compliance with the noise criteria, and the relevant Package should be required as a condition of development. However, this should not remove the option to pursue alternative measures or designs. Departures from the deemed-to-comply specifications need to be accompanied by acoustic certification from a competent person, to the effect that the development will achieve the requirements of the Policy.

Superior construction standards, such as those specified in the “deemed-to-comply” packages, are now becoming more prevalent in residential buildings; and do not significantly increase the cost of building. A similar standard of construction has been recommended by the Western Australian Planning Commission for new housing in areas forecast to be seriously affected by aircraft noise.<sup>2</sup> That recommendation followed a comprehensive assessment of the efficacy and costs of noise attenuation measures, taking into account the recent changes in industry building standards as well as changes to the *Building Code of Australia*.

Where transport noise levels are more than 8 dB above the noise *target*, i.e. 3 dB above the noise *limit*, or where noise-sensitive development other than residential is proposed, a Detailed Assessment should be prepared by a competent person. The report should specify the level of noise reduction required and the noise insulation measures needed to comply with the Policy. The approval may require that the construction drawings be checked for compliance with the Detailed Assessment, and that follow-up verification be carried out to certify compliance.

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<sup>2</sup> Statement of Planning Policy No 5.1, *Land Use Planning in the Vicinity of Perth Airport* and the accompanying report on *Aircraft Noise Insulation for Residential Development in the Vicinity of Perth Airport*, February 2004.

### Package A: Noise levels within the *margin*

The following noise insulation package is designed to meet the indoor noise standards for residential developments in areas where noise levels exceed the noise *target* but are within the *limit*.

| Area type                          | Orientation               | Package A measures                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Indoors</b>                     |                           |                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Bedrooms                           | Facing road/rail corridor | <ul style="list-style-type: none"> <li>• 6mm (minimum) laminated glazing</li> <li>• Fixed, casement or awning windows with seals</li> <li>• No external doors</li> <li>• Closed eaves</li> <li>• No vents to outside walls/eaves</li> <li>• Mechanical ventilation/airconditioning<sup>3</sup></li> </ul>                                                                                                        |
|                                    | Side-on to corridor       | <ul style="list-style-type: none"> <li>• 6mm (minimum) laminated glazing</li> <li>• Closed eaves</li> <li>• Mechanical ventilation/airconditioning</li> </ul>                                                                                                                                                                                                                                                    |
|                                    | Away from corridor        | No requirements                                                                                                                                                                                                                                                                                                                                                                                                  |
| Living and work areas <sup>4</sup> | Facing corridor           | <ul style="list-style-type: none"> <li>• 6mm (minimum) laminated glazing</li> <li>• Fixed, casement or awning windows with seals</li> <li>• 35mm (minimum) solid core external doors with acoustic seals<sup>5</sup></li> <li>• Sliding doors must be fitted with acoustic seals</li> <li>• Closed eaves</li> <li>• No vents to outside walls/eaves</li> <li>• Mechanical ventilation/airconditioning</li> </ul> |
|                                    | Side-on to corridor       | <ul style="list-style-type: none"> <li>• 6mm (minimum) laminated glazing</li> <li>• Closed eaves</li> <li>• Mechanical ventilation/airconditioning</li> </ul>                                                                                                                                                                                                                                                    |
|                                    | Away from corridor        | No requirements                                                                                                                                                                                                                                                                                                                                                                                                  |
| Other indoor areas                 | Any                       | No requirements                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Outdoors</b>                    |                           |                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Outdoor living area <sup>6</sup>   | Facing corridor           | <ul style="list-style-type: none"> <li>• Minimum 2.0m high solid fence (e.g. Hardifence, pinelap, or Colorbond)</li> <li>• Picket fences are not acceptable</li> </ul>                                                                                                                                                                                                                                           |
|                                    | Side-on to corridor       |                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                    | Away from corridor        | No requirements                                                                                                                                                                                                                                                                                                                                                                                                  |

<sup>3</sup> See section on Mechanical ventilation/airconditioning for further details and requirements.

<sup>4</sup> These deemed-to-comply guidelines adopt the definitions of indoor spaces used in AS 2107-2000. A comparable description for bedrooms, living and work areas is that defined by the Building Code of Australia as a "habitable room". The Building Code of Australia may be referenced if greater clarity is needed. A living or work area can be taken to mean any "habitable room" other than a bedroom. Note that there are no noise insulation requirements for utility areas such as bathrooms. The Building Code of Australia describes these utility spaces as "non-habitable rooms".

<sup>5</sup> Glazing panels are acceptable in external doors facing the transport corridor. However these must meet the minimum glazing requirements.

<sup>6</sup> The Policy requires that at least one outdoor living area be reasonably protected from transport noise. The protected area should meet the minimum space requirements for outdoor living areas, as defined in the Residential Design Codes of Western Australia.

**Package B: Noise within 3 dB above the *limit***

The following noise insulation package is designed to meet the indoor noise standards for residential developments in areas where transport noise levels exceed the noise *limit* but by no more than 3 dB (See Table 1 in the Policy).

| Area type                          | Orientation               | Package B measures                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Indoors</b>                     |                           |                                                                                                                                                                                                                                                                                                                                                                                                     |
| Bedrooms                           | Facing road/rail corridor | <ul style="list-style-type: none"> <li>10mm (minimum) laminated glazing</li> <li>Fixed, casement or awning windows with seals</li> <li>No external doors</li> <li>Closed eaves</li> <li>No vents to outside walls/eaves</li> <li>Mechanical ventilation/airconditioning<sup>7</sup></li> </ul>                                                                                                      |
|                                    | Side-on to corridor       | <ul style="list-style-type: none"> <li>10mm (minimum) laminated glazing</li> <li>Closed eaves</li> <li>Mechanical ventilation/airconditioning</li> </ul>                                                                                                                                                                                                                                            |
|                                    | Away from corridor        | No requirements                                                                                                                                                                                                                                                                                                                                                                                     |
| Living and work areas <sup>8</sup> | Facing corridor           | <ul style="list-style-type: none"> <li>10mm (minimum) laminated glazing</li> <li>Fixed, casement or awning windows with seals</li> <li>40mm (minimum) solid core external doors with acoustic seals<sup>9</sup></li> <li>Sliding doors must be fitted with acoustic seals</li> <li>Closed eaves</li> <li>No vents to outside walls/eaves</li> <li>Mechanical ventilation/airconditioning</li> </ul> |
|                                    | Side-on to corridor       | <ul style="list-style-type: none"> <li>6mm (minimum) laminated glazing</li> <li>Closed eaves</li> <li>Mechanical ventilation/airconditioning</li> </ul>                                                                                                                                                                                                                                             |
|                                    | Away from corridor        | No requirements                                                                                                                                                                                                                                                                                                                                                                                     |
| Other indoor areas                 | Any                       | No requirements                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Outdoors</b>                    |                           |                                                                                                                                                                                                                                                                                                                                                                                                     |
| Outdoor living area <sup>10</sup>  | Facing corridor           | <ul style="list-style-type: none"> <li>Minimum 2.4m solid fence (e.g. brick, limestone or Hardifence)</li> <li>Colorbond and picket fences are not acceptable</li> </ul>                                                                                                                                                                                                                            |
|                                    | Side-on to corridor       |                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                    | Away from corridor        | No requirements                                                                                                                                                                                                                                                                                                                                                                                     |

<sup>7</sup> See section on Mechanical ventilation/airconditioning for further details and requirements.

<sup>8</sup> These deemed-to-comply guidelines adopt the definitions of indoor spaces used in AS 2107-2000. A comparable description for bedrooms, living and work areas is that defined by the Building Code of Australia as a "habitable room". The Building Code of Australia may be referenced if greater clarity is needed. A living or work area can be taken to mean any "habitable room" other than a bedroom. Note that there are no noise insulation requirements for utility areas such as bathrooms. The Building Code of Australia describes these utility spaces as "non-habitable rooms".

<sup>9</sup> Glazing panels are acceptable in external doors facing the transport corridor. However these must meet the minimum glazing requirements.

<sup>10</sup> The Policy requires that at least one outdoor living area be reasonably protected from transport noise. The protected area should meet the minimum space requirements for outdoor living areas, as defined in the Residential Design Codes of Western Australia.

## **Mechanical ventilation/airconditioning**

Where outdoor noise levels are above the “target”, both Packages A and B require mechanical ventilation or airconditioning to ensure that windows can remain closed in order to achieve the indoor noise standards.

In implementing Packages A and B, the following need to be observed:

- evaporative airconditioning systems will not meet the requirements for Packages A and B because windows need to remain open;
- refrigerative airconditioning systems need to be designed to achieve fresh air ventilation requirements;
- air inlets need to be positioned facing away from the transport corridor where practicable;
- ductwork needs to be provided with adequate silencing to prevent noise intrusion.

## **Notification**

Notifications on certificates of title and/or advice to prospective purchasers advising of the potential for noise impacts from road and rail corridors can be effective in warning people of the potential impacts of transport noise. Such advice can also bring to the attention of prospective developers the need and opportunities to reduce the impact of noise through sensitive design and construction of buildings and the location and/or screening of outdoor living areas.

Notification should be provided to prospective purchasers, and required as a condition of subdivision (including strata subdivision) for the purposes of noise-sensitive development or planning approval involving noise-sensitive development, where external noise levels are forecast or estimated to exceed the “target” criteria as defined by the Policy. In the case of subdivision and development, conditions of approval should include a requirement for registration of a notice on title, which is provided for under section 12A of the Town Planning and Development Act and section 70A of the Transfer of Land Act. An example of a suitable notice is given below.

*Notice: This property is situated in the vicinity of a transport corridor, and is currently affected, or may in the future be affected, by transport noise. Further information about transport noise, including development restrictions and noise insulation requirements for noise-affected property, are available on request from the relevant local government offices.*

## **APPENDIX B**

### Terminology

The following is an explanation of the terminology used throughout this report.

### **Decibel (dB)**

The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

### **A-Weighting**

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as  $L_A$  dB.

### **$L_1$**

An  $L_1$  level is the noise level which is exceeded for 1 per cent of the measurement period and is considered to represent the average of the maximum noise levels measured.

### **$L_{10}$**

An  $L_{10}$  level is the noise level which is exceeded for 10 per cent of the measurement period and is considered to represent the “intrusive” noise level.

### **$L_{90}$**

An  $L_{90}$  level is the noise level which is exceeded for 90 per cent of the measurement period and is considered to represent the “background” noise level.

### **$L_{eq}$**

The  $L_{eq}$  level represents the average noise energy during a measurement period.

### **$L_{A10,18\text{hour}}$**

The  $L_{A10,18\text{ hour}}$  level is the arithmetic average of the hourly  $L_{A10}$  levels between 6.00 am and midnight. The CoRTN algorithms were developed to calculate this parameter.

### **$L_{Aeq,24\text{hour}}$**

The  $L_{Aeq,24\text{ hour}}$  level is the logarithmic average of the hourly  $L_{Aeq}$  levels for a full day (from midnight to midnight).

### **$L_{Aeq,8\text{hour}} / L_{Aeq}(\text{Night})$**

The  $L_{Aeq}(\text{Night})$  level is the logarithmic average of the hourly  $L_{Aeq}$  levels from 10.00 pm to 6.00 am on the same day.

### **$L_{Aeq,16\text{hour}} / L_{Aeq}(\text{Day})$**

The  $L_{Aeq}(\text{Day})$  level is the logarithmic average of the hourly  $L_{Aeq}$  levels from 6.00 am to 10.00 pm on the same day. This value is typically 1-3 dB less than the  $L_{A10,18\text{hour}}$ .

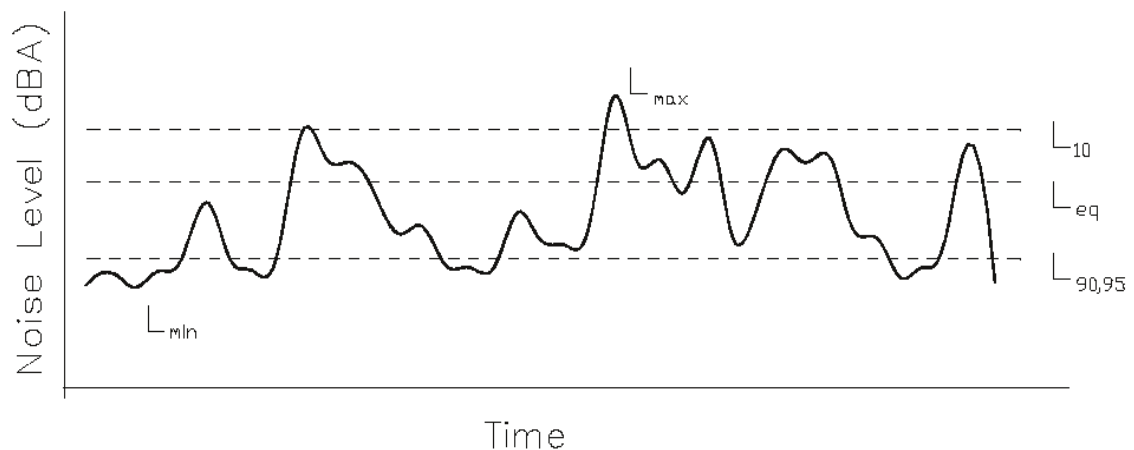
### Satisfactory Design Sound Level

The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive.

### Maximum Design Sound Level

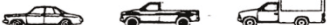











The level of noise above which most people occupying the space start to become dissatisfied with the level of noise.

### Chart of Noise Level Descriptors



### Austroads Vehicle Class

AUSTROADS Vehicle Classification System

| Level 1<br>Length<br>(indicative)       | Level 2<br>Axles and<br>Axle Groups | Level 3<br>Vehicle Type | AUSTROADS Classification                                                                              |       |                                                                                               |                                                                                       |
|-----------------------------------------|-------------------------------------|-------------------------|-------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Type                                    | Axles                               | Groups                  | Typical Description                                                                                   | Class | Parameters                                                                                    | Typical Configuration                                                                 |
| Short<br>up to 5.5m                     | 1 or 2                              | 3                       | Short<br>Sedan, Wagon, 4WD, Utility,<br>Light Van, Bicycle, Motorcycle, etc                           | 1     | $d(1) \leq 3.2m$ and axles = 2                                                                |   |
|                                         |                                     |                         | Short - Towing<br>Trailer, Caravan, Boat, etc                                                         | 2     | groups = 3<br>$d(1) \geq 2.1m$ , $d(1) \leq 3.2m$ ,<br>$d(2) \geq 2.1m$ and axles = 3, 4 or 5 |   |
| Medium<br>5.5m to 14.5m                 | 2                                   | 2                       | Two Axle Truck or Bus                                                                                 | 3     | $d(1) > 3.2m$ and axles = 2                                                                   |   |
|                                         |                                     |                         | Three Axle Truck or Bus                                                                               | 4     | axles = 3 and groups = 2                                                                      |  |
|                                         |                                     |                         | Four Axle Truck                                                                                       | 5     | axles > 3 and groups = 2                                                                      |  |
|                                         |                                     |                         | Three Axle Articulated<br>Three axle articulated vehicle, or<br>Rigid vehicle and trailer             | 6     | $d(1) > 3.2m$ , axles = 3<br>and groups = 3                                                   |   |
| Long<br>11.5m to 19.0m                  | 4                                   | > 2                     | Four Axle Articulated<br>Four axle articulated vehicle, or<br>Rigid vehicle and trailer               | 7     | $d(2) < 2.1m$ or $d(1) < 2.1m$ or $d(1) > 3.2m$<br>axles = 4 and groups > 2                   |   |
|                                         |                                     |                         | Five Axle Articulated<br>Five axle articulated vehicle, or<br>Rigid vehicle and trailer               | 8     | $d(2) < 2.1m$ or $d(1) < 2.1m$ or $d(1) > 3.2m$<br>axles = 5 and groups > 2                   |   |
|                                         |                                     |                         | Six Axle Articulated<br>Six axle articulated vehicle, or<br>Rigid vehicle and trailer                 | 9     | axles = 6 and groups > 2 or<br>axles > 6 and groups = 3                                       |   |
| Medium<br>Combination<br>17.5m to 36.5m | > 6                                 | 4                       | B Double<br>B Double, or<br>Heavy truck and trailer                                                   | 10    | groups = 4 and axles = 6                                                                      |   |
|                                         |                                     |                         | Double Road Train<br>Double road train, or Medium articulated<br>vehicle and one dog trailer (M.A.D.) | 11    | groups = 5 or 6<br>and axles > 6                                                              |   |
| Large<br>Combination<br>Over 33.0m      | > 6                                 | > 6                     | Triple Road Train<br>Triple road train, or<br>Heavy truck and three trailers                          | 12    | groups > 6<br>and axles > 6                                                                   |   |

**Definitions:**

Group: Axle group, where adjacent axles are less than 2.1m apart

Groups: Number of axle groups

Axles: Number of axles (maximum axle spacing of 10.0m)

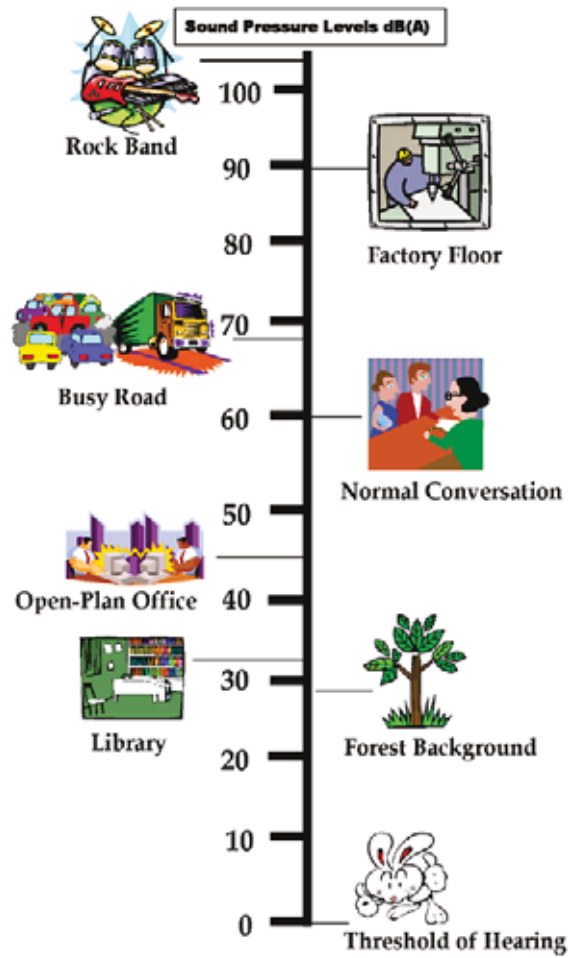
d(1): Distance between first and second axle

d(2): Distance between second and third axle

**Definitions:** Group: Axle group, where adjacent axles are less than 2.1m apart  
Groups: Number of axle groups  
Axles: Number of axles (maximum axle spacing of 10.0m)

$d(1)$ : Distance between first and second axle  
 $d(2)$ : Distance between second and third axle

## Typical Noise Levels



**APPENDIX 8:  
Traffic Impact  
Assessment +  
Addendum**



























**PROPOSED RESIDENTIAL DEVELOPMENT  
LOT 51 FLYNN DRIVE, CARRAMAR**

**TRAFFIC IMPACT STATEMENT - ADDENDUM**

transport planning • traffic engineering • project management

**Proposed Residential Development  
Lot 51 Flynn Drive, Carramar**

**Traffic Impact Statement  
Addendum**

Prepared for:  
**Woodland Consortium Pty Ltd**

December 2011

Prepared by:  
**TRANSCORE PTY LTD**  
61 York Street, Subiaco WA 6008  
PO Box 42, Subiaco WA 6904  
Telephone (08) 9382 4199  
Facsimile (08) 9382 4177

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**Author:** Vladimir Baltic

**Project manager:** Behnam Bordbar

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# 1 INTRODUCTION

This addendum to the original Traffic Impact Statement has been prepared by Transcore on behalf of Woodland Consortium Pty Ltd, with regard to the proposed Rezoning Application (Rural to Urban) and subdivision of Lot 51 Flynn Drive (subject site) in Carramar, City of Wanneroo (subject site).

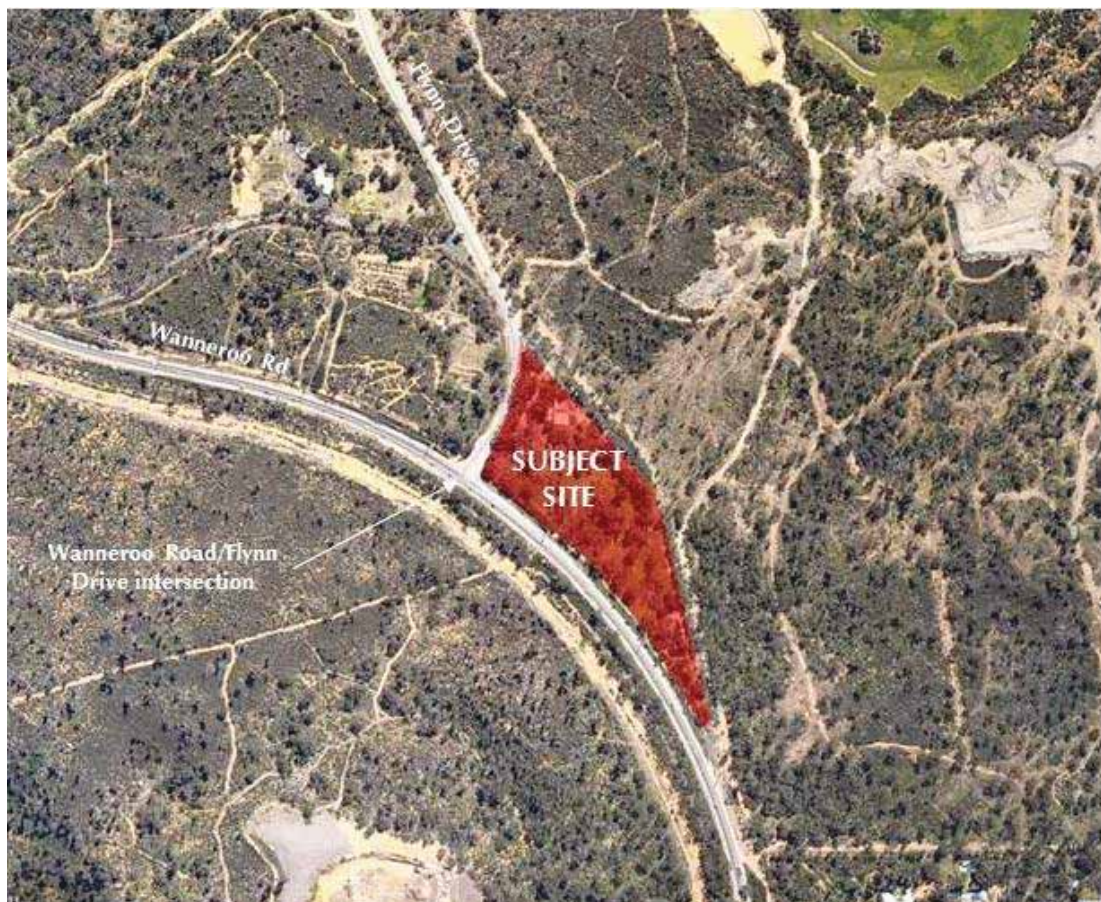
Transcore originally prepared a traffic report for this development in March 2006. An Addendum to the original traffic report was necessitated following a change in the lot yield from 7 to approximately 40 residential lots in the latest development proposal.

The proposed residential development on Lot 51 entails approximately 40 residential lots. The Main Access would be located off Flynn Drive, approximately 50m northeast of the existing intersection of Flynn Drive with Wanneroo Road. The proposed subdivision also includes a potential road link to the adjacent Lot 1 located immediately to the east and earmarked for the future residential development. The likelihood and actual location of this link will be confirmed in the subdivision stages of the development; however, in the concept plan for Lot 51 plan the link road is indicatively shown at the south-eastern end of the subject site.

Accordingly, this traffic report assesses the impact of the proposed increase in lot yield at the subject site by estimating the traffic that would be generated by residential development, and the resultant additional traffic on the surrounding road network.

## 2 EXISTING SITUATION

The subject site is located approximately 30km north of the Perth CBD and 4 kilometres north of the Joondalup Town Centre. The subject site is located at the south-east corner of Flynn Drive/Wanneroo Road unsignalised T-intersection. The site is currently occupied by a single-storey dwelling with balance of site being vacant. A vehicular crossover to this site is located on Flynn Drive, approximately 140m north-east from the Flynn Drive/Wanneroo Road intersection. (Refer **Figure 1**).



**Figure 1. Aerial photo of the subject site**

**Wanneroo Road** in the vicinity of the subject site is a 9m wide, undivided two-lane two-way road with a sign-posted speed limit of 90km/hr. It has a left-turn slip pocket into Flynn Drive on the northern approach of the intersection. The north-eastern approach is flared to allow straight-through traffic to pass traffic turning right into Flynn Drive.

According to traffic count information sourced from Main Roads WA, Wanneroo Road, north of Flynn Drive carried approximately 17,000 vehicles per day in March 2010, with weekday morning and evening peak hour volumes of 1,411 vehicles (peak hour at 7:30AM) and 1,542 vehicles (peak hour at 4:30PM), respectively.

Although under the *WAPC Liveable Neighbourhoods* guidelines, Wanneroo Road presents the physical characteristics of an *Integrator Arterial B* road, it is classified as a *Primary Distributor Road* (Main Roads WA, *Functional Road Hierarchy* document).

**Flynn Drive** is an undivided two-way two-lane road with a sign posted speed limit of 80 km/h, with a bend warning sign supplemented by an advisory speed sign of 60km/h around the curved horizontal alignment of Flynn Drive on its westbound approach to the Flynn Drive/Wanneroo Road intersection. These signs are located approximately 150m from the Flynn Drive/Wanneroo Road intersection.

The traffic counts sourced from Main Roads WA (July 2010) for Flynn Drive, west of Pinjar Road, show that on a typical weekday it carried an average of 1,080 vehicles per day. During morning (6:30AM) and afternoon peak (3:30PM) hour volumes Flynn Drive recorded 99 and 117 vehicles per hour, respectively.

In Main Roads WA Functional Road Hierarchy document Flynn Drive is classified as a *Regional Distributor* road.

Due to the future development of the Neerabup Industrial Park (located to the northeast of the subject site) and the forecast significant increase in traffic volumes along Flynn Drive<sup>1</sup>, the existing north-south section of Flynn Drive abutting the subject site would be realigned east-west to intersect with Wanneroo Road approximately 600m north from its current intersection. The section of Flynn Drive abutting the subject site would ultimately be cul-de-saced and the existing intersection of Flynn Drive/Wanneroo closed.

Flynn Drive is ultimately proposed to be upgraded to a dual divided carriageway standard to serve the Neerabup Industrial Park and the proposed residential developments to the northeast of the subject site. Its future intersection with Wanneroo Road would be signalised as part of the Flynn Drive upgrade project.

There are also plans for Flynn Drive to extend further west of Wanneroo Road to ultimately provide a connection to Mitchell Freeway. Plans for this extension are still tentative with no fixed timeframe set yet.

Though the volumes are currently low, Flynn Drive functions as an *Integrator Arterial* road and, once realigned, proposed in the MRS to serve as an 'Other Regional Road'. The section of Flynn Drive abutting Lot 51 is classified as a "Local Road". Refer **Figure 2**.

With the increase in traffic attracted to this part of Neerabup, Main Roads WA has indicated that there are also plans for the dualling of Wanneroo Road from Joondalup Drive to Hall Road though no timeframe has been confirmed to date.

---

<sup>1</sup> According to the traffic forecasts prepared for the Neerabup Industrial Park, Flynn Drive is forecasted to ultimately carry approximately 35,900 vpd (east of Wanneroo Road)



**Figure 2. Extract from WAPC Metropolitan Region Scheme document**

The City of Wanneroo has resolved to defer the construction of the Flynn Drive Realignment Project until a firm budget and timeline for the construction of the dual carriageway of Wanneroo Road (from Joondalup Drive to Hall Road) is produced by the State Government<sup>2</sup>. Furthermore, the City resolved to request Main Roads WA undertake temporary improvement works for the existing Flynn Drive/Wanneroo Road intersection, funded from the State Government BlackSpot funding initially granted for upgrade of this intersection.

The City has also resolved to proceed with the completion of design of the Flynn Drive Realignment Project on the proposed realigned section of Flynn Drive, incorporating profile changes as agreed with Main Roads WA<sup>3</sup>.

<sup>2</sup> *City of Wanneroo Council meeting, 16 November 2010 (IN03-11/10 Deferment of the Flynn Drive Realignment Project)*

<sup>3</sup> *City of Wanneroo Council meeting, 26 July 2011 (IN01-07/11 Flynn Drive Realignment Project)*

### 3 PROPOSED DEVELOPMENT

The proposed residential subdivision is located on Lot 51 Flynn Drive in Carramar, City of Wanneroo. The subject site (approximately 3.3ha) is located immediately southeast of the existing Wanneroo Road/Flynn Drive intersection.

According to the concept plan prepared by BDG (LAK CAR 01-01, dated 18 November 2011), the proposed development comprises 40 residential lots ranging in size from 225m<sup>2</sup> to 580m<sup>2</sup> with one 800m<sup>2</sup> superlot. Access point for the development is proposed off Flynn Drive approximately 50m northeast of the existing Wanneroo Road/Flynn Drive intersection. The Flynn Drive access is proposed to operate as a full-movement intersection (refer **Figure 3** for more details).

The development concept plan also features a road link to the adjacent Lot 1 located immediately to the east (future residential development). The actual location of this road link is yet to be confirmed; however, in the concept plan for Lot 51 plan the link road is indicatively shown at the south-eastern end of the subject site.

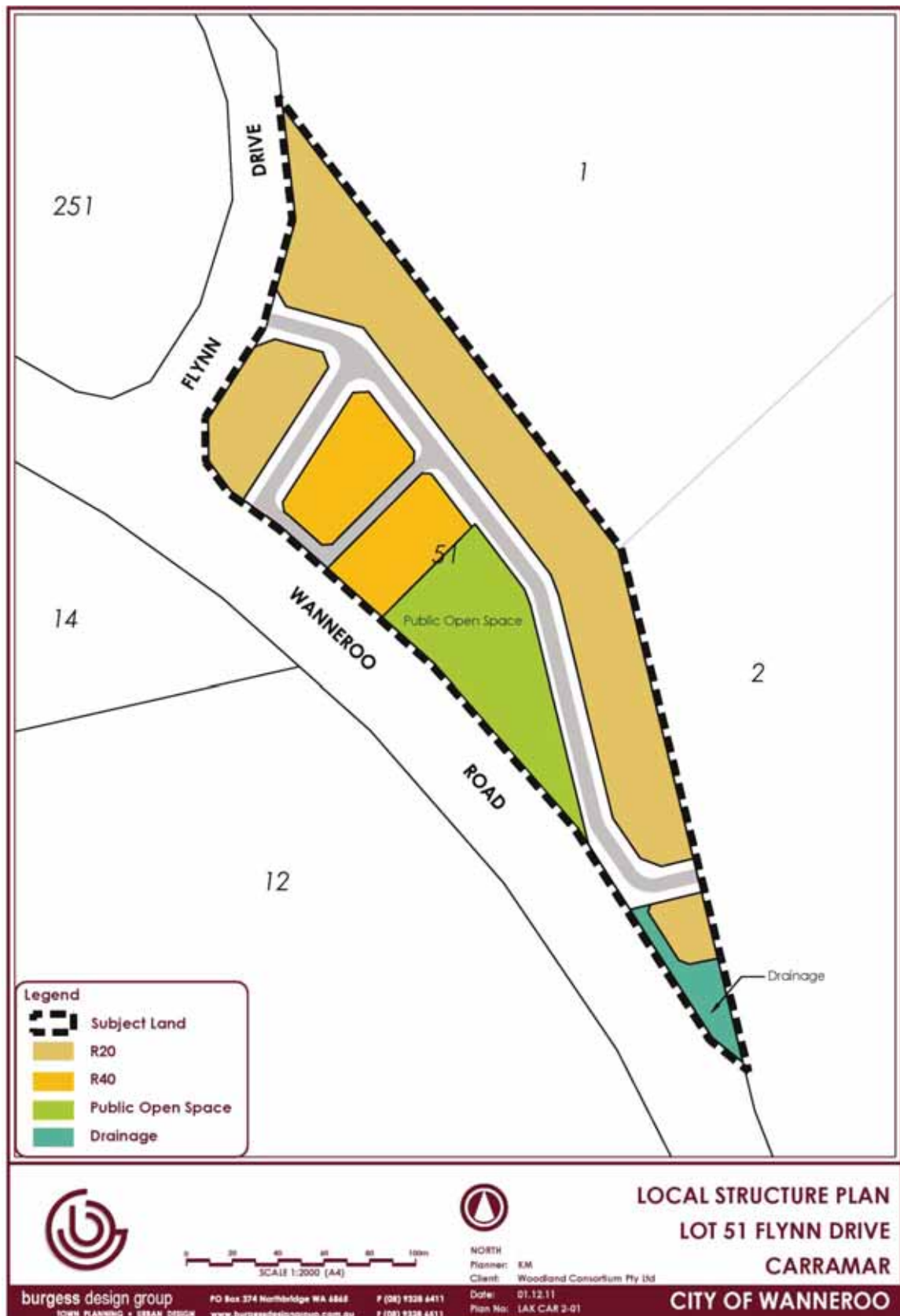


Figure 3: Lot 51 Flynn Drive LSP

## 4 TRAFFIC ASSESSMENT

### 4.1 Trip Generation and Distribution

This section of the report provides an estimation of the traffic expected to be generated by the proposed residential development and assess the potential impact of this traffic on Flynn Drive and Wanneroo Road.

To estimate the traffic that would be generated by the proposed development the document *"Guide to Traffic Generating Developments, Roads and Traffic Authority of New South Wales" (2002)* was sourced. From this document, a daily generation rate of 9 trips per dwelling and a peak hour generation rate of 0.85 trips per dwelling were utilised. Accordingly, the subdivision is estimated to generate a total of 360 daily vehicle trips for a typical weekday and 34 vehicle trips during morning and afternoon peak hours (total of ins and outs).

Assuming a directional split of 20/80 for the morning peak period and 80/20 for the evening peak period, the forecasted movements at the Access Street/Flynn Drive intersection would be 7 inbound and 27 outbound trips over the morning peak period and vice versa for the afternoon peak.

The derived total daily, morning and evening peak hour entry and exit volumes are summarised in **Table 1** below.

| Period                    | Entry | Exit | Total |
|---------------------------|-------|------|-------|
| Morning peak hour traffic | 7     | 27   | 34    |
| Evening peak hour traffic | 27    | 7    | 34    |
| Total daily traffic       | 180   | 180  | 360   |

**Table 1: Estimated morning peak hour, evening peak hour and total daily traffic distribution**

Based on the site location, with Wanneroo Road located a short distance to the west and with the Perth CBD and Joondalup town centre located to the south of the subject site, the following trip distribution it is assumed:

- 82% of generated traffic to and from the north (Wanneroo Road north);
- 8% of generated traffic to and from the south (Wanneroo Road south);
- 10% of generated traffic to and from the east (Flynn Drive east/Tranquil Drive);

**Figure 4** below illustrates the resulting distribution of the development-generated trips for total daily, morning and evening peak periods at the following intersections:

- Wanneroo Road/Flynn Drive;
- Flynn Drive/Access Road;



**Figure 4: Lot 51 development –morning peak, afternoon peak and total daily trip distribution**

It should be noted that the estimated Lot 51 traffic generation illustrated in **Figure 3** does not allow for any through traffic from the neighbouring Lot 1 traversing the subject site to access Flynn Drive as a consequence of the proposed road link between the two sites. The impact of the possible road link between the Lot 51 and the future residential development on Lot 1 was investigated in a separate traffic report prepared for Lot 1 & 2 Flynn Drive LSP in November 2010. The result of this analysis has shown minimal reciprocal traffic movements between Lot 51 and Lot 1 confirming limited operational benefit to either of the developments.

## 4.2 Impact on Surrounding Roads

In accordance with the assumed directional distribution of the development-generated traffic outlined in the previous section, net traffic increases on surrounding roads are illustrated in the **Table 2**.

| Roads                   | Total daily traffic volumes (vpd) |     |        |              |
|-------------------------|-----------------------------------|-----|--------|--------------|
|                         | Current                           | New | Total  | Increase (%) |
| Flynn Dr (W of site)    | 1,080                             | 324 | 1,404  | 30%          |
| Flynn Dr (E of site)    | 1,080                             | 36  | 1,116  | 3.3%         |
| Wanneroo Rd (S of site) | 17,000                            | 292 | 17,292 | 1.7%         |
| Wanneroo Rd (N of site) | 17,000                            | 32  | 17,032 | <1%          |

**Table 2. Existing and estimated future traffic volumes on surrounding roads**

In summary, the net traffic impact as a result of the proposed development has the following effect on the surrounding road network:

- **Flynn Drive (west of the subject site):** Even though the anticipated increase in total daily traffic along the short section of Flynn Drive is notable (approximately 30%), the total daily traffic in the post-development stage is still well within desirable traffic volume threshold for this type of the road.
- **Flynn Drive (east of the subject site):** The total daily traffic in the post-development stage is moderate and well within the desirable traffic volume threshold for this type of the road.
- **Wanneroo Road (north of Flynn Drive):** The traffic from the proposed development renders minimal increase in existing traffic volumes along this section of Wanneroo Road.
- **Wanneroo Road (south of Flynn Drive):** The traffic from the proposed development renders minimal increase in existing traffic volumes along this section of Wanneroo Road.

Accordingly, it is concluded that the development proposal will have moderate to negligible impact on the operation of surrounding road network, namely Flynn Drive and Wanneroo Road.

The proponent is advised to seek permission for implementation of emergency controlled access on Wanneroo Road from Main Roads WA from the safety point of view and with respect to the fire management requirements. Alternatively, emergency access could be provided off Flynn Drive.

#### ***4.3 Sight Distance at Flynn Drive/Access Road Intersection***

Preliminary on-site investigation indicates that there would be sufficient sight visibility from the proposed access point to the development on Flynn Drive. The Flynn Drive/Wanneroo Road intersection to the west is clearly visible from the proposed Access Street/Flynn Drive intersection.

According to AUSTROADS "*Guide to Road Design Part 4A: Unsignalised and Signalised Intersections*" the "Safe Intersection Sight Distance is the minimum standard which should be provided on the major road at any intersection". It provides sufficient distance for a driver of a vehicle on the major road to observe a vehicle from a minor road approach moving into a collision situation, and to decelerate to a stop before reaching a collision point." The safe intersection sight distances for a speed of 60km/h and 80km/h are 114 metres and 170 metres, respectively.

The existing sight distance available to the eastern approach of the Access Street/Flynn Drive intersection is estimated at approximately 200m. Therefore, the sight visibility to the east of the Access Street/Flynn Drive intersection is deemed sufficient. Moreover, this proposed intersection would be located approximately 80m further west of the existing site crossover and further away from the bend on Flynn Drive.

## 5 CONCLUSIONS

This Addendum Traffic Impact Statement has been prepared by Transcore on behalf of Woodland Consortium Pty Ltd, with regard to a Rezoning Application residential (Rural to Urban) and subdivision for Lot 51 Flynn Drive (subject site) in Carramar, City of Wanneroo.

The proposed subdivision plan for the subject site is for a development with a yield of approximately 40 lots and an access street which would form an unsignalised T-intersection with Flynn Drive. This junction would be located approximately 50m north-east of the unsignalised T-intersection of Flynn Drive/Wanneroo Road.

The traffic assessment undertaken in this report showed that the proposed development would generate approximately 360 daily vehicle trips during a typical weekday trips for a typical weekday with approximately 34 vehicle trips during morning and afternoon peak hours (total of ins and outs).

The traffic that would be generated by the proposed residential development would not have a significant impact on the traffic operations of Flynn Drive and Wanneroo Road. In addition, the sight distance at the proposed Access Street/Flynn Drive intersection satisfies the AUSTRAODS Safe Intersection Sight Distance requirements. The proposed Access Street/Flynn Drive intersection would be located approximately 80m further west from the existing site crossover and further away from the existing bend on Flynn Drive.

Finally and as a result of the traffic investigation and analysis undertaken in this report, it is concluded that the impact of the traffic from this development on the operation of the surrounding road network is marginal to moderate and therefore does not necessitate any upgrades to these roads.

## **APPENDIX 9: Engineering Servicing Report**

---

**LOT 51 FLYNN DRIVE, CARRAMAR**  
**CITY OF WANNEROO**

---

**ENGINEERING SERVICES REPORT**

Prepared for: Burgess Design Group  
351 Newcastle Street  
Northbridge  
WA 6865

Prepared by: VDM Consulting  
310 Selby Street North  
Osborne Park  
WA 6017

CONSULTING ENGINEERS AND

---

**Offices:**

Western Australia  
Queensland  
Northern Territory



New South Wales  
Victoria  
Hanoi, Vietnam

## Document Control Record

|              |                                                                                   |
|--------------|-----------------------------------------------------------------------------------|
| Prepared by: | Oleg Omelchuk                                                                     |
| Position:    | Senior Civil Engineer                                                             |
| Signed:      |  |
| Date:        | 28/11/2011                                                                        |

|              |                                                                                     |
|--------------|-------------------------------------------------------------------------------------|
| Approved by: | Enzo Biagioni-Froudast                                                              |
| Position:    | Principal, Infrastructure                                                           |
| Signed:      |  |
| Date:        | 28/11/2011                                                                          |

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VDM Consulting (WA) Pty Ltd  
ACN: 009 351 400

310 Selby Street North,  
OSBORNE PARK WA 6017

PO Box 1852,  
Osborne Park DC 6916

Telephone: +61 8 9241 1800

Facsimile: +61 8 9241 1999

Email: [enquiries@vdmgroup.com.au](mailto:enquiries@vdmgroup.com.au)

Internet: [www.vdmconsulting.com.au](http://www.vdmconsulting.com.au)



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## 1. INTRODUCTION

VDM Consulting was engaged by Burgess Design Group on behalf of Woodland Consortium Pty Ltd to prepare an engineering services report to support the submission of proposed Metropolitan Region Scheme (MRS) Amendment Report that is required to rezone Lot 51 Flynn Drive, Carramar from Rural to Urban.

The subject land comprises of 3.304 hectare (ha) land and is located approximately 8 km north of the Wanneroo City. The site is roughly triangular shaped parcel and is bounded by Flynn Drive to its northwest and Wanneroo Road to the western boundary. Undeveloped land is located along eastern boundary of the site.

## 2. SITE EVALUATION & BULK EARTHWORKS

### 2.1. SITE TOPOGRAPHY

The subject land is currently vacant and not cleared of vegetation. It also does not appear to have been used for agricultural activities previously. The existing house and garage are at the north side of the site.

The site has a general surface fall from northwest to southeast with relatively flat areas in the middle of the site.

Levels across the site range from RL 50m AHD (Australian Height Datum) to RL 37m AHD.

Refer to aerial site layout plan with existing contours attached as **Appendix A**.

### 2.2. SITE GEOLOGY

Whilst a formal Geotechnical investigation was not undertaken for this report, a desktop study utilising existing Geological Maps was used for a global review of general soil conditions.

Reference to the Muchea Geological Survey Map series indicates that the primary soil condition for the area is classified as Sand (S7) overlaying Limestone (LS1).

The S7 Sand is classified as sand derived from Tamala Limestone (QTs), being pale and olive yellow, medium to coarse-grained, sub angular quartz with a trace of feldspar moderately sorted, of residual origin. The S8 Sand layers may be found at depths ranging between RL15 to RL90 AHD. The permeability of the sand unit (S7) is likely to be moderate according to the physical properties listed in the General Features for the material. The S7 Sand is described as having a few limitations; some settlements can be expected under the foundations, some ability to attenuate pollutants due to small clay content, usually considerable depth to water table.

The LS1 Limestone is classified as of Tamala Limestone Sand (Qtl) in part in origin, being light yellowish brown, fine to coarse-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, surface kankar, and of eolian origin. The LS1 Limestone layers may be found at depths ranging between R.L.0 to R.L.90 AHD. The permeability of the sand unit (LS1) is likely to be high according to the physical properties listed in the General Features for the material. The LS1 Limestone is described as having variable bearing capacities depending on the degree of

cementation. Common solution cavities and fissure could lead to severe settlement under load and also offer an easy path for pollutants down to the water table.

For further reference, please refer to the Geological & Geomorphology Plan attached as **Appendix B**.

### 2.3. GROUND WATER LEVEL

Preliminary advice from the Perth Groundwater Atlas indicates that the nominal groundwater level is at RL 18m AHD with 0.5m to 3m fluctuation due to seasonal variation and flows westwards.

Formal geotechnical investigation will be undertaken to confirm ground water levels at the subdivision stage of development.

### 2.4. BULK EARTHWORK

The general philosophy of the site earthworks strategy is to minimise the amount of cut and fill within the subject site while maintaining a suitable level of connection with the adjacent Wanneroo Road, Flynn Road and undeveloped land on the east side. The undulating topography of the subject site will mandate a significant amount of retaining walls to be constructed on site in order to create level building pads.

Preparatory works should be limited to the following:-

- i. Removal of fencing and other improvements as necessary, however, retaining as many existing and significant trees and vegetation as possible.
- ii. Stripping and grubbing of areas to be earth worked with due regards to vegetation preservation in selected areas.
- iii. Strip and stockpiling topsoil.
- iv. Cut to fill operations and imported fill to proposed road as required.
- v. Replace topsoil to batters and verges.
- vi. Stabilise any areas where topsoil has not been respread.

Site levels will be set in accordance with the following parameters:-

- vii. Geotechnical and soil parameters to ensure that the site achieves a minimum Class "A" site.
- viii. Building pad levels to be designed to ensure that floor levels maintain a clearance of a minimum of 0.5m to the regional 1:100 year flood level.
- ix. Finished pad levels are to conform to the regional drainage requirement as identified in the published urban stormwater drainage strategies consistent with recent government initiatives for the area.

VDM anticipates that the bulk earthwork operations for the recommended development option will be completed using material available from site plus imported clean fill to fulfil the development requirements.

Upon completion of bulk earthwork, any disturbed areas will be stabilised either by respreading the stockpiled topsoil from the bulk earthwork operations or via hydro mulching stabilisation as appropriate or in accordance with the requirements of the City of Wanneroo.

### 3. ROADWORKS

All proposed internal roadworks will be designed and constructed in accordance with the requirements and standards of the City of Wanneroo, as appropriate to the regulatory control requirement of the individual roads and hierarchy requirements.

The proposed development will incorporate a legible and highly developed urban road structure. Roadworks will generally consist of traditional kerbed and asphalt pavements.

Entrance roads into the development may be subject to intersection treatments and include refuge islands and other facilities that will provide an identity entry statement.

Minimum recommended carriageway widths will be selected with due reference to local authority and Residential R-Codes.

In order to achieve a legible road hierarchy within the development cells it is recommended that the following carriageway widths be planned within the development:-

|                          |                                                                                                                  |
|--------------------------|------------------------------------------------------------------------------------------------------------------|
| i. Main internal roads   | 6.0m seal width within a dedicated road reserve (16m at entrance roadways)                                       |
| ii. Minor internal roads | 6.0m seal width within a dedicated road reserve (generally 14-15m max), can be reduced to 13m when fronting POS. |
| iii. Laneways            | 6.0m seal width within a 6.0m road reserve                                                                       |

### 4. STORMWATER DRAINAGE

#### 4.1. EXISTING SITE DRAINAGE

The existing land currently drains from the highest point at northwest of site to the southeast low point. There are no permanent water bodies on the subject site and all overland runoff is catered by ground infiltration to recharge ground water table.

#### 4.2. PROPOSED STORMWATER SYSTEM

It is proposed that all roads will be kerbed and drained with conventional pipe drainage system consisting of collector gullies, manholes and controlled outfalls to the proposed soakage basins or in accordance with Australian Rainfall & Runoff Guidelines and the City of Wanneroo's design criteria and standards.

Where utilised, the piped network will terminate into a bubble-up arrangement in the swales or dry basin soakage systems within the Public Open Space areas. Any soakage areas or basins incorporated within public spaces should be landscaped to encourage nutrient stripping and natural filtration of the stormwater drainage.

#### 4.3. DRAINAGE FEATURES AND STRUCTURES

It is envisaged that the council will require to keep the post development stormwater runoff for the events up to 100 ARI within the development. Therefore it is anticipated that the proposed stormwater

drainage design will be a combination of conventional piped drainage system draining into open infiltration swales, and kerbed roads draining directly into swales for roads adjacent to areas of public open space.

Any surcharge beyond major storm event not contained within the designed soakage basins will overflow to adjacent Wanneroo Road.

Stormwater runoff from storm events having a recurrence interval of 1 in 10 year or less will infiltrate via swale drains and other storage / soakage features throughout the site to the shallow soil profile and then to the superficial aquifer below the swales. Prior to discharging into each swale stormwater will pass through a Stormwater Pollutant Trap (GPT) or similar.

The objective of this design approach is to minimise stormwater collection, and maximise the amount of stormwater which is locally managed by direct infiltration to the superficial aquifer, in accordance with DOW urban water management objectives. This in turn reduces the potential for entrained contaminants to be exported from the site in surface runoff to receiving water bodies, thereby reducing the risk of poor water quality in the downstream systems.

Roof runoff will be generally infiltrated on site on individual allotments that have sufficient sand fill or collected and piped to street drainage. Allowance will be made in the size of stormwater infiltration swale for these additional contributing flows if required.

#### 4.4. STORMWATER INFILTRATION SWALE DESIGN

It is proposed to create shallow vegetated stormwater infiltration swales, within the main Public Open Space area and /or along the proposed roads. Where provided, these swales will be designed to cope with up to 1 in 10 year ARI storm event associated with runoff from streets and verges within the site. The run off from 1 in 100 year storm event will be also contained on site. The run off beyond major event will be directed along the kerbs to discharge into the swales and thence decant via dedicated road reserve to existing site outfalls or stormwater system.

Side slopes in each swale will be a maximum of one vertical in six horizontal for safety and ease of maintenance. The maximum depth of water in each swale will be limited to 0.6 metres

### 5. WASTEWATER DISPOSAL (SEWER)

Preliminary information from Water Corporation of WA indicates that there is no existing infrastructure in the area. New sewer line can connect via gravity to the existing sewer near Golf Links Drive and Wanneroo Road. However in order to maintain sufficient cover and fall the sewer line will need to follow the contours of the existing ground and to be constructed through some of the large lots south of the site. The approximate length of the proposed sewer line is 1800 metres. Please refer to the plan attached in the **Attachment C** that shows preliminary layout of the sewer and potable water lines in the area.

All developed lots would need to be served with a conventional gravity sewer system with the majority of the reticulation sewers located within road reserves. The internal sewer reticulation would be designed in accordance with the Water Corporation Sewerage Manual and connect into the proposed 150mm diameter pipe along the Eastern side of the site.

There is also 450GRP sewer pressure pipeline on the western side of Wanneroo Road, which considered to be a critical asset of Water Corporation.

## **6. POTABLE WATER SUPPLY**

Preliminary information from Water Corporation indicates that there is no existing water main in the subject area. The water supply can be complete by extension of the existing 300mm diameter water main in Wanneroo Road northwards from Golf Link Drive to Carramar Road. And then 250mm diameter water main to the site. It is anticipated that this existing system can provide water to the development. The approximate length of 300mm water main is 500 meters and 1400 meters for 250mm water main.

The internal water reticulation shall be designed and constructed in accordance with standard Water Corporation requirements. Standard Water Corporation water headwork charges will apply to this development.

## **7. POWER, TELECOMMUNICATION & GAS**

### **7.1. WESTERN POWER**

Preliminary information from Western Power indicates that there is an existing service network that runs along the eastern side of Wanneroo Road. The existing underground power line is 22kV and it is anticipated that this network will have sufficient capacity to service the development with underground power, however we would recommend to confirm it with West Power once the development's power consumption is known.

A fibre optic cable is also running north along the western boundary of the site and follows the underground cables layout.

Western Power will require that the development be serviced with underground power. This system will connect to the existing underground systems located in Fifty Road.

The cost of this work will need to be met in full by the developer. Standard Western Power conditions will apply. Western Power will also charge service fees which are addition to supply and installation costs that will need to be paid by the developer.

### **7.2. STREET LIGHTING**

Standard Western Power Street lighting design principles would be adopted for the internal lighting network.

Should non-standard Western Power Street lighting be requested, prior approval of the local authority would be required.

### **7.3. TELECOMMUNICATION**

Preliminary information from Telstra indicates there is an existing network in the vicinity of the subject land. The existing Telstra networks run along the Wanneroo Road and on the eastern side of the Lot 51. It is anticipated that this network will have sufficient capacity to service the development with telecommunication services.

Telstra will install any new telecommunication network facilities to the proposed lots, subject to the developer providing, at their cost, trenching for cable laying.

No headwork charges for Telstra services are anticipated.

#### 7.4. GAS SUPPLY

Preliminary information from WA Gas Network has indicates there is an existing 150mm diameter high pressure gas main in Wanneroo Road suitable for connection.

It is anticipated that the network will have sufficient capacity to service the development with reticulated gas services by connection of the existing main. The pressure reducing station would need to be installed to reticulate the gas throughout the subdivision. Standard headwork costs will apply for the mains extension to service the development.

We would love to note that there are other developers in this area who are looking at commencing the work in the next year or so. We would suggest that there might be an opportunity to liaise with them in regard to services to this area.

## Appendix A – Overall Layout with Existing Topography



**burgess design group**  
TOWN PLANNING • URBAN DESIGN

0 10 20 30 40 50m  
SCALE 1:3,000 (A4)

PO Box 374 Northbridge WA 4865  
[www.burgessdesigngroup.com.au](http://www.burgessdesigngroup.com.au)

T (08) 9328 6411  
F (08) 9328 6511



NORTH  
Planner: KM  
Client: LAKESHORE BUILDERS  
Date: 18.10.11  
Plan No: LAK CAR 10-01

**AERIAL PLAN**  
**LOT 51 FLYNN DRIVE**  
**CARRAMAR**  
**CITY OF WANNEROO**



## Appendix B – Geological Mapping Plan



TABLE 1: SUMMARY OF LAND USES AND ZONING REGULATIONS

| Zone        | Color      | Regulation                    | Notes                             |
|-------------|------------|-------------------------------|-----------------------------------|
| Residential | Light Blue | Single-family dwellings       | Minimum lot size: 1000 sqm        |
| Commercial  | Yellow     | Retail and service activities | Maximum height: 3 stories         |
| Industrial  | Orange     | Manufacturing and processing  | Separation from residential zones |
| Green Space | Green      | Parks and recreation          | Minimum area: 5000 sqm            |
| Water       | Blue       | Wetlands and water bodies     | Prohibited construction           |

TABLE 2: ZONING REGULATIONS

| Zone        | Regulation                    | Notes                             |
|-------------|-------------------------------|-----------------------------------|
| Residential | Single-family dwellings       | Minimum lot size: 1000 sqm        |
| Commercial  | Retail and service activities | Maximum height: 3 stories         |
| Industrial  | Manufacturing and processing  | Separation from residential zones |
| Green Space | Parks and recreation          | Minimum area: 5000 sqm            |
| Water       | Wetlands and water bodies     | Prohibited construction           |

TABLE 3: ZONING REGULATIONS

| Zone        | Regulation                    | Notes                             |
|-------------|-------------------------------|-----------------------------------|
| Residential | Single-family dwellings       | Minimum lot size: 1000 sqm        |
| Commercial  | Retail and service activities | Maximum height: 3 stories         |
| Industrial  | Manufacturing and processing  | Separation from residential zones |
| Green Space | Parks and recreation          | Minimum area: 5000 sqm            |
| Water       | Wetlands and water bodies     | Prohibited construction           |

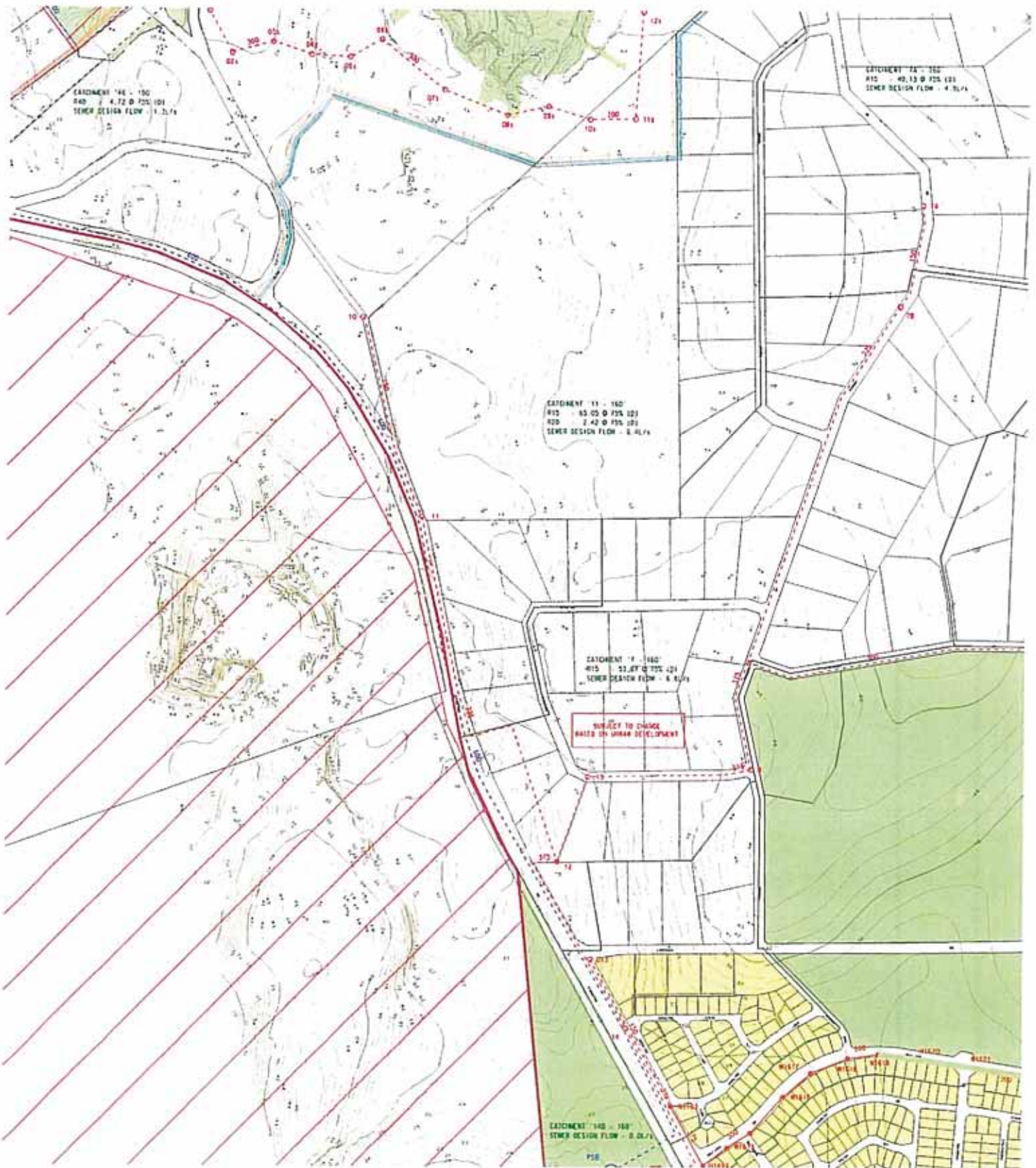


Map of the coastline and surrounding waters of Muchea.



## Appendix C – Sewer & Water Plan

----- PROPOSED WATER  
----- PROPOSED SEWER





## Appendix D – Drainage Principles & Examples

### **WSUD Estate Drainage - Implemented Examples**

**Examples of constructed swales and stormwater storage structures:-**

- **Waterhall Estate Guildford**
- **Maddington Riverside Estate**

**Below are typical details layout plans and photos demonstrating the typical features that will be incorporated in the Lot 51 Flynn Drive design.**

**EXAMPLE OF ESTATE DRAINAGE UTILISING SWALES AND STORAGE/DETENTION SYSTEMS. EXAMPLE BELOW IS MADDINGTON RIVER ESTATE, MADDINGTON.**





## TYPICAL DETAIL DRAINAGE SWALE & BIOFILTRATION SYSTEM



## **APPENDIX 10: Geotechnical Site Investigation**























## **APPENDIX 11: Drainage Assessment**





























